factsheet for the implementation of the Integrated Monitoring and Assessment Programme (IMAP) related to the Ecological Objectives 2 (EO2, Non-Indigenous Species (NIS)) under the Ecosystem Approach process (EcAp) of the Barcelona Convention.

EO2: Common Indicator 6. Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species, particularly invasive, non-indigenous species, notably in risk areas (EO2, in relation to the main vectors and pathways of spreading of such species).

Content	Actions	Guidance
General		
Reporter	Underline appropriate	UNEP/MAP/MED POL **SPA/RAC** REMPEC PAP/RAC Plan Bleu (BP)
Geographical scale of the assessment	Select as appropriate	Regional: **Mediterranean Sea** Eco-regional: NWM (North Western Mediterranean); ADR (Adriatic Sea); CEN (Ionian and Central Mediterranean Seas); AEL (Aegean and Levantine Sea) Sub-regional: Please, provide appropriate information
Contributing countries	Text	
Core Theme	Select as appropriate	1-Land and Sea Based Pollution **2-Biodiversity and Ecosystems** 3-Land and Sea Interaction and Processes
Ecological Objective	Write the exact text, number	**EO2. Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem**
IMAP Common Indicator	Write the exact text, number	**CI6. Trends in abundance, temporal occurrence, and spatial distribution of non-indigenous species, particularly invasive, non-indigenous species, notably in risk areas (EO2, in relation to the main vectors and pathways of spreading of such species)**
Indicator Assessment Factsheet Code	Text	**EO2CI6**
Rationale/Methods		
Background (short)	Text (250 words)	**Work undertaken to define indicators, key pressures and drivers** The February 2014 Integrated Correspondence Group on GES and Targets (Integrated CorGest) of the EcAp process of the Barcelona Convention selected the Common Indicator 6 "Trends in the abundance, temporal occurrence and spatial distribution of non-indigenous species, particularly invasive nonindigenous species, notably in risk areas in relation to the main vectors and pathways of spreading of such species" from the integrated list of indicators adopted in the 18th Conference of the Parties (COP 18), as a basis of a common monitoring program for the Mediterranean in relation to non-indigenous species. The Integrated Monitoring and Assessment Programme (IMAP), adopted at the 19th Conference of the Parties to the Barcelona Convention (COP 19) in Athens, included definitions of ecological objectives, operational objectives and related indicators for the implementation of the EcAp, as well as guidelines for monitoring to address Common Indicator 6. Four main pathways, i.e. the Suez Canal, shipping, aquaculture, and aquarium trade, were identified as the main drivers of species introduction in the Mediterranean. **Policy context and targets** The CBD's Aichi Biodiversity Target 9 is that "by 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment". This is also reflected in Target 5 of the EU Biodiversity Strategy (EU 2011). The new EU Regulation 1143/2014 on the management of invasive alien species seeks to address the problem of IAS in a comprehensive manner so as to protect native

		biodiversity and ecosystem services, as well as to minimize and mitigate the human health or economic impacts that these species can have. The Regulation foresees three types of interventions: prevention, early detection and rapid eradication, and management. The Marine Strategy Framework Directive (MSFD) specifically recognizes the introduction of marine alien species as a major threat to European biodiversity and ecosystem health, requiring EU Member States to include alien species in the definition of GES and to set environmental targets to reach it. Hence, one of the 11 qualitative descriptors of GES defined in the MSFD is that "non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem" (Descriptor 2). Among the indicators adopted to assess this descriptor are "trends in abundance, temporal occurrence and spatial distribution in the wild of non-indigenous species, particularly invasive non-indigenous species, notably in risk areas, in relation to the main vectors and pathways of spreading of such species". Ecological Objective 2 and the Common Indicator 6 are in agreement with the MSFD objectives and targets.
Background (*extended)*	Text (no limit), images, tables, references	
Assessment methods	Text (200-300 words), images, formulae, URLs	
Results		NOTE: If the assessment has been performed at different geographical scales, include the results and conclusions accordingly.
Results and Status, including trends (brief)	Text (500 words), images	Two basin-wide inventories of the marine alien species of the Mediterranean have been published the last years, by Zenetos et al. (2010, 2012) and Galil (2012). Furthermore, many national lists of marine alien species have been published, most of them the last decade, including Croatia, Cyprus, Greece, Israel, Italy, Libya, Malta, Slovenia, and Turkey. All known alien species introductions have been compiled in the Marine Mediterranean Invasive Alien Species online database (MAMIAS; www.mamias.org), developed by RAC/SPA in collaboration with the Hellenic Centre for Marine Research (HCMR). According to MAMIAS, 1057 non-indigenous species have been reported in the Mediterranean Sea (excluding vagrant species and species that have expanded their range without human assistance through the Straits of Gibraltar), of which 618 are considered as established. Of those established species, 106 have been flagged as invasive. Among the four Mediterranean sub-regions, the highest number of established alien species has been reported in the eastern Mediterranean, whereas the lowest number in the Adriatic Sea (Table 1). In terms of alien species richness, the dominant group is Mollusca, followed by Crustacea, Polychaeta, Macrophyta, and Fish (Fig. 1). The taxonomic identity of alien species differs among the four sub-basins, with macrophytes being the dominant group in the western and central Mediterranean and in the Adriatic Sea (Table 1).

Table 1: Summarized information for each Mediterranean sub-region about the status of alien invasions. Sources: MAMIAS, Zenetos et al. (2012)

	Eastern Mediterranean	**Central Mediterranean**	**Adriatic**	**Western Mediterranean**
number of established alien species	468	183	135	215
most important pathway of introduction	Suez Canal	shipping	shipping	shipping
2nd most important pathway	shipping	Suez Canal	aquaculture	aquaculture
richest taxons in alien biota	Mollusca, Crustacea	Macrophyta, Polychaeta	Macrophyta, Mollusca	Macrophyta, Crustacea
trend in the rate of new introductions (based on the last 3 decades)	increasing	decreasing	decreasing	decreasing

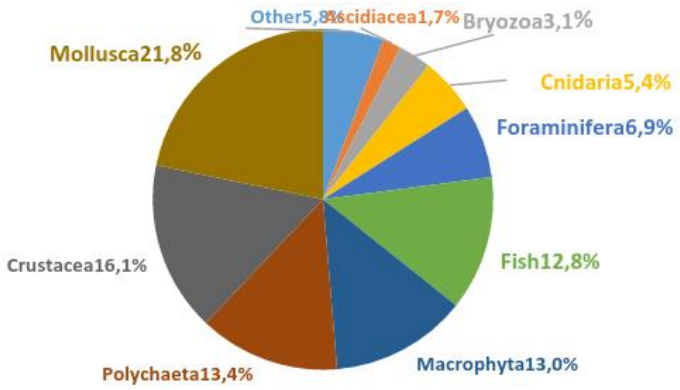


Figure 1: Contribution of the major taxa in the alien marine biota of the Mediterranean Sea. Modified from Zenetos et al. (2012).

Alien species in the Mediterranean Sea are linked to four main pathways of introduction: the Suez Canal, shipping (ballast waters and hull fouling), aquaculture, and aquarium trade. Overall in the Mediterranean, the Suez Canal is the most important pathway, contrary to the situation in Europe, where shipping is the most important (Fig. 2). Nevertheless, the importance of pathways varies among the four Mediterranean sub-regions, with shipping being the most important pathway in the western and central Mediterranean and the Adriatic (Table 1). An assessment of the 'gateways' (i.e. countries of initial introduction) to alien invasions in the European Seas (Nunes et al. 2014) revealed marked geographic patterns depending on the pathway of introduction. The Suez Canal was the predominant pathway of first introductions in Egypt, Lebanon, Israel, Syria and the Palestine Authority (all in the eastern Mediterranean), representing more than 70% of each country's first introduction events. For the other Mediterranean countries, shipping was the predominant pathway of initial introduction.

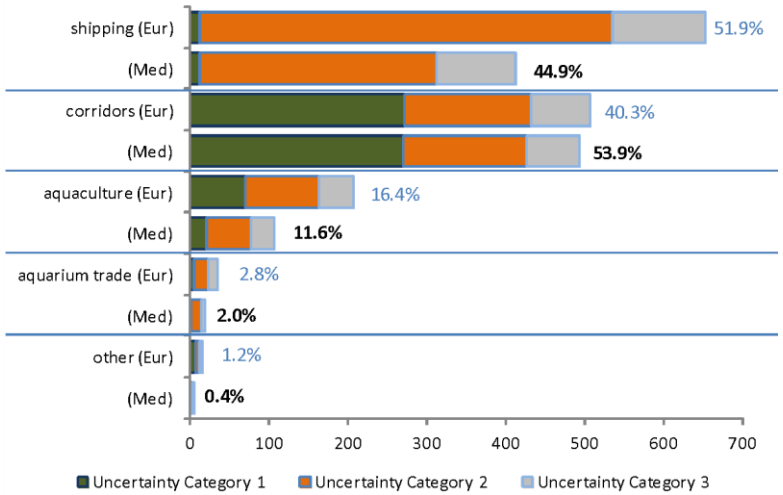


Figure 2: Number of marine alien species known or likely to have been introduced by each of the main pathways, in Europe (Eur) and the Mediterranean (Med). Percentages add to more than 100% as some species are linked to more than one pathway (blue percentages refer to the European total, while black percentages to the Mediterranean total). Uncertainty categories: (1) there is direct evidence of a pathway/vector; (2) a most likely pathway/vector can be inferred; (3) one or more possible pathways/vectors can be inferred; (4) unknown (not shown in the graph). Modified from Katsanevakis et al. (2013), Zenetos et al. (2012).

New introductions of alien species in the Mediterranean Sea have an increasing trend in the rate of new introductions by 30.7 species per decade, and the current (as of the 2000s) rate of new introductions exceeds 200 new species per decade (Fig. 3).

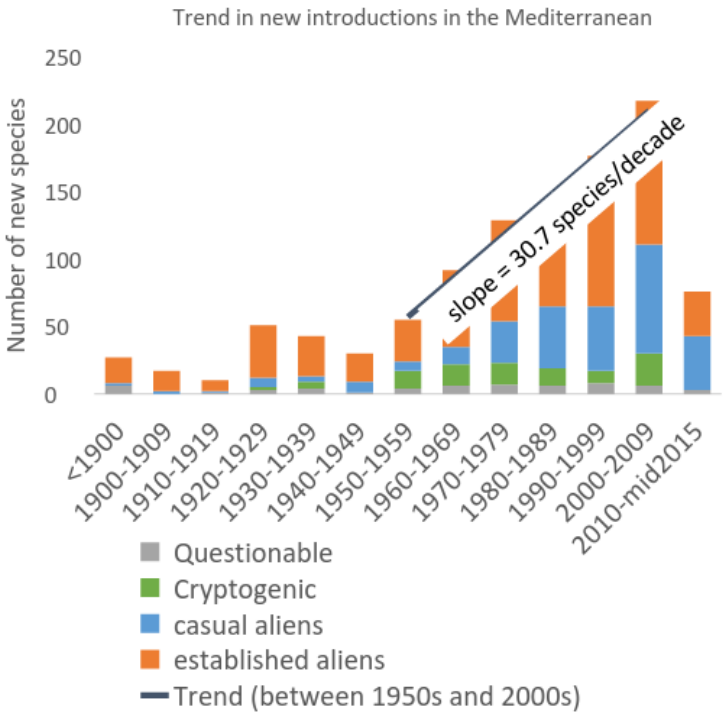
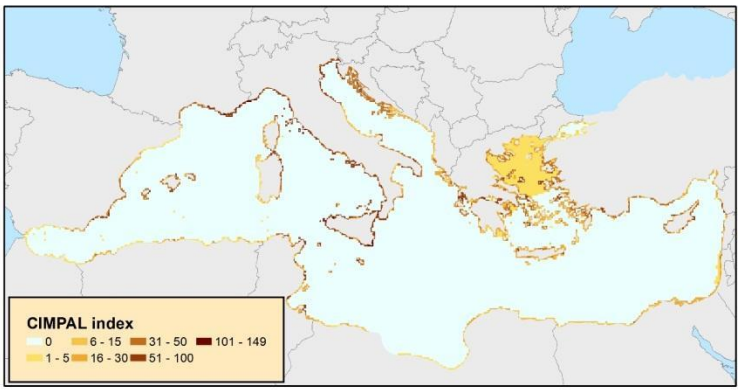


Figure 3: Trend in new introductions of alien marine species per decade in the Mediterranean Sea. Source: MAMIAS

However, this increasing trend in the rate of new introductions mainly reflects new introductions in the eastern Mediterranean, while in the other sub-regions the rate of new introductions is decreasing (Fig. 4).

		 *Figure 4: Trend in new introductions of alien marine species per decade in the Mediterranean sub-regions (eastern, central, western Mediterranean, and Adriatic Sea). Source: MAMIAS* The cumulative impact of alien species on the Mediterranean marine habitats was recently assessed and mapped, using the CIMPAL index, a conservative additive model, based on the distributions of alien species and habitats, as well as the reported magnitude of ecological impacts and the strength of such evidence (Katsanevakis et al. 2016). The CIMPAL index showed strong spatial heterogeneity, and impact was largely restricted to coastal areas (Fig. 5).  *Figure 5: Map of the cumulative impact score (CIMPAL) of invasive alien species to marine habitats. Modified from Katsanevakis et al (2016).*
Results and Status, including trends (extended)	Text(no limit), figures, tables	
Conclusions		
Conclusions (brief)	Text (200 words)	Important progress has been made the last decade in creating inventories of non-indigenous species, and on assessing pathways of introduction and the impacts of invasive alien species on a regional scale. The development and regular updating of MAMIAS substantially contributes to address Common Indicator 6. Nevertheless, research effort currently greatly varies among Mediterranean countries and thus on a regional basis current assessments and comparisons may be biased. Evidence for most of the reported impacts of alien species is weak, mostly based on expert judgement; a need for stronger inference is needed based on experiments or ecological modelling. The assessment of trends in abundance and spatial distribution is largely lacking. Regular dedicated monitoring and long time series will be needed so that estimation of such trends is possible in the future. NIS identification is of crucial importance, and the lack of taxonomical expertise has already resulted in several NIS having been overlooked for certain time periods. The use of molecular approaches including bar-coding are often needed to confirm traditional species identification.

Conclusions (extended)	Text (no limit)	
Key messages	Text (2-3 sentences or maximum 50 words)	
Knowledge gaps	Text (200-300 words)	
List of references	Text (10 pt, Cambria style)	Galil BS, 2012. Truth and consequences: the bioinvasion of the Mediterranean Sea. Integrative Zoology 7 (3): 299–311. Katsanevakis S, Zenetos A, Belchior C, Cardoso AC, 2013. Invading European Seas: assessing pathways of introduction of marine aliens. *Ocean and Coastal Management* 76: 64–74. Katsanevakis S, Tempera F, Teixeira H, 2016. Mapping the impact of alien species on marine ecosystems: the Mediterranean Sea case study. *Diversity and Distributions* 22: 694–707. Nunes AL, Katsanevakis S, Zenetos A, Cardoso AC, 2014. Gateways to alien invasions in the European Seas. *Aquatic Invasions* 9(2): 133–144. Zenetos A, Gofas S, Verlaque M, Çinar ME, Garcia Raso JE, *et al*, 2010. Alien species in the Mediterranean Sea by 2010. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part I. Spatial distribution. *Mediterranean Marine Science* 11 (2): 318–493. Zenetos A, Gofas S, Morri C, Rosso A, Violanti D, *et al*, 2012. Alien species in the Mediterranean Sea by 2012. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part 2. Introduction trends and pathways. *Mediterranean Marine Science* 13(2): 328–352.