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Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring

Podgorica, Montenegro, 2-3 April 2019

**Agenda item 3: State of Play of Integrated Monitoring and Assessment Programme (IMAP)
Implementation with Regards to EO5 and EO9, MEDPOL Monitoring Programme and Way Forward**

Updated List of Priority Contaminants under MAP/Barcelona Convention (Draft)

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Note by the Secretariat

Implementation of the MAP/Barcelona Convention and its Protocols for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources (the LBS Protocol) and Protection of the Mediterranean Sea against Pollution resulting from Exploration and Exploitation of the Continental Shelf and the Sea Bed and its Subsoil (the Offshore Protocol), as the main legal framework regarding the reduction of pollutants within the Mediterranean region, may require an update of the priority chemicals list.

The 18th Meeting of the Contracting Parties (COP 18), held in Istanbul, Turkey, adopted in Decision IG. 21/9 (IG. 21/3, Annex II) a list of substances to be observed within the MED POL monitoring programme. The 19th Meeting of the Contracting Parties (COP 19), held in February 2016, in Athens, Greece, adopted the Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria (Decision IG. 22/7), with a list of regionally agreed good environmental status descriptions, common indicators and targets, with principles and clear timeline for its implementation.

The Meeting of the MED POL Focal Points, held on 29-31 May 2017, in Rome, Italy considered first updated list of priority contaminants in the Mediterranean (UNEP(DEPI)/MED WG.439/16, Report on Specific Issues), as well as the potential inclusion of this list into national monitoring programmes, if so decided. During the discussions, the meeting paid particular attention to data gaps on contaminants, especially on emerging contaminants, and the need for further information to fill these knowledge gaps. In this regard, the meeting highlighted the importance of ongoing national monitoring programmes and the need to continue periodic reviews carried out by the Secretariat, taking also into consideration the work of EU and other Regional Seas Conventions.

To that end, this document presents a second follow up¹² of the list of the priority contaminants to propose additional priority contaminants to be considered in the framework of the Integrated Monitoring and Assessment Programme (IMAP) and its Ecological Objective 9.

The sources of information to perform the selection of these substances are based mainly in available lists of chemicals of concern internationally, such as:

- OSPAR and HELCOM Regional Seas conventions Priority List of Chemicals and Substances of concern;
- The European Commission WFD and MSFD Directives and the JRC “Watch List” of priority substances;
- The Stockholm, Rotterdam and Basel Conventions list;
- The US Environmental Protection Agency Lists.

¹⁵th Meeting of the Ecosystem Approach Coordination Group. Rome, Italy, 14-15 September 2015, UNEP(DEPI)/MED WG.420/Inf.13;

²Meeting of the MED POL Focal Points, Rome, Italy, 29-31 May 2017, UNEP(DEPI)/MED WG.439/Inf.11.

List of Abbreviations / Acronyms

CI	Common Indicator
COP	Conference of the Parties
CORMON	Correspondence Group on Monitoring
EcAp	Ecosystem Approach
EO	Ecological Objective
EU	European Union
HELCOM	Baltic Marine Environment Protection Commission - Helsinki Commission
IMAP	Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria
JRC	Joint Research Center
MAP	Mediterranean Action Plan
MED POL	Programme for the Assessment and Control of Marine Pollution in the Mediterranean Sea
OSPAR	Convention for the Protection of the Marine Environment for the North-East Atlantic
QA/QC	Quality Assurance/Quality Control
POPs	Persistent Organic Pollutants
RSC	Regional Sea Convention
WoS	Web of Science
WL	Watch List

1. State-of-the-art (bibliographic databases 2014-2019)

An update of the latest bibliographic developments of the environmental investigations and research studies on emerging and unregulated chemicals monitored and assessed in the Mediterranean region has been undertaken and is presented in this document for the last 5 years period (2014-2019) since the last review in 2017 (see Annex I from UNEP(DEPI)/MED WG.439/Inf.11). The main search have been performed through the Web of Science and their databases and have been achieved in two steps.

Firstly, the key words ‘emerg* chem* mediterranean’ were used to wider the results (note, research studies are majorly directed towards freshwater environments, river basin management, waste water treatment plans to mention few) with a total of 1715 titles in the Mediterranean region for the last 5 years, were the latest relevant work in the marine environment for 2018 was marked, as a first step. Secondly, the general category and research domain was selected Science and Technology and solely for articles and reviews (publication type). As this, the search outcomes for the period 2014-2019 returned all the previously examined and selected works in 2018; and therefore, this step was useful to check and to validate the power of the performed search (ca. not missing information through narrowing the search criteria) with a total of 125 publications. Finally, the selection of the Marine and freshwater biology and Environmental Sciences Ecology (Research Areas categories) returned 89 and 115 titles, respectively, indicating some classifies under both categories.

The further analysis of the final outcome for 2014-2019 (February 2019), through Web of Science (WoS) online tools, was focused on these 125 publications. The figures below present the main results (by selecting in all the cases the top 5 results/subcategories) in terms of Research Areas, Countries, Institutions and Research Journal. The Figures 1 and 2 presents the finding for the latest 5 years (2014-2019).



Figure 1. WoS databases outcome for the period 2014-Feb 2019 in terms of emerging chemical research in the Mediterranean Sea by research area and publication journal (only top 5 subcategories)

are shown). Note, for the journals there is a database mismatch for the journal Science of the Total Environment and is duplicated.

From Figures 1 and 2, some significant facts can be observed. Figure 1, tag 84 the publications under Public Environmental Occupational Health (third subcategory) and followed by Toxicology and Zoology. Despite is an arbitrary classification, to some extent it relates the investigations performed for emerging and unregulated to Human Health effects domain. Further, the 125 publications are majorly classified under the first four subcategories being the top first Environmental Sciences Ecology and this works are published primarily in the following research journals: Marine Pollution Bulletin, The Science of the Total Environment, Marine Environmental Research and Environmental Pollution, although the distances are very close with the remaining ones and highly scattered among other research journal titles.

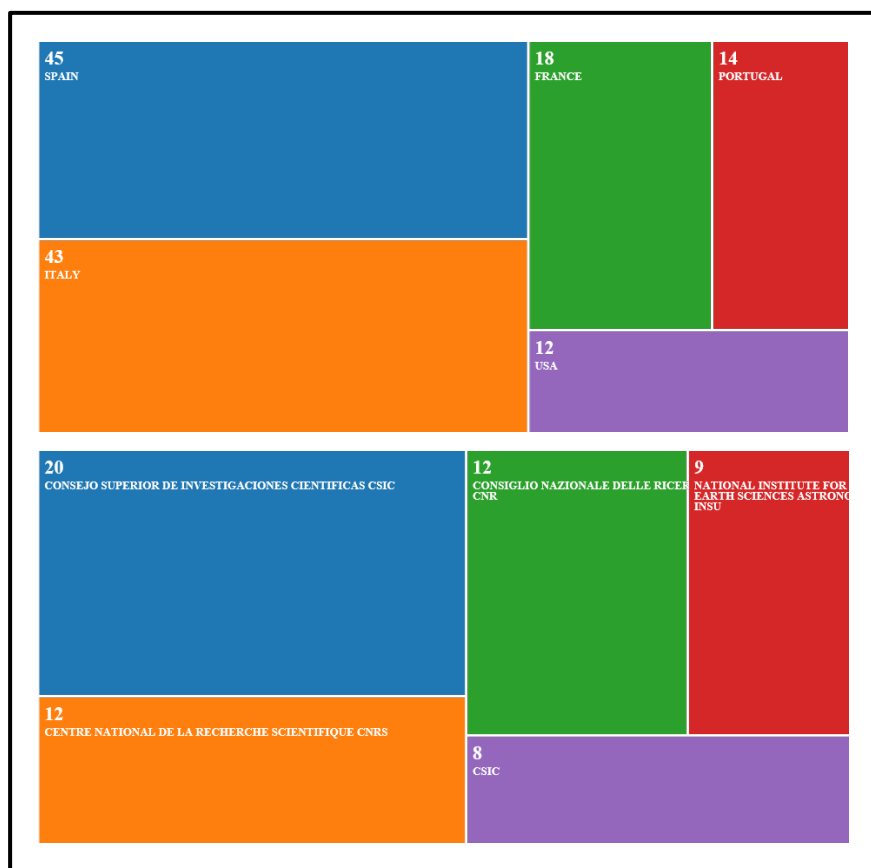


Figure 2. WoS databases outcome for the period 2014-Feb 2019 in terms of emerging chemical research in the Mediterranean Sea by country and institution (only top 5 subcategories are shown). Note, for institutions there is a database mismatch for the Spanish CSIC and is duplicated and INSU is part of the CNRS in France.

On the other hand, Figure 2 shows the main countries and their institutions by number of publications, thus, performing research in the Mediterranean on the emerging chemicals. Notably, Spain, Italy and France are the countries contributing strongly in the Mediterranean, with Spain and Italy contributing nearly to the half of the published work under this theme for the period 2014-Feb2019. Surprisingly, it should be noticed that the United States followed by Portugal are the fourth and the fifth countries contributing to studies in the Mediterranean, but this is explained by scientific collaborations between these countries. Further, Figure 2 reveals, that the leading institutions working in the topic are: the Spanish Research Scientific Council (CSIC, Spain), the Centre National de la Recherche Scientifique (CNRS, France) including the National Institute for Earth Sciences and Astronomy (INSU, CNRS),

followed by the Consiglio Nazionale delle Ricerca (CNR, Italy), with 20, 12 and 12 associated publications for the period 2014-Feb 2019.

Therefore, the result of this analysis shows that the leading organizations and countries in the Mediterranean leading the research on emerging and unregulated chemicals are the long-established scientific research institutions. The continuity of Figure 2 by selecting the top 10 results instead of 5 point to the marine organizations in the same countries, namely, the Spanish Institute of Oceanography (IEO, Spain), the Stazione Zoologica Anton Dohrn di Napoli (SZN, Italy) and l'Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER, France), with 8, 8 and 7 publications during the period 2014-Feb 2019.

As a conclusion, it is clear that based on the WoS databases and the facts depicted in Figures 1 and 2, the research and scientific knowledge is carried out by national research organizations rather than marine research organizations, and therefore, closer links between these types of institutions should continue, even strongly, to increase the scientific-based knowledge related to the emerging chemicals research and priority contaminants assessments in the Mediterranean, through both national and cross-border cooperation, including Contracting Parties in different sub regions.

From the last evaluation of the research studies the situation has not changed significantly in terms of chemical compounds or organizations as seen above. However, on the regulatory scene the input has been provided by the JRC (JRC, 2018) in terms of priority chemicals in the Watch List with the proposed deselection of Diclofenac (e.g. NSAIDs) which was included in the previous MAP/Barcelona Convention list in 2017. Therefore, Figures 3, 4 and 5, reproduces the assessment earlier performed (UNEP(DEPI)/MED WG.439/Inf.11, Meeting of the MED POL Focal Points, Rome, Italy, 29-31 May 2017) showing the percentages of studies conducted in the Mediterranean found in major bibliographic databases.

Figures 3 to 5 show the most studied compounds (in % percentages in number of publications) corresponding to the full list of chemicals and groups of chemicals under the combined matched-list including the chemicals prioritized by all 3 RSCs (see next section) shown in the document UNEP(DEPI)/MED WG.439/Inf.11 which still reflects the situation in the Mediterranean Sea. In 2018, the review of the initial WL by the JRC was undertaken (JRC, 2018) and updated the list by proposing the removal of some of the proposed chemicals and setting the time window for the list revision every 2 years. Notably, as mentioned above, the Diclofenac (i.e. a NSAID, Non-steroidal anti-inflammatory drugs) has been proposed for removal from the first WL among few others. Lately, the comparative and thresholds between regional seas conventions in the European area has also been performed by the JRC (JRC, 2019). Despite, Diclofenac has been studied with a 32% in the related publications by 2017, it has been proposed for deselection from the EU 1stWL for surface waters, as a consequence of its low environmental assessed hazard.

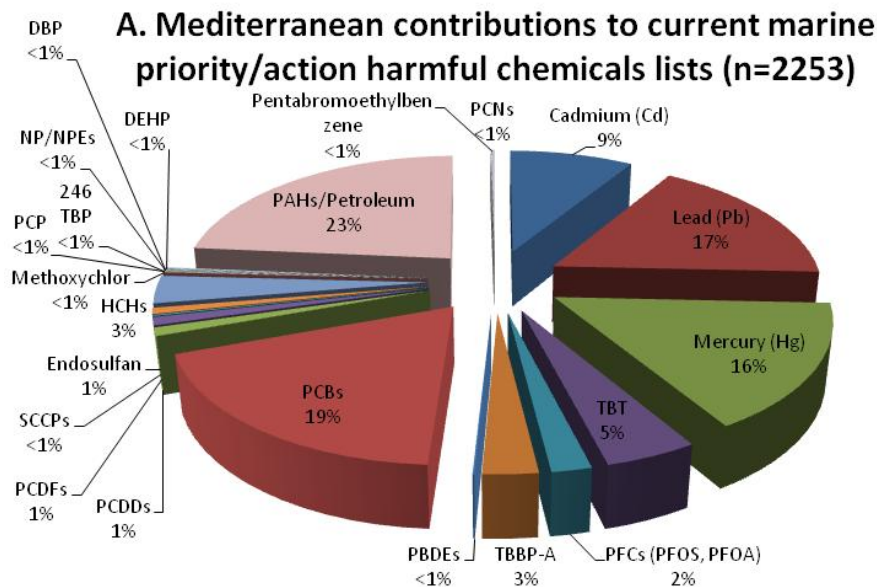


Figure 3. Percentages of the Mediterranean research contributions on current and common priority chemicals listed in OSPAR, HELCOM and Barcelona Convention. Source: UNEP(DEPI)/MED WG.439/Inf.11.

B. Orther organohalogenated compounds and metals under the Barcelona Convention-LBS Protocol (n=725)

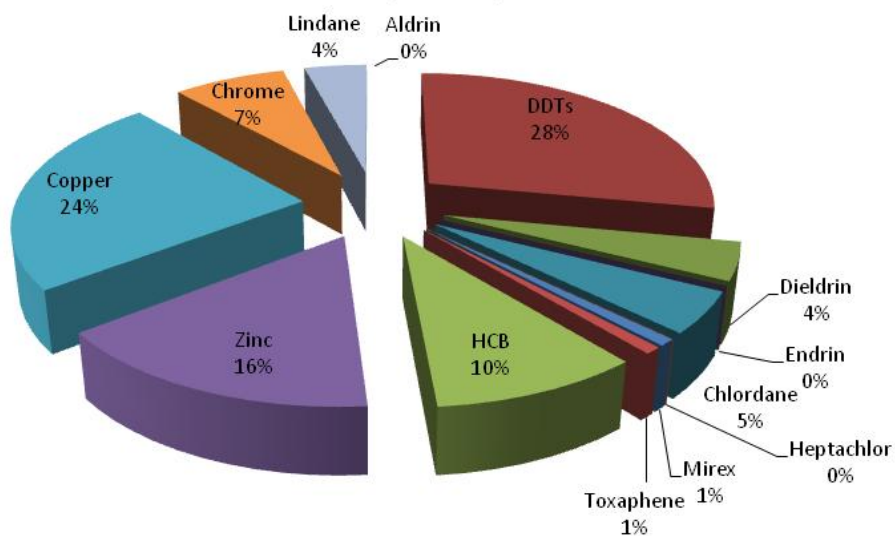


Figure 4. Percentages of the Mediterranean research contributions on common current and priority chemicals listed in OSPAR, HELCOM and Barcelona Convention. Source: UNEP(DEPI)/MED WG.439/Inf.11.

C. Pharmaceuticals and Hormones studies contributions in the Mediterranean (n=27)

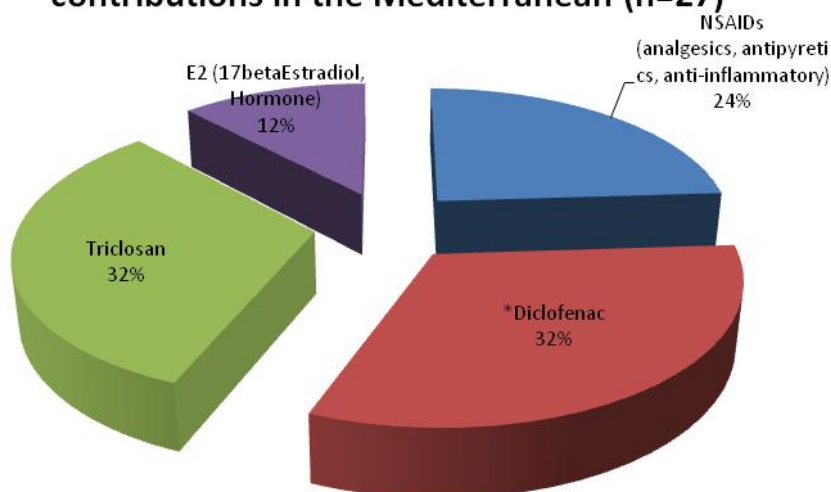


Figure 5. Percentages of the Mediterranean research contributions on common current and priority chemicals listed in OSPAR, HELCOM and Barcelona Convention. To notice, the JRC revision of the ‘Watch list’ has proposed the removal of Diclofenac compound (JRC, 2018). Source: UNEP(DEPI)/MED WG.439/Inf.11.

2. Comparison of target chemicals and groups under RSCs

The comparison of common groups of chemicals and individual compounds between Regional Seas Conventions (RSCs), which are listed by two or more RSCs are shown in Table 1, including the list agreed by MED POL Focal Points, as well as by the Contracting Parties through Decision IG.21/3 at their 18th Meeting (COP 18), held in Istanbul, Turkey,. The lists of chemicals under the Barcelona Convention, have also considered the main categories of the others Regional Seas Conventions since 2009, with the exception of perfluorinated compounds (PFCs), such as PFOS (Table 1). The later was included in the MAP/Barcelona Convention list in 2017 and remain in the updated list provided in this document.

Table 1. Comparison of groups of chemicals under Regional Seas Conventions (note: only chemicals and categories which are listed by two or more RSCs are shown).

Categories and/or chemical compounds	MAP/Barcelona Convention (MED POL, 2009)	HELCOM (2010)	OSPAR (2013)
Metallic compounds			
Cadmium	X	X	X
Lead and organic lead compounds	X		X
Mercury and organic mercury compounds	X	X	X
Organometallic compounds			
Organic tin compounds	X	X	X
Organohalogenated compounds			
Perfluorooctanylsulphonic acid (PFOS)		X	X

Brominated flame retardants (PBDEs)	x	x	x
Polychlorinated biphenyls (PCBs)	x	x	x
Polychlorinated dibenzodioxins (PCDDs)	x	x	x
Polychlorinated dibenzofurans (PCDFs)	x	x	x
Short chain chlorinated paraffins (SCCP)	x	x	x
Endosulfan	x	x	x
Hexachlorocyclohexane isomers (HCH)	x		x
Pentachlorophenol (PCP)			x
Nonylphenol/ethoxylates (NP/NPEs)	x	x	x
Octylphenol/ethoxylates (OP/OPEs)	x	x	x
Polychlorinated naphthalenes (PCNs)	x		x
Polycyclic aromatic compounds			
Polyaromatic hydrocarbons (PAHs)	x		x
Phatales			
Diethylhexylphthalate (DEHP)	x		x

* Agreed at the Meeting of the MEDPOL Focal Points in November 2009, in Aix-en Provence, France, as well as at the 18th Meeting of the Contracting Parties (EcAp Decision IG.21/3)

As pointed out in the earlier report (UNEP(DEPI)/MED WG.439/Inf.11) the most relevant categories and compounds are listed under the Barcelona Convention for 14 categories (which included individual metallic and/or organometallic compounds), despite the information on different groups of chemicals are still very limited for the majority of them, particularly for new synthetic compounds. In Table 1, it can be observed that the OSPAR Convention is the most complete with regard priority chemicals for action in the marine environment. On the other hand, the HELCOM Priority Chemicals List from 2010, seems not to include some of the most relevant substances of concern in the marine environment (ca. legacy pollutants) such as Lead and Polyaromatic Hydrocarbons, despite assessed in the Baltic Sea Reports in 2010 (HELCOM, 2010b) and 2017 (<http://stateofthebalticsea.helcom.fi/>), and included also in the Integrated Assessment of Hazardous Substances (Supplementary Report to the First Version of the 'State of the Baltic Sea' Report 2017)(accessible online).

In Table 1 the individual compounds and chemical groups coincidences considered under RSCs are presented and should be interpreted as general proposed chemical categories to be further developed and investigated. The MAP/Barcelona convention includes other chemicals, such as pesticides (Aldrin, Endrin, Mirex, HCB, Lindane or DDTs) and metallic compounds (Chrome, Copper and Zinc). Some substances have been de-selected form RSCs due to their ban at European level or based in monitoring evidences of no occurrence and/or under a risk-based approaches and accounts for the regional differences in the RSCs prioritization. In the Mediterranean Sea, the different levels of regional policies implementation, as well as the transboundary nature of marine contaminants and pollution, requires some substances to be still considered.

3.Updating the priority chemicals for the Mediterranean Sea.

The basic criteria for the selection of the List of Priority Contaminants under MAP/Barcelona Convention are the following:

- Recommendation as per other RSCs and relevant international organisations;
- Recommendation as per EU Joint Research Center (Ispra, Italy);
- Research studies pointing to potential threat to the marine environment;
- Laboratory (analytical methods) considerations (in line with MED POL Monitoring Programme), and;

- Target matrices (mussel and sediment) prioritization (current MED POL Monitoring Programme IV/IMAP strategies)

Further, whilst considering the available knowledge with regard chemical substances, particularly for emerging and unregulated chemicals, a necessary quality assurance/quality control (QA/QC) selection approach should be considered to guarantee the robustness of data. In this context, examples are found in some publications (Richardson, B., 2012; Bricker et al., 2014).

Therefore, the proposed priority chemicals (Table 2) relay on chemicals which in practice could be also included in the current analytical protocols almost straight forward accompanied by availability of funding by the Contracting Parties. In any case, a further short-list of the List of Priority Contaminants under MAP/Barcelona Convention might be performed taking into consideration the main matrices, biota (bivalve sp.) and sediments, sampled in the Mediterranean Sea, to be *de facto* included in the IMAP EO9 requirements as mandatory chemicals under the consensus of the Contracting Parties. In this way, the harmonisation of data, including QA/QC, as well as collaborative efforts and potentially joint monitoring programmes to gather knowledge for these priority substances through the Mediterranean region will be achieved.

Currently, the mandatory IMAP target chemicals under EO9 request for total mercury (HgT), Cadmium (Cd) and Lead (Pb), as well as Polycyclic Aromatic Hydrocarbons (PAHs) in biota and sediments. For organochlorinated compounds, PCBs, Hexachlorobenzene, Lindane and sum of DDTs are required for biota and at least, congeners 28, 52, 101, 118, 138, 153, 180, 105 and 156, plus Aldrin, Dieldrin, Hexachlorobenzene, Lindane and sum of DDTs for sediment. Moreover, sub-indicators of contamination, such as tributyltin, TBT, low molecular weight PAHs and emerging pollutants are recommended to be carried out on a country decision basis until a firm COP Meeting Decision will be taken. Therefore, IMAP addresses some individual compounds and categories as per Table 1.

Table 2. Updated List of Priority Contaminants under MAP/Barcelona (earlier proposal in 2017, UNEP(DEPI)/MED WG.439/Inf.11).

Categories	Substances (and primary target matrices)	Origins/Regulation
Organohalogenated compounds	Perfluorooctanesulfonate (PFOS) – b, s	USEPA; OSPAR, 2013; HELCOM, 2010
	Perfluorooctanoic acid (PFOA) – b, s	USEPA; OSPAR, 2013; HELCOM, 2010
	Perperfluorobutanoic acid (PFBA) – b, s	USA (Richardson and Kimura, 2016)
	Perfluorobutanesulfonate (PFBS) – b, s	USA (Richardson and Kimura, 2016)
	Tetrabromobisphenol (TBBP-A) – b, s	OSPAR, 2013
	Dicofol (pesticide) – b, s	OSPAR, 2013
	Hexabromocyclododecanes (HCDs) – b, s	HELCOM, 2010; Asia-Pacific (Tanabe et al., 2012); US (Dodder et al., 2014)
	Endosulfan (pesticide) – b, s	MED POL, 2009; OSPAR, 2013; HELCOM, 2010
	Hexachlorocyclohexane isomers (HCHs) – b, s	MED POL, 2009; OSPAR, 2013
	Methoxychlor (pesticide) – b, s	OSPAR, 2013
	Pentachlorophenol (PCP) (pesticide) – b, s	OSPAR, 2013
Trifluralin (pesticide) – b, s	OSPAR, 2013	
Organic nitrogen compounds	4-(dimethylbutylamino)dyphenilamin (6PPD)-b, s	OSPAR, 2013
Organic ester	Neodecanoic acid, ethenyl ester – w, b, s	OSPAR, 2013
Environmental phenols	Nonylphenol/Ethoxylates (NPs/NPEs) – w, s	MED POL 2009; USEPA; OSPAR, 2013; HELCOM, 2010

	Octylphenol/Ethoxylates (Ops/OPEs) – w, s	MED POL, 2009; USEPA; OSPAR, 2013; HELCOM, 2010
	2, 4, 6-tri-tert-butylphenol – w, s	OSPAR, 2013
Pharmaceuticals*	Clotrimazole – w	OSPAR, 2013
	Triclosan (phenol) and by-products – w, b	USA (California), 2015
	NSAIDs (e.g. Diclofenac) – w, b	EU-WFD Watch List, 2015, Revision 2018
	Other antibiotics, bactericides, etc. – w, b, s	Sea-based sources (JRC, 2015)
Hormones	Estrone (E1) – w	EU-WFD Watch List, 2015
	17 β Estradiol (E2) – w	EU-WFD Watch List, 2015
	17 α Ethylinestradiol (EE1) – w	EU-WFD Watch List, 2015
Phthalate esters	Dibutylphthalate (DBP) - s	OSPAR, 2013
	Diethylhexylphthalate (DEHP) – s	MED POL, 2009; OSPAR, 2013
Synthetic musks	Musk xylene	OSPAR, 2013
	Tonalide (AHTN) - w, b, s	USA/Asia (Nakata et al., 2012)
	Galaxolide (HHCb) – w, b, s	US/Asia (Nakata et al., 2012)
Plastic additives (BVUSs)	Benzotriazoles (e.g. UV-P, UV-320, UV-326, UV-327, UV-328) – b, s	USA/Asia (Nakata et al., 2012; EU (Picot et al., 2014)
Metals/Elements	Arsenic – b, s	Sea-based sources (JRC, 2015)
	Barium – b, s	Sea-based sources (JRC, 2015)
	Iron – b, s	Sea-based sources (JRC, 2015)
	Manganese – b, s	Sea-based sources (JRC, 2015)
	Molybdenum – b, s	Sea-based sources (JRC, 2015)
	Nickel – w, b, s	Sea-based sources (JRC, 2015)
	Vanadium – w, b, s	Sea-based sources (JRC, 2015)
Organometallic compounds	Organic mercury (e.g. methylmercury) – b (fish)	WHO (World Health Organisation)

*the revision of the EU 1st Watch List has proposed to deselect Diclofenac compound (JRC, 2018),
Note: w-seawater, b-biota and s-sediment;

4. Main findings

- 1) The List of Priority Contaminants under MAP/Barcelona Convention within the MED POL Monitoring Programme and IMAP have been revised according the latest lists of priority contaminants development in the EU region and internationally and shows no major changes compared to other RSCs. The proposed updated List of Priority Contaminants could provide the basis for a prioritization of substances to be further included within IMAP Guidance Factsheets related to Ecological Objective 9 in addition to the mandatory or recommended substances for Common Indicators 17 and 20. Therefore, they should be considered either as mandatory or recommended under the consensus of the Contracting Parties.
- 2) There are only minor observations of relevance for updated List of Priority Contaminants under MAP/Barcelona Convention within the MED POL Monitoring Programme and IMAP related to the compounds selected in the first list of Priority Contaminants form 2017, as follows:
 - Diclofenac compound has been proposed for its deselection from the European 1st Watch List in 2015, by JRC in 2018, and therefore this change has been noted in present updated list;
 - Methylmercury is maintained in present updated list as per the UN Minamata ‘mercury’ Convention this compound has relation to possible sources in the Mediterranean;
 - A number of other contaminants specifically relevant and monitored from a global point of view are also maintained (e.g. USA, Japan);
 - The potential contaminants listed by JRC (JRC, 2015 and 2017) are observed and main compounds maintained, particularly, from a potential sea-based origin.

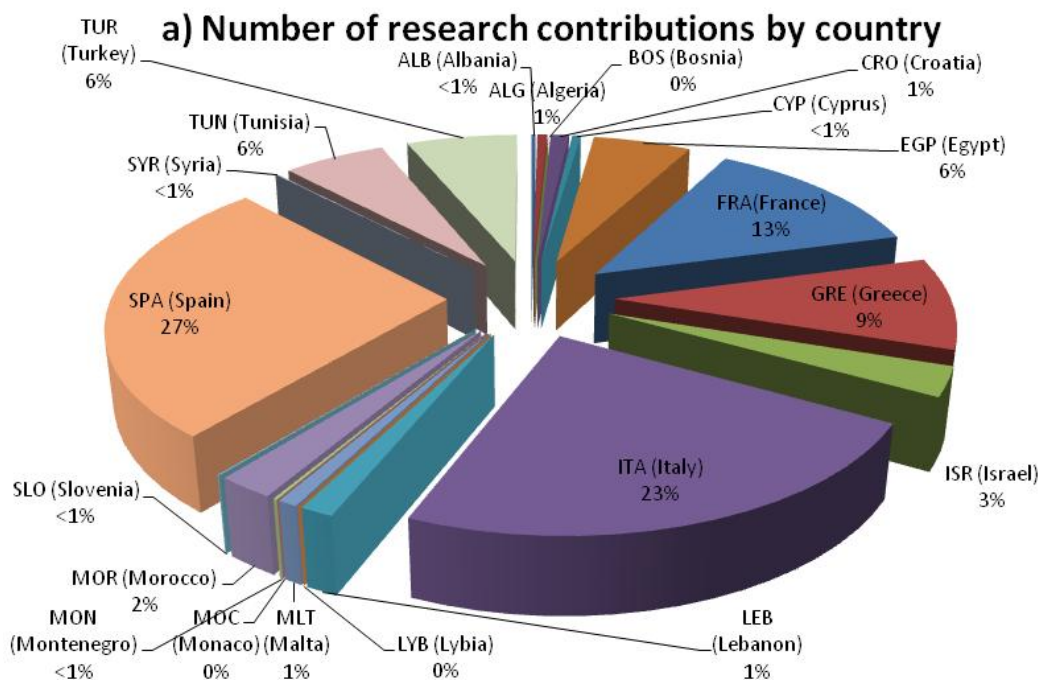
- 3) The proposed updated List of Priority Contaminants under MAP/Barcelona Convention within the MED POL Monitoring Programme and IMAP should be considered and amended by the meetings of respective CorMons, as necessary, taking into consideration other particular national, sub-regional or even regional considerations, including new potential sea-based sources (e.g. deep-sea mining), as well as potential atmospheric sources into the marine environment.
- 4) The inclusion of the additional chemicals in the IMAP Common Indicators 17 and 20 monitoring programmes should provide with further environmental information of the potential threats posed in the marine environment by chemicals and the measures to be taken.

Annex I
Earlier Mediterranean regional results 2017 (bibliographic findings, extract from
UNEP(DEPI)/MED WG.439/Inf.11)

Based on bibliographic research performed in the main databases (Elsevier and Thomson Reuters), the figures below show the distribution of contributions in terms of research papers, books, conference proceedings and other formats in the Mediterranean region for the topic of marine pollution. Both Figures (1a and 1b, based on Elsevier and Thomson and Reuters databases, respectively) indicates that nine Contracting Parties, namely Morocco, Israel, Tunisia, Turkey, Egypt, Greece, Italy, France and Spain lead the research and monitoring inputs with regard to chemical pollution in the Mediterranean (not specifically to emerging and unregulated substances). The latest three countries, Italy, France and Spain, show the highest percentages of contribution in both databases.

The latest, Figure 2, shows the number of research contributions by countries these geographical distributions (subregions) might not be fully accurate, and respond to the methodology and indexed keywords in order to retrieve the information from those databases. Therefore, the comparison of databases is of high importance (Figure 2a and 2b).

To note, that the majority of investigations and monitoring survey for chemical pollution under the LBS Protocol of the Barcelona Convention and published in scientific journals has been performed in the coastal environments (mussel chemical monitoring, and recently, sediments), and rarely in other compartments in the marine ecosystems, such as the open sea or the continental platform or seabed, and should be considered under the Offshore Protocol of the Barcelona Convention in the years to come under the IMAP programme.



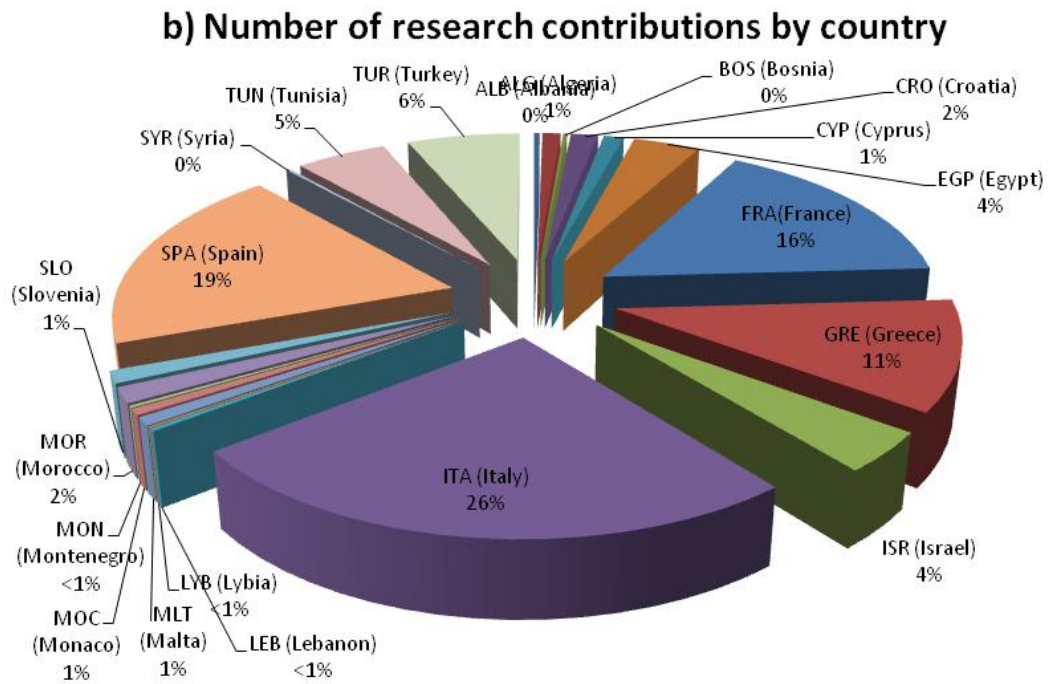


Figure 1. Percentages of the research contributions from two different bibliographic databases on pollution research for common marine pollution chemicals and priority chemicals listed under OSPAR, HELCOM and Barcelona Convention targeting the Mediterranean Sea. (a) ELSEVIER, ScienceDirect, b) THOMSON AND REUTERS, Web of Science (WoS).

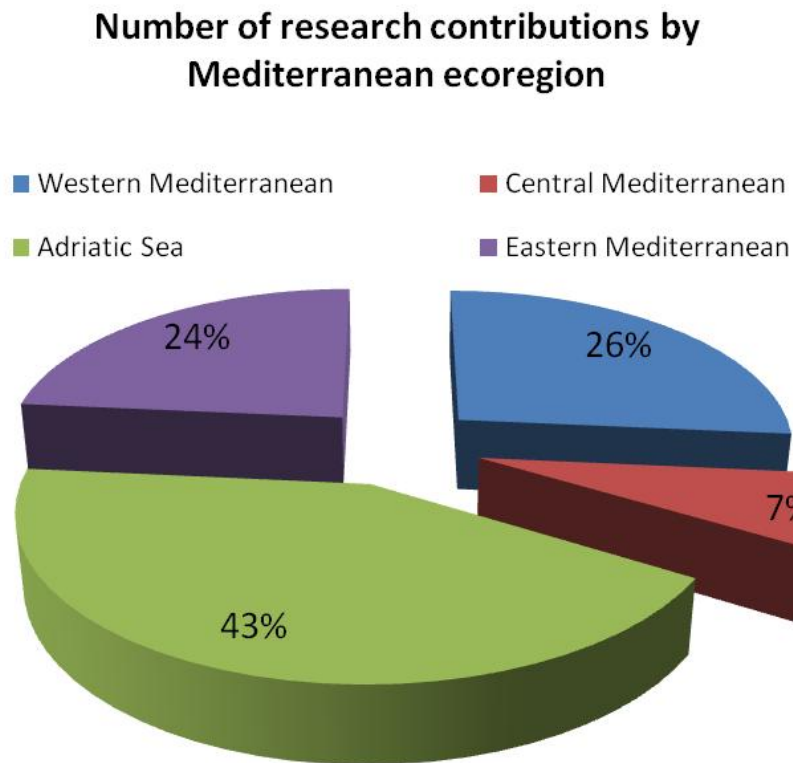


Figure 2. Percentage of research contributions by subregions in the Mediterranean Sea (Elsevier Databases search in January 2017).

Annex II
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