Results of the IMAP Environmental Assessment of CI 20 in the Mediterranean region

Given the complete lack of data reported for CI 20, the environmental assessment of CI 20 was performed, by using the following two approaches: i) assessment of the status based on data reported to IMAP-IS for CI 17 contaminants in biota up to 31st, October 2022, the cutoff date for data reporting to be used in the 2023 MED QSR, using the EU concentration limits for regulated contaminants, and ii) assessment of present status based on bibliographic studies, following the same approach applied for preparation of the 2017 MED QSR, however by using newer available scientific literature.

a) Assessment of the status based on data reported to IMAP-IS for contaminants in biota (CI 17)

640. Data reported to IMAP-IS for CI-17 was investigated and the relevant data extracted and used for present initial marine environment assessment for IMAP CI 20. The relevant data consisted of the concentrations of trace metals (Cd, Hg and Pb) in fish and molluscs; PAHs in molluscs and PCBs in fish and molluscs. It should be emphasized that these data were collected within IMAP monitoring programs to assess the status of the marine environment and not to protect human health.

a.1. Assessment of data reported for the mandatory monitoring species Mytilus galloprovincialis (MG) and Mullus barbatus (MB)

641. For the assessment of CI 20, based on data reported for CI 17 contaminants in biota, the available data for the mandatory species M. galloprovincialis and M. barbatus are summarized in Table 3.1.7.3., along with the number of data points that exceeded the concentration limits for human consumption.

642. It was found that most of the measured concentrations were below the concentration limits for the regulated contaminants in the EU, with a few exceptions in Cyprus, Montenegro, and Spain. The maximal percentage of values above the EU criteria for one specific contaminant was low (14%). Examination of the national data submitted by Italy confirmed the assessment based on CI 17 and on the scientific literature .

643. Examination of CI 17 data i.e., data for TM and organic contaminants per sub-regions (Table 3.1.7.3.) showed that data for *M. galloprovinciallis* were available only for the WMS and the ADR. Values above the concentration's limits were found for only 14 data points out of 1002 (1.4%).

644. Examination of the CI-17 data i.e. only data related to TM were available, per sub-regions (Table 3.1.7.3.) showed that data for *M. barbatus* were available for the ADR (56 data points), CEN (15 data points) and AEL (213 data points). All concentrations were below the EU concentration limits.

a.2. Assessment of data reported to IMAP-IS for other species

645. The biota files from the IMAP-IS database were screened again for species other than the mandatory monitoring species, M. galloprovincialis and M. barbatus, for CI 17. Additional species were reported as shown here-below.

646. Cyprus (2020-2021). Cd, Hg and Pb were measured in the muscle of the fish Boops boops (n=13), Thynnus alalunga (n=52) and Merluccius merluccius (n=1). All the concentrations were below the concentration limits for the regulated contaminants in the EU, except for Hg in 6 samples of T.

alalunga. Σ4 PAHs and Σ6 PCBs were reported for Boops boops (n=10) and T. alalunga (n=15). All concentrations were below detection limit and for Σ6 PCBs also below the concentration limits in the EU. No criteria were given for PAHs in fish.

647. Croatia (2019). Cd and Pb were measured in the muscle of the fish Merluccius merluccius (n=3), Mullus surmuletus (n=1), Pagellus erythrinus (n=3), Sparus aurata (n=9). All concentrations were below the concentration limits for the regulated contaminants in the EU.

648. France (2017)106. Cd, Hg, Pb (n=6 each) and Σ4 PAHs and Σ6 PCBs (n=4 and n=2, respectively) were measured in the mollusc (bivalve) Crassostrea gigas and Cd, Hg, Pb were measured in 7 samples of the mollusc (bivalve) Venerupis decussata. All concentrations were below the concentration limits for the regulated contaminants in the EU.

649. Israel (2015, 2018, 2020). Cd and Hg were measured in 6 samples of the mollusc (bivalve) Donax trunculus, and Cd and Hg were measured in 26 samples of the mollusc (bivalve) Mactra corallina. All concentrations were below the concentration limits for the regulated contaminants in the EU.

650. Lebanon (2019). Cd, Hg, Pb (n=11 each) and Σ6 PCBs (n=3) were measured in the fish Diplodus sargus and Cd, Hg, Pb (n=15 each) and Σ6 PCBs (n=13) were measured in the fish Euthynnus alletratus. All concentrations were below the concentration limits for the regulated contaminants in the EU.

651. Malta (2017 and 2019). Cd, Hg, Pb (n=4 each), dioxin like PCBs and Total dioxins and furans (n=1 each) were measured in the fish Merluccius merluccius. All concentrations were below the concentration limits for the regulated contaminants in the EU.

652. Morocco (2019-2021). Cd, Hg, Pb (n=30 each) were measured in the mollusks Callista chione (n=30) and petite praire (n=6). All concentrations were below the concentration limits for the regulated contaminants in the EU. Σ4 PAHs were reported for C. chione (n=15) and petite praire (n=3). All concentrations were below the concentration limits for the regulated contaminants in the EU.

b) Assessment of the status based on bibliographic studies

653. In the context of CI 20, to protect human health, trace metals in fish were reported for many species across the Mediterranean countries: Algeria, Croatia, Greece, Italy, Lebanon, Morocco, Spain and Türkiye. Trace metals in molluscs were reported in various species from Italy, Lebanon, Morocco and Türkiye. Organic contaminants in fish were reported for various species from France, Italy and Tunisia, and in molluscs for Egypt, France, Italy, Tunisia and Türkiye. Trace metals and organic contaminants were reported also for some crustaceans and cephalopod species. Information on consumers` health risk was available for Algeria, Croatia, Italy, Tunisia and Türkiye, only. The literature review is summarized here-below and in Table 3.1.7.4 and Figure 3.1.7.1.

654. Algeria (WMS): Cd, Hg, Cu were reported in Sardina pilchardus and in Mullus barbatus collected from the Algerian coast (2017-2018). Concentrations were below the concentration limits for the regulated contaminants in the EU, except concentrations of Cd in some specimens from the bay of

[106] Data from EMODNet.

Algiers that were higher than the EU regulatory threshold. The average Pb concentrations did not exceed the regulatory value, although some specimens had concentrations higher than the threshold. Consumption of S. pilchardus from Algerian coast was not likely to have adverse effect on human health and a few risks were assigned to the consumption of contaminated M. barbatus (Hamida et al. 2018, Aissioui et al. 2021, Aissioui et al. 2022).

655. Croatia (ADR): Cd, Hg and Pb were reported for fish from 11 species[107] purchased in 2016 from supermarkets located in different Croatian cities. Hg and Pb concentrations were below the concentration limits for the regulated contaminants in the EU. Mean Cd levels in bluefin tuna exceeded the EU limit. Consumer health risk calculated from the dietary intakes for Cd was low, with exception of bluefin tuna. For Hg, frequent consumption of European sea bass, carp and bluefin tuna over a long period may have toxicological consequences for consumers. In a different study in 2016, the concentration of Hg did not exceed EU regulations in European pilchard and European anchovy (Bilandžić et al. 2018, Sulimanec Grgec et al. 2020).

656. Egypt (AEL): Persistent organic pollutants were reported in the mollusc Donax trunculus at the Rosetta Nile branch estuary. PCBs levels were well below tolerable average residue levels established by FDA and FAO/WHO for human fish consumption (Abbassy 2018).

657. France (WMS): Persistent organic pollutants (POP[108]s) were evaluated in six fish and two cephalopods species from an impacted area in NW Mediterranean Sea (Rhone river estuary vicinity). For Atlantic bonito (Sarda sarda) and chub mackerel (Scomber colias), the estimated weekly intakes of dioxin-like POPs for humans overpassed the EU tolerable weekly intake. Concentrations of nondioxin-like PCBs in S. sarda were above the EU maximum levels in foodstuffs, pointing to a risk (Castro-Jiménez et al. 2021).

658. Greece (AEL): Cd, Hg and Pb were reported in 4 fish species[109]. Concentrations in S. aurata and D. labrax were below the concentration limits for the regulated contaminants in the EU. In sardine and anchovy, nutritional benefits seem to outweigh the potential risks arising from fish metal content (Renieri et al. 2019, Sofoulaki et al. 2019).

659. Italy (ADR, CEN, WMS) (TM in fish and mussel): Hg, Cd, Pb were determined in 160 specimens of fish belonging to sixteen species collected in 2018 from commercial centers of South Italy. The concentrations were below the EU regulation, except for Cd in bluefin tuna, which exceeded the tolerable value. The estimated hazard quotient of Hg indicated a high probability of experiencing non-carcinogenic health risks (Storelli et al. 2020). Hg was measured in 42 commercial fish species caught off the Central Adriatic and Tyrrhenian coasts of Italy and in 6 aquaculture species. Hg levels exceeding the EC regulation limits were found in large-size specimens of high trophic-level pelagic and demersal

[107] Hake (Merluccius merluccius, n=7), Atlantic mackerel (Scomber scombrus, n=7), cod (Gadus morhua, n=7), chub mackerel (Scomber japonicas, n=7), fresh and canned sardine (Sardina pilchardus, n=7), European sea bass (Dicentrarchus labrax, n=13), gilthead sea bream
(Sparus aurata, n=11), bluefin tuna (Thunnus thynnus, n=8), salmonbass (Argyrosomus regius, n=8), rainbow trout (Oncorhynchus mykiss, n=7) and carp (Cyprinus carpio, n=7).

[108] Polybrominated diphenyl ethers (PBDEs), polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs), polychlorinated biphenyls (PCBs)

[109] Seabream (*Sparus aurata*), sea bass (*Dicentrarchus labrax*) sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*)

species. An estimation of the human intake of mercury associated to the consumption of the studied fish and its comparison with the tolerable weekly intake is provided (Di Lena et al. 2017). Hg measured in European hake (Merluccius merluccius) caught in the northern and central Adriatic Sea were lower than the level set by EU regulations (Girolametti et al. 2022). Cd, Pd measured in the swordfish Xiphias gladius muscles were lower than the levels set by EU regulations. Hg in 32% of samples exceeded European maximum limits. Risk assessment indicates hazardous state concerning Hg (Di Bella et al. 2020).

660. Cd, Hg, Pb in Mytilus galloprovincialis did not exceed the maximum limits as established by EU regulation from the Gulf of Naples and Domitio littoral (2016-2019) nor in specimens from the Claich Lagoon (Sardinia, 2017), the Marche (2016-2017) nor in Sicily (2016) (Esposito et al. 2020, 2021; Cammilleri et al. 2020).

661. Italy (ADR, CEN, WMS) (Organic contaminants in fish and mollusc). PAHs were measured Sardina pilchardus and Solea solea caught in the Catania Gulf (Sicily, 2017) (Ferrante et al. 2018). EU criteria for PAH the protection of human health exist only for mollusc and not for fish. Polychlorinated dioxins and furans (PCDD/Fs) and dioxin-like polychlorinated biphenyls (dl-PCBs) measured in fish[110] were below the maximum limits set by the EC for human consumption (Barone et al. 2021). Σ6 PCBs and dioxins and dioxin-like PCBs were lower than the values in the EU regulation in specimens of 3 edible fish species[111] samples in 2017 in the Northern Tyrrhenian Sea (Bartalini et al. 2020). PCDD/Fs, PCBs, measured in fish[112] from Taranto (2016) and PCDD/Fs and dl-PCBs) measured in fish[113] from Southern Italy (2019) were below the regulatory limits specified for these contaminants within the EU (Ceci et al. 2022, Barone et al. 2021). Σ6 PCBs in in marine organisms[114] collected from the contaminated Augusta Bay (Southern Italy, 2017) showed variable concentrations with a mean value above EU regulation in 2 fish species. Benzo[a] Pyrene (BaP) in mussels exceed threshold limit of the EU regulation. No risk analysis was performed. (Traina et al. 2021).

662. PCBs, dioxins and PAHs in Mytilus galloprovincialis, farmed in the waters of the Gulf of Naples and Domitio littoral (2016 to 2019), did not exceed the maximum limits as established by EU regulation, except for PAHs in a localized area in the winter (Esposito et al. 2020). Concentrations of Benzo(a)pyrene (BaP) and Σ4PAHs[115] exceeded the limit reported in EC in the Regulation for the mollusk Donax trunculus, caught in the Catania Gulf (Sicily, 2017). Risk assessment indicated concern for the health of high frequency molluscs consumers (Ferrante et al. 2018). PCDD/Fs and dl-PCBs in seafood[116] from Southern Italy (2019) and in mussel from Taranto (2016) were below the maximum limits set by the EC for human consumption except for a single sample taken from a known specific contaminated site in Taranto (Barone et al. 2021; Ceci et al. 2022).

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[110] rosefish, Euro-pean hake, red mullet, common sole, bluefin tuna

[111] Sardine (*Sardina pilchardus*), anchovy (*Engraulis encrasicolus*) and bogue (*Boops boops*).

[112] hake, mullet, sea bream, bogue, red mullet mackerel, sardines and sand steenbras

[113] rosefish, Euro-pean hake, red mullet, common sole, bluefin tuna

[114] In 2017, mussels (*Mytilus galloprovincialis*) obtained from a commercial farm and transplanted to two sites in Augusta Bay and resampled after 5 weeks and 7 months. Fish: 96 specimens of finfish (*Sphyraena sphyraena*, *Trigla lucerna*, *Mullus barbatus*, *Pagellus* spp., *Diplodus* spp.) and shellfish (*Parapaeneus kerathurus* and *Sepia* spp.) were obtained through local fishermen

[115] benzo(a)pyrene (BaP), benz(a)anthracene (BaA), benzo(b)fluoranthene (BbF) and chrysene (CH)

[116] (cephalopods: common octopus, common cuttlefish, European squid), (shellfish: Mediterranean mussel, striped venus clam, common scallop), (crustaceans: red shrimp, spottail mantis shrimp, Norway lobster)

663. Lebanon (AEL): Pb, Cd, and Hg were determined in three fish species (Siganus rivulatus, Lithognathus mormyrus and Etrumeus teres), in shrimp (Marsupenaeus japonicus) and in bivalve (Spondylus spinosus) commonly consumed by the local population. Trace metals concentrations were found to be below the maximum levels set by the EU (Ghosn et al. 2019).

664. Morocco (WMS): Cd and Pb concentrations were measured in soft tissues of M. galloprovincialis. Concentrations did not exceed EU regulations (Azizi et al. 2018; 2021). Cd, Hg and Pb concentrations measured in the fish Liza ramada were also below the values set in the EU regulation (Mahjoub et al. 2021).

665. Spain (WMS): The concentrations of Pb, Cd and Hg measured in the highly migratory Thunnus alalunga and Katsuwonus pelamis were below the tolerable limits considered by EU regulation (Chanto-García et al. 2022).

666. Tunisia (CEN): Organic contaminants (PAHs, PCBs and pesticides) were measured in fish (Sparus aurata and Sarpa salpa) muscle tissue collected from five stations along the Tunisian coast between (2018-2019). Σ6 PCBs for the fish were below the EC regulations. (Jebara et al. 2021). Concentrations of 21 legacy and emerging per- and polyfluorinated alkyl substances (PFAS)117 were measured in in 9 marine species (3 fish, 2 crustaceans and 4 mollusks)118 collected from Bizerte lagoon, Northern Tunisia (2018). Exposure to PFAS through seafood consumption indicates that it should not be of concern to the local consumers (Barhoumi et al. 2022).

667. Türkiye (AEL): Concentrations of Cd, Pb and Hg levels were measured in 9 fish, 1 mollusc and 1 shrimp species119 from the Aegean and Levantine Seas. All the results were found compatible with the Turkish Food Codex and EU Regulation limits except for Cd in two samples from the Mediterranean Sea. As a whole, the seafood was found to be safe for human consumption (Kuplulu et al. 2018). Cd and Pb measured in the fish Trachurus mediterraneus, Sparus aurata and Pegusa lascaris were below the values set in the EU regulation (Karayakar et al. 2022). Mytilus galloprovincialis, were transplanted from a clean site to the 3 sites in Nemrut Bay, known to be impacted by of industrial activities. Benzo(a)pyrene and Σ_4 PAHs levels in the mussels from the clean site were below the EU regulations[120] (Kucuksezgin et al. 2020).

668. Türkiye (AEL): Specific natural radionuclide (^{226}Ra, ^{232}Th and ^{40}K) concentrations were measured in wild and farmed European seabass collected from the Mediterranean coast of Türkiye (AEL) in 2018. From the radiological point of view, the radioactivity doses measured and the consumption of both wild and farmed seabass from the Mediterranean coast of Türkiye do not pose any risk to human health (Ozmen and Yilmaz 2020).

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[117] PFASs are not addressed in the EU regulation

[118] Fish: European eel (*Anguilla anguilla*), common sole (*Solea solea*), sea bass (*Dicentrarchus labrax*); crab (*Carcinus maenas*), shrimp (*Penaeus notialis*), common cuttlefish (*Sepia officinalis*) gastropod mollusc- banded dye-murex (*Hexaplex trunculus*), clam (*Ruditapes decussatus*) and farmed mussel (*Mytilus galloprovincialis*)

[119] Fish: mullet (Mugil cephalus), shad (Alosafallax), hake (Merluccius merluccius), whitting (Merlangius euxmus), seabass (Dicentrarchus labrax), turbot (Scophthalmus maximus), red mullet (Mullus barbatus), blue fish (Pomatomus saltatrix), seabream (Sparus auratus). Mussel: (Mytilus galloprovincialis). Shrimp (Penaeus indicus)

[120] Mussels transplanted from the clean site to the impacted Nemrut bay exhibited in certain occasions PAHs concentrations higher than the concentrations in the EU regulation. Mussels from this area are not used for human consumption.

669. From the above elaboration, it can be concluded that the assessment of CI 20 based on recent peer reviewed literature included 36 relevant studies. Most (25) reported concentrations of trace metals while 12 studies reported on organic contaminants. Concentrations in a wide variety of fish species were reported in 26 studies and concentrations in molluscs in 17 studies. Data on crustaceans and cephalopods were reported in 8 studies.

670. Most of the studies found that the concentrations of the contaminants were below the concentration limits for the regulated contaminants in the EU (24 studies), or if some of the contaminants were higher than regulation, risk analysis showed no risk to human health (7 studies). Only 6 studies reported on possible risk for human health from the consumption of seafood.

671. Examination of the literature data per sub-regions was performed by counting the number of times contaminants (Cd, Hg, Pb, B(a)P) and the number of group of contaminants (Σ4 PAHs, Σ6 PCBs, PCDD/Fs and Σ (PCDD/F and dl PCBs)) (Table 3.1.7.4) were addressed in the literature. There were 37 entries for the WMS, 25 for the ADR, 24 for the CEN and 23 for the AEL sub-region. The percentages of blue status from the total entries were high: 78, 80, 71 and 87% for the WMS, ADR, CEN and AEL, respectively. Red status was assigned to 11, 12, 8 and 11% of the entries for the WMS, ADR, CEN and AEL, respectively (Figure 3.1.7.1).

Table 3.1.7.3. Number of data points extracted from IMAP-IS CI 17 database, of relevance for IMAP CI 20, are shown in black. Assessment findings are shown in red and indicate the number of data points exceeding the criteria i.e. the concentration limits for the regulated contaminants in the EU. Table is sorted by species and alphabetical order of CPs. MG – *Mytilus galloprovincialis*; MB- *Mullus barbatus*. No criteria are specified in the EU regulations for Hg and Σ_6 PCBs in *M. galloprovincialis* nor for PAHs in *M. barbatus*.

CP	Year	Species	Cd	Hg	Pb	Σ_4 PAHs	Benzo(a) pyrene	Σ_6 PCBs
Albania	2020	MG	2	2	2			2
			0		0			
Croatia	2019-2020	MG	37	35	37			19
			0		0			
France	2015, 2017-2018	MG	50	50	50	25	25	23
			0		0	0	0	
Italy	2015-2019	MG	33	170	33		53	
			0		0		0	
Montenegro	2018-2020	MG	28	28	28	21	21	21
			0		4	0	0	
Morocco	2017-2021	MG	27	27	27	6	6	
			0		0	0	0	
Slovenia	2016-2021	MG	21	21	15	12	12	
			0		0	0	0	
Spain	2015-2017,2019	MG	70	70	70	42	42	40
			0		6	6	1	
Croatia	2019-2020	MB	11	10	11			
			0	0	0			
Cyprus	2020-2021	MB	14	14	14	12	12	12
			0	1	0			0

CP	Year	Species	Cd	Hg	Pb	Σ_4 PAHs	Benzo(a) pyrene	Σ_6 PCBs
Israel	2015, 2018-2020	MB	58	60				
			0	0				
Lebanon	2019	MB	14	14	14			
			0	0	0			
Malta	2017, 2019	MB	5	5	5			
			#	0	0			
Montenegro	2018	MB	8	8	8			
			0	0	0			
Türkiye (AEL)	2015	MB	25	25	25		8	
			0	0	0			

#All data were reported to IMAP-IS as below detection limit. Detection limit was higher than the EU maximum regulatory level criteria.

Table 3.1.7.4. Summary of the findings from the scientific literature, used to support present assessment, arranged alphabetically by country. The findings of some of the studies were summarized in more than one row, to allow for the separation of taxa (i.e. fish from mollusc) and contaminants (trace metals from organics). It includes sum of 4 PAHs (benzo(a)pyrene (BaP), benz(a)anthracene (BaA), benzo(b)fluoranthene (BbF) and chrysene (CH) (Σ_4 PAHs); Benzo(a)Pyrene (B(a)P); sum of 6 non dioxin like PCBs (Σ_6 PCBs); sum of polychlorinated dibenzo-para-dioxins and polychlorinated dibenzofurans (PCDD/Fs) and Σ (PCDD/Fs and dioxin like (dl)) PCBs).
Cells in blue: values below EU criteria; cells in green: values above EU criteria but no health risk detected; cells in yellow: values above EU criteria, risk analysis was not reported; cells in red: above EU criteria with risk to human health.

Reference	Country	Sampling Year	Species	Study area	Cd	Hg	Pb	Σ_4 PAHs	B(a)P	Σ_6 PCBs	PCDD/Fs	Σ (PCDD/F and dl PCBs)
Hamida et al. 2018	**Algeria**		sardines	Bay of Boumerdés	❑		❑					
Aissioui et al. 2022	**Algeria**	2017-2018	*S. pilchardus*	Algiers, Dellys and Bejaia	❑❑	❑	❑					
Aissioui et al. 2021	**Algeria**	2017-2018	*M. barbatus*	Algiers, Dellys and Bejaia	❑❑	❑	❑❑					
Bilandžić et al. 2018	**Croatia**	2016	11 fish species	Purchased from supermarkets (Croatian cities)	❑❑	❑	❑					
Sulimanec Grgec et al. 2020	**Croatia**	2016	European pilchard, European anchovy	Eastern ADR	❑							
Abbassy, 2018	**Egypt**	2017	*Donax trunculus*	Rosetta, Nile branch estuary						❑		
Castro-Jiménez et al. 2021	**France**		Fish and cephalopods	Rhone river estuary vicinity, known as impacted						❑❑	❑❑	
Renieri et al. 2019	**Greece**	2017-2018	*Sparus aurata, Dicentrarchus labrax*	Aquaculture sites and fish market, Heraklion	❑	❑	❑					
Sofoulaki et al. 2019	**Greece**		*Sardina pilchardus, Engraulis encrasicolus*	From 6 Greek coastal areas	❑	❑	❑					

Reference	Country	Sampling Year	Species	Study area	Cd	Hg	Pb	Σ_4 PAHs	B(a)P	Σ_6 PCBs	PCDD/Fs	Σ (PCDD/F and dl PCBs)
Storelli et al. 2020	**Italy**	2018	16 fish species	Purchased from commercial centers of South Italy (Apulia)	□□	□□	□					
Di Lena et al. 2017	**Italy**		42 fish species	Central Adriatic and Tyrrhenian coasts of Italy and from aquaculture		□□						
Girolametti et al. 2022	**Italy**	2018-2019	*M. merluccius*	Northern and central ADR		□						
Di Bella et al. 2020	**Italy**	2017	*Xiphias gladius*	Adriatic and Tyrrhenian Seas	□	□□	□					
Esposito et al. 2020	**Italy**	2016-2019	*M. galloprovincialis*	Gulf of Naples and Domitio littoral, known impacted areas	□	□	□					
Esposito et al. 2021	**Italy**	2017	*M. galloprovincialis*	Euthrophic Calich Lagoon, Sardinia	□	□	□					
Tavoloni et al. 2021	**Italy**	2016-2017	*M. galloprovincialis*	Areas along Marche coast	□	□	□					
Cammilleri et al. 2020	**Italy**	2016	*M. galloprovincialis*	10 large urban agglomerations, high industrial activities and national interest sites of Sicily (Barcellona Pozzo di Gotto, Catania, Gela, Licata, Messina, Milazzo, Palermo, Siracusa, Termini Imerese and Trappeto)	□	□	□					
Ferrante et al. 2018	**Italy**	2017	*S. pilchardus, S. solea*	Fish market in Catania Gulf (Sicily				□□				
Barone et al. 2021	**Italy**	2019	5 fish species	Bari, Lecce, Taranto, Foggia, Brindisi and Matera							□	□

Reference	Country	Sampling Year	Species	Study area	Cd	Hg	Pb	Σ_4 PAHs	B(a)P	Σ_6 PCBs	PCDD/Fs	Σ (PCDD/F and dl PCBs)
Bartalini et al. 2020	**Italy**	2017	3 fish species	Northern Thyrrenian Sea						□		□
Ceci et al. 2022	**Italy**	2016	7 fish species	coasts of Abruzzo, Apulia and Sicily						□	□	
Traina et al. 2021	**Italy**	2017	5 fish species	contaminated Augusta Bay (Southern Italy)		□□				□□		
Esposito et al. 2020	**Italy**	2016-2019	*M. galloprovincialis*	Farmed in the Gulf of Naples and Domitio littoral, areas heavily influenced by human activities				□□		□		□
Ferrante et al. 2018	**Italy**	2017	*Donax trunculus*	Fish market in Catania Gulf (Sicily				□□	□□			
Barone et al. 2021	**Italy**	2019	Cephalopods, shellfish and crustaceans	Bari, Lecce, Taranto, Foggia, Brindisi and Matera							□	□
Ceci et al. 2022	**Italy**	2019	*M. galloprovincialis*	□ussel farm, Taranto Area						□	□	
Traina et al. 2021	**Italy**	2017	*M. galloprovincialis*	Augusta Bay (Southern Italy Known as impacted				□	□□	□		
Ghosn et al. 2019	**Lebanon**	2016-2017	3 fish, 1 shrimp, 1 bivalve species	coastline: Tripoli, Beirut and Saida	□	□	□					
Ghosn et al. 2020b	**Lebanon**	2017	1 bivalve, 1 shrimp species	3 sites along the Lebanese coast	□	□	□					
Ghosn et al. 2020a	**Lebanon**	2017	2 fish species	3 sites along the Lebanese coast	□	□	□					
Azizi et al. 2018	**Morocco**	2016	*M. galloprovincialis*	aquaculture farm in Cala Iris sea of Al Hoceima	□		□					
Azizi et al. 2021	**Morocco**	2018	*M. galloprovincialis*	farm installed along the Al Hoceima	□							
Mahjoub et al. 2021	**Morocco**	2018	*L. ramada*	port of Béni Ansar and Ras Kebdana	□	□	□					

Reference	Country	Sampling Year	Species	Study area	Cd	Hg	Pb	Σ_4 PAHs	B(a)P	Σ_6 PCBs	PCDD/Fs	Σ (PCDD/F and dl PCBs)
Chanto-García et al. 2022	**Spain**		*T. alalunga, K. pelamis*	Not mentioned	❑	❑	❑					
Jebara et al. 2021	**Tunisia**	2018-2019	*S. aurata,* S. *salpa*	five stations along the Tunisian coast						❑		
Barhoumi et al. 2022	**Tunisia** ^^	2018	3 fish, 2 crustaceans and 4 mollusks species	Bizerte lagoon								
Kuplulu et al. 2018	**Türkiye**	Not reported	9 fish, 1 mollusc and 1 shrimp species	purchased from fishermen of fish markets	❑❑	❑	❑					
Kucuksezgin et al. 2020	**Türkiye**	2016-2017	*M. galloprovincialis*	Transplanted into Nemrut bay Known as impacted				❑❑	❑❑			
Karayakar et al. 2022	**Türkiye**	2016-2017	3 fish species	bought from local fishermen in the Karatas region (Adana)	❑		❑					

***** Specific sampling area or organism or size class, no health risk detected; # Cd exceeded EU regulation in bluefin tuna; & Risk for human consumption, specific species and size class; % No EU regulation concerning PAHs in fish, only in mollusc; + Exceeded EU regulation, specific organism or size class, no risk analysis performed; ^^Study measured organics not addressed in EU regulations, no risk to health detected.

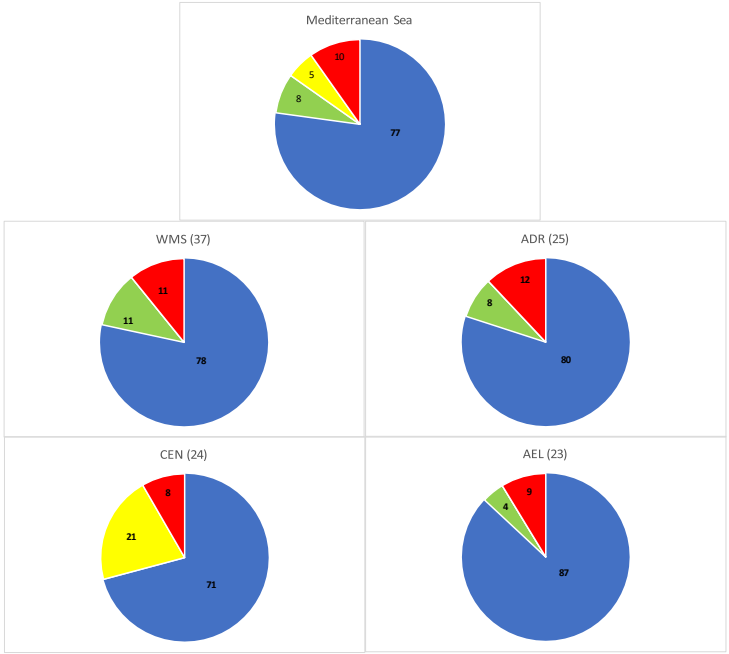

Figure 3.1.7.1. Assessment of CI 20 in the Mediterranean Sea and sub-regions based on recent peer-reviewed literature. Seventeen studies from Italy had results for 2 different sub-regions. Numbers in the chart are the percentage from total entries in each status. Number in parenthesis is the number of studies for each sub-region. Blue: values below EU criteria; green: values above EU criteria but no health risk detected; yellow: values above EU criteria, risk analysis was not reported; red: above EU criteria with risk to human health.

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