Table S2. Ranking of Mediterranean countries in terms of share of the total impact estimated across the basin. The percentage contribution of each pathway to the total impact estimate of each country is provided on the right-hand half of the table. Columns 5 to 7 contain indicators of each country's EEZ, coastal and offshore areas in the Mediterranean.

Rank	Country	(Sum of) Weighted Impacts*	% Medit. Total Impact	Med EEZ area (km^2)	Coastal cells (km^2)	Offshore cells (km^2)	PERCENTAGE CONTRIBUTION OF EACH PATHWAY PER COUNTRY			
							SUEZ	SHIPPING	AQUACULTURE	ACQUARIA
1	Italy	18271.1	29.0	538170	39803	498367	14	55	17	13
2	Greece	17409.9	27.7	493195	67409	425786	38	57	5	0
3	Turkey	5228.2	8.3	83052	23900	59152	53	41	6	0
4	Croatia	4773.5	7.6	55438	14931	40507	4	52	13	32
5	Spain	3748.5	6.0	260228	14195	246033	22	50	19	9
6	France (Medit.)	3699.0	5.9	88138	8353	79785	1	64	16	19
7	Tunisia	2793.8	4.4	100411	9434	90977	49	37	14	0
8	Cyprus	1551.6	2.5	98039	4182	93857	65	35	0	0
9	Egypt	1375.5	2.2	170510	8671	161839	60	26	13	0
10	Algeria	934.2	1.5	128778	7732	121045	36	45	19	0
11	Libya	928.2	1.5	357156	11709	345447	79	17	3	0
12	Israel	539.0	0.9	27738	1542	26196	57	26	17	0
13	Albania	439.8	0.7	11192	2495	8697	20	75	5	0
14	Malta	352.0	0.6	55409	776	54633	13	51	36	0
15	Lebanon	317.2	0.5	19261	1381	17880	59	25	16	0
16	Syria	311.0	0.5	10180	1166	9014	82	17	1	0
17	Morocco	103.2	0.2	18149	2649	15500	25	50	25	0
18	Montenegro	78.2	0.1	7450	704	6745	18	82	0	0
19	Slovenia	27.7	0.0	186	137	49	0	32	68	0
20	Monaco	21.3	0.0	284	20	264	0	63	5	33
21	Gibraltar (UK)	6.0	0.0	426	100	326	20	60	20	0
22	Bosnia & Herzeg.	2.3	0.0	13	13	0	8	92	0	0

* weighted impacts are calculated per cell by multiplying the impact score of the cell by the ratio of the cell area divided by $100km^2$. This was done to account for the cell clipping occurring near the coast and the EEZ margins, which generated cells smaller than 10km×10km.

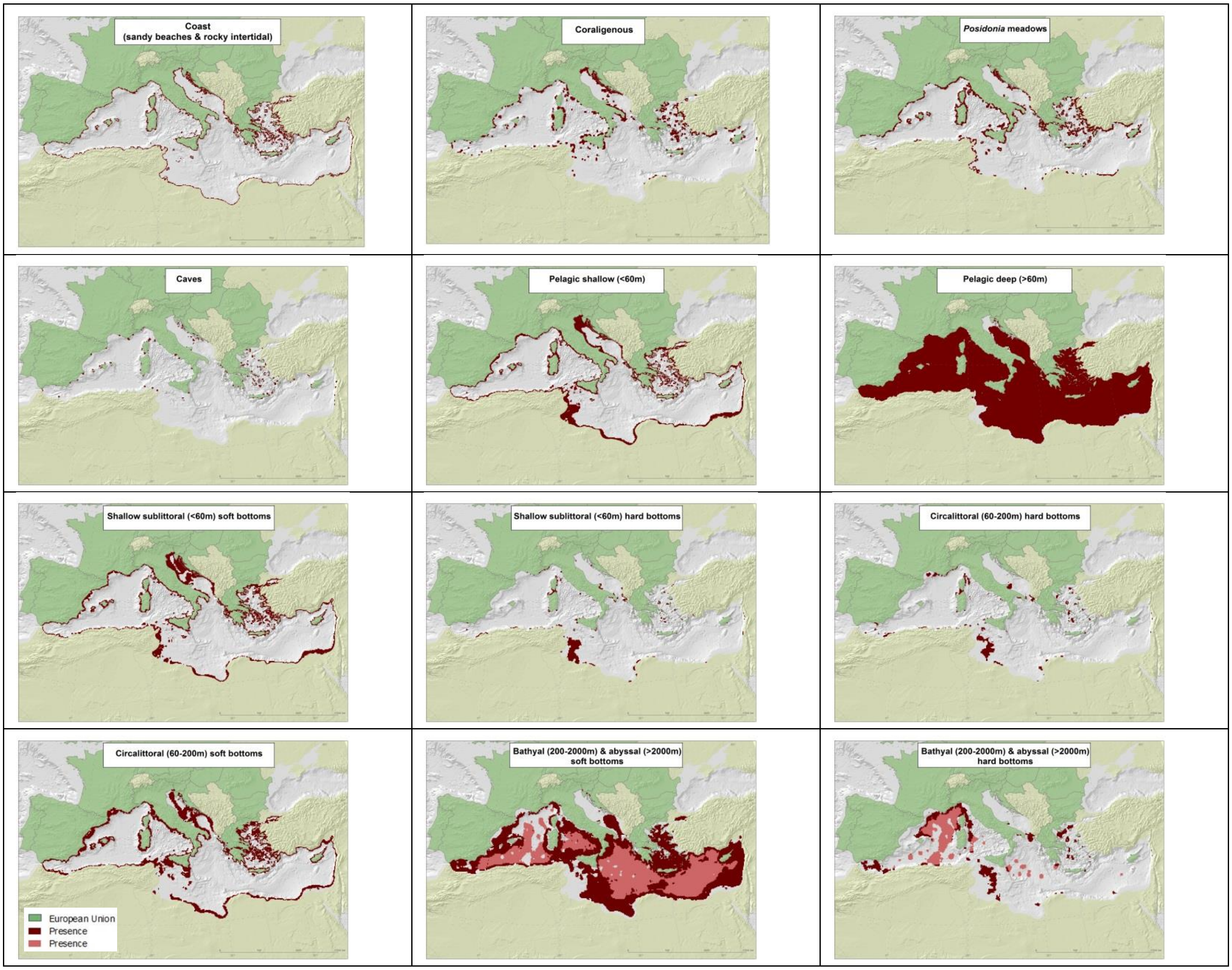

Figure S1. The 13 habitat layers used for the estimation and mapping of the cumulative impact index of invasive alien species on the marine ecosystems of the Mediterranean Sea.

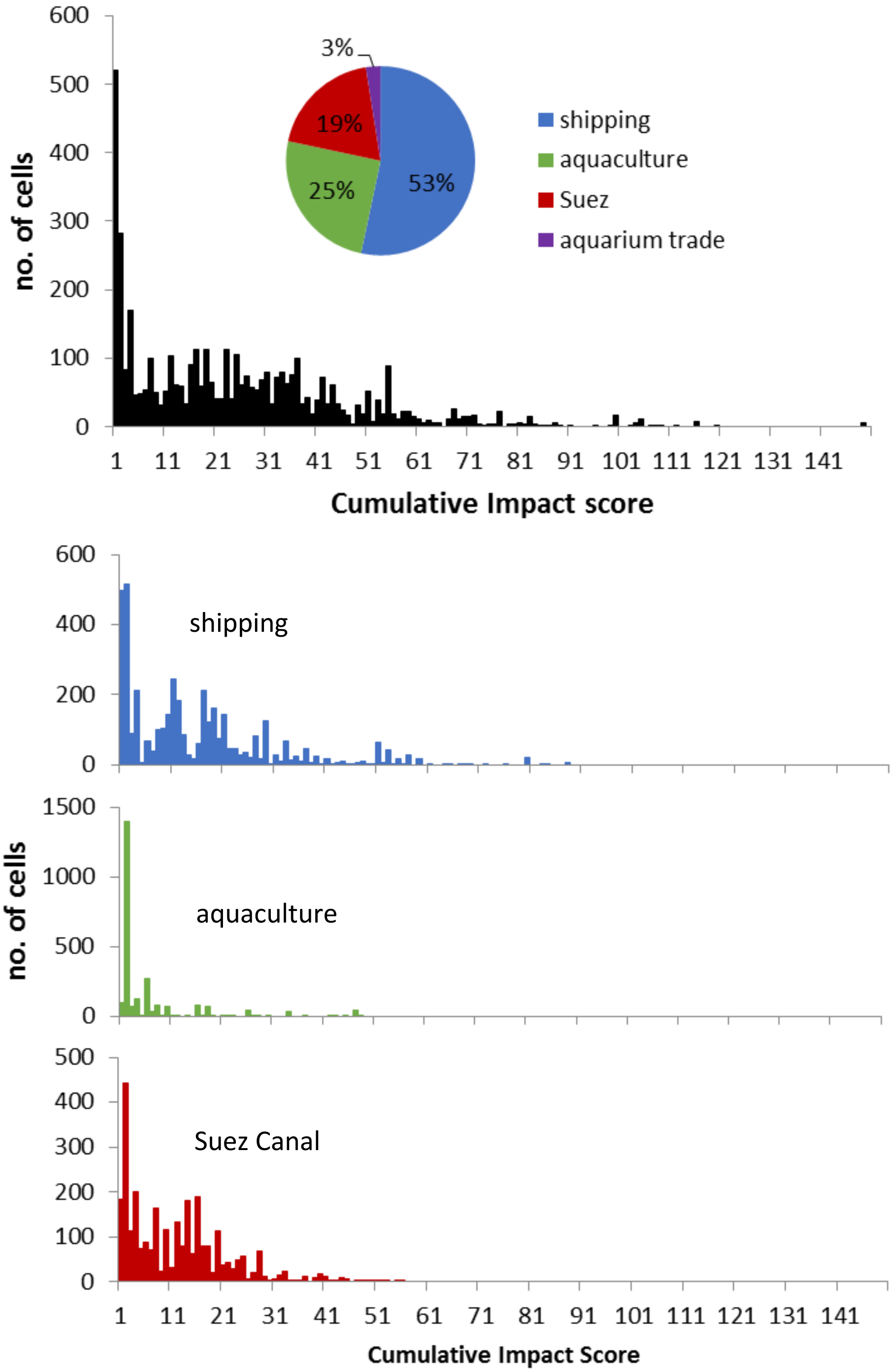

Fig. S2: Histogram of cumulative impact (CIMPAL) scores depicting the number of 10x10 km cells that fall within each impact category (based on the uncertainty-averse strategy). Zero values were not included. Histograms of cumulative impact scores estimated by including only species introduced by each of the three main pathways of introduction are also given. The pie chart depicts the proportion of the high-impact alien marine species introduced by each of the related pathways of introduction. Some species that were linked to two pathways (see Table S1 in Supporting Information) were given a value of 1/2 for each of the two associated pathways so that in the pie chart the overall contribution of each species was always 1.

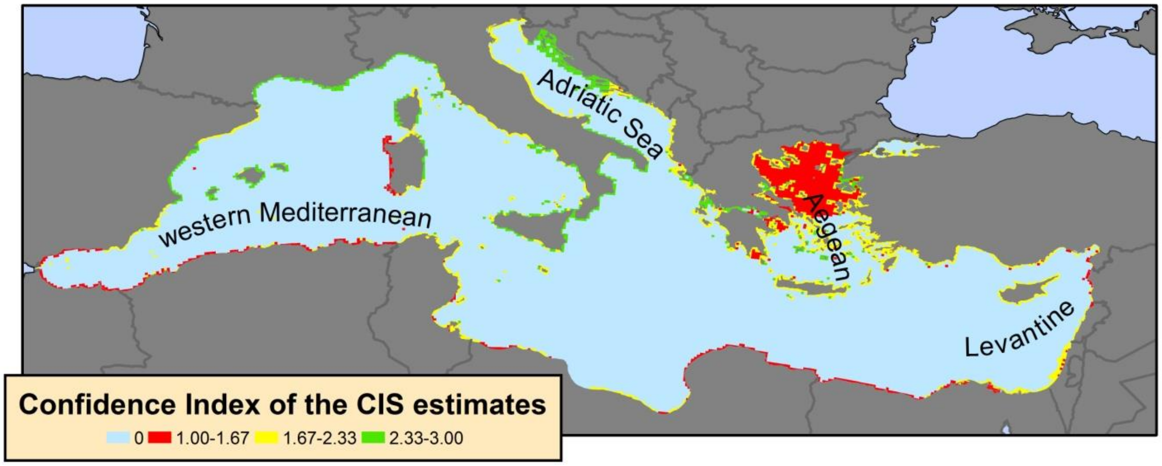

Fig. S3: Confidence index of the estimates of the estimated cumulative impact (CIMPAL) score of alien species on the marine ecosystems of the Mediterranean Sea. The confidence index is zero on cells for which there is no impact and varies between 1–3 in all other cells; 1 corresponds to the lowest confidence (i.e., all impact estimates are based on expert judgement), while 3 corresponds to the highest confidence (i.e., all impact estimates are based on experimental studies). In the areas of low confidence, it is likely that the true impact is higher than what is depicted in Fig. 2 (down-weighted due to low confidence, according to the scoring system of Fig. 1).

w_{ij}: impact weights for species i and habitat j

		Impact				
		Minimal	Minor	Moderate	Major	Massive
Strength of Evidence	High	0	1	2	3	4
	Medium	0	0	1	2	3
	Low	0	0	0	1	2

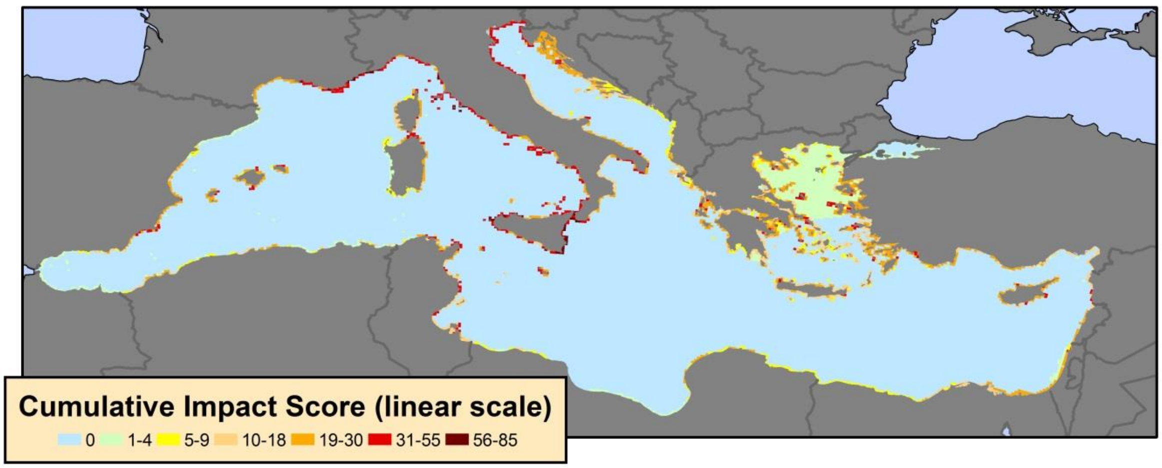

Figure S4. Mediterranean Sea map of the cumulative impact score of 60 invasive alien species to 13 marine habitats (bottom), as in Fig. 2 of the article, but by using a linear scale for the impact weights (top).

w_{ij}: impact weights for species i and habitat j

Strength of Evidence	Impact: Minimal	Minor	Moderate	Major	Massive
High	0	1	10	100	1000
Medium	0	0	1	10	100
Low	0	0	0	1	10

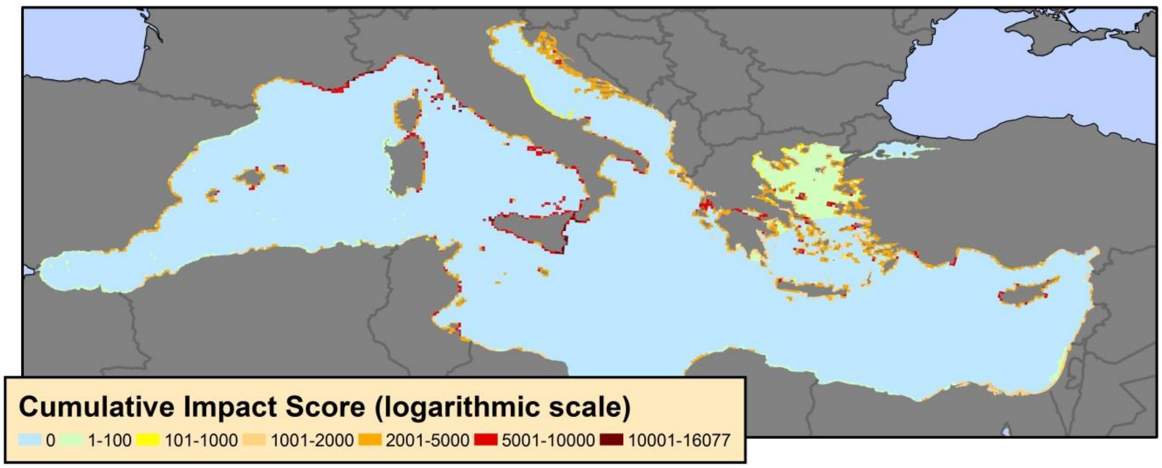

Figure S5. Mediterranean Sea map of the cumulative impact score of 60 invasive alien species to 13 marine habitats (bottom), as in Fig. 2 of the article, but by using a logarithmic scale for the impact weights (top).

Supplementary analysis 1: Treatment of uncertainty

Methodology

We identified five main sources of uncertainty associated with the CIMPAL index and linked them to each of its parameters (n, m, A_i, H_j, $w_{i,j}$) , presenting a "*traceable account of all sources of uncertainty*" as suggested by Mastrandrea et al. (2011). The type of information available allows only a qualitative assessment of uncertainty, in terms of a 'confidence level' (CL) as in the IPCC (Intergovernmental Panel on Climate Change) guidance (Mastrandrea et al., 2011). The CL comprises of two components, an assessment of the 'strength of evidence' (SoE) and the 'level of agreement' (LoA). The summary terms advised for reporting when using each component of confidence are: robust, medium and limited for SoE, and high, medium and low for LoA. If information for both these aspects (SoE and LoA) is available then, the level of confidence should be reported using 5 classes: very high, high, medium, low and very low, after a combination of both components as suggested by Mastrandrea et al. (2011).

The spatial variation of confidence associated with the reported impacts of alien species could be accounted for only for one of these sources of uncertainty, i.e. the strength of evidence of the reported impacts $w_{i,j}$, which was defined as: robust, if based on manipulative or natural experiments; medium, if based on modelling, direct observations, or non-experimental-based correlations; and low, if based only on expert judgement. We used these three levels of confidence: robust (3), medium (2) and low (1), to calculate an index of confidence per each 10x10 km cell of our grid in the Mediterranean Sea. The three levels of evidence were used to derive an average confidence on the reported habitat-specific impacts of all species present in a cell, conditional to habitat presence. This was then used to map the confidence index per cell for the entire study area.

Uncertainty of CIMPAL parameters

There are five sources of uncertainty linked to the five parameters of CIMPAL. The first source of uncertainty is related to the distinction between alien species with high and those with non-high impact, which defines the number of target species to be included in the assessment, i.e. our n. High-impact species have been defined on the basis of a set of criteria (SoE) agreed within a group of experts (LoA) in Katsanevakis et al. (2014a). However, since this depends on the current knowledge available regarding species impacts on biodiversity and ecosystems, the number of high-impact species (n) is likely to increase as new studies are undertaken. For the inventory of included species we consider there is high agreement (based on current knowledge) and medium evidence, in the absence of impact assessments for all Mediterranean aliens (Table S3). As the number of high-impact species will probably increase, this uncertainty leads to an underestimation of the actual cumulative impact in the Mediterranean Sea, the extent of which is currently not possible to quantify and report here.

A second source of uncertainty is associated with the alien species population state in the area, which is represented in CIMPAL by A_i. For this study only their presence/absence was available and not a more informative index of state such as abundance. Alien species records for the Mediterranean come from several and well validated sources, with high agreement on the reported presences in the region (LoA), but acknowledging the often limited evidence, with scattered and highly heterogeneous data (SoE) available, on the distribution and occurrence of many of those species across the whole study area (Table S3). The use of presence/absence data, however, is not representative of the relative contribution of each species to the cumulative impact. Adding species abundance on the go is an option as robust information becomes available (e.g. per species or locally), which would gradually improve the accuracy of the cumulative impacts map in the Mediterranean. Using presence data causes an overestimation of the CIMPAL index as wherever a species is present, the value of A_i would always be 1, while with abundance data it would be less or equal to 1. Uncertainty in Ai relates also to the resolution of species distribution data used (10x10km). Such a coarse scale increases the probabilities of matching a species and a habitat in a wider area, overestimating the CIMPAL index.

Other two sources of uncertainty refer to the quality of the habitat data, which reflect in the number of habitats defined, i.e. our *m*, and in the extent and spatial distribution of each habitat across the study area, i.e. our H_j. The selection of habitat maps was essentially driven by the scale at which this study was undertaken. Habitat maps available for the entire Mediterranean Sea basin use widely recognized and agreed (LoA) but broad habitat categories (Figure S1). Such coarse definition (SoE) decreases ecological significance, but is essential to ensure coherence throughout the study area. Still, greater habitat data availability and better characterization was observed for the northern and western sectors of the Mediterranean basin than in the eastern and especially the southern sectors (Giakoumi *et al.*, 2013; Levin *et al*., 2014). Therefore, the evidence (SoE) collected is also not spatially homogeneous. Another constraint is the use of simple presence/absence habitat information (for the definition of H_j) combined with the low spatial resolution, which systematically overestimates cumulative impact in cells with more than one habitat.

The last source of uncertainty identified is associated with the characterization of the impact of alien species on habitats, both its specificity and magnitude of impact, represented in CIMPAL by $w_{i,j}$. The impacts of alien species were accounted for alongside an associated strength of evidence (SoE; Table S1): robust (3), if based on manipulative or natural experiments; medium (2), if based on modelling, direct observations, or non-experimental-based correlations; and limited (1), if based only on expert judgment. We cannot report the level of agreement (LoA), since no standardized expert elicitation method was used during that process (Katsanevakis et al. 2014a).

Table S3. Summary of uncertainty associated with each of the CIMPAL index parameters, following IPCC standard nomenclature (Mastrandrea et al., 2011). A qualitative assessment of uncertainty is reported as Confidence Level (CL) or by one of its components: strength of evidence (SoE) or level of agreement (LoA), referring to the full dataset and on a case-by-case basis, i.e. per species or per habitat. The general influence of the options made for each parameter, in this study, is reported as under- or overestimating the final outcome of the index or unknown, if the effect of its variation is unpredictable.

	CIMPAL index parameters				
Confidence level components	*n*	*A*	*m*	*H*	*w*
SoE	medium	limited	medium	limited	*medium (but see Table S1 for case-by-case SoE)*
LoA	high	high	high	medium	*not available*
final CL:	***high***	***medium***	***high***	***low***	*not available*
Influence on CIMPAL index	*underestimation*	*overestimation*	*unknown*	*overestimation*	*underestimation*

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Supplementary analysis 2: Comparison of the ranking of sites according to the CIMPAL index based on the two decision-making strategies: the uncertainty-averse and the precautionary approach

We compared the two approaches to calculate the CIMPAL index, uncertainty averse *vs* precautionary, using the non-parametric Wilcoxon Signed-Rank Test for paired data (R package MASS was used). We tested if the two approaches have identical data distributions, by comparing the matched samples. If $p < 0.05$ (95% significance level), the null hypothesis that the distributions are identical is rejected.

Results of test:

Wilcoxon signed rank test with continuity correction ($V = 0$, p-value < 2.2e-16) indicates that the true location shift is not equal to 0. We conclude, at 95% significance level, that the distribution of the CIMPAL values based on the two approaches is different.

a) b)

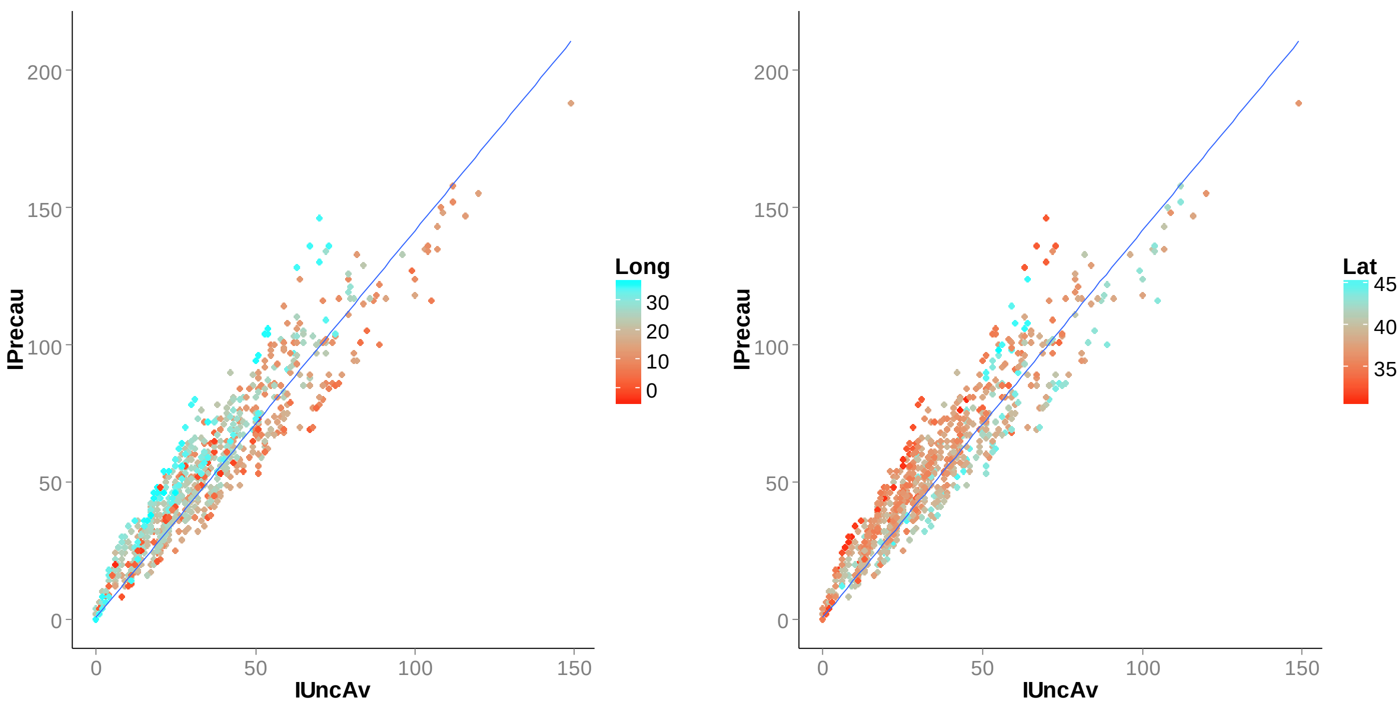

Figure S6. Comparison of two versions of the CIMPAL index calculated with different decision-making strategies: uncertainty averse (IUncAv) *versus* precautionary (IPrecau). The color gradient (dots) represents the cells' (a) longitudinal (Long) and (b) latitudinal (Lat) geographic distribution in the Mediterranean Sea.

The two approaches generate significantly different distribution patterns (not related with differences in magnitude between the CIMPAL index in the two approaches), meaning that the risk areas differ significantly between the two maps.

The scatterplots (Figure S6) show furthermore that:

1. There seems to be an increased dispersion towards higher index values, meaning that the risk maps produced by the two approaches differ most in the upper risk zone. This indicates that the choice of method has relevant implications when informing management.

2. The fact that eastern (Figure S6a) and southernmost (Figure S6b) Mediterranean CIMPAL values appear to be particularly inflated by the precautionary approach seems to corroborate our current perception that there is a spatial pattern in our knowledge distribution, and these are in effect areas of particular gaps and lack of evidence regarding the impacts of alien species on biodiversity. Therefore these are areas where uncertainty is also higher and for which risk maps produced by the UncAv approach are more likely to fail to predict the real magnitude of cumulative impact. These should be areas of concern for targeting further research.

Below, Figure S7 shows the spatial pattern of the differences in magnitude between the two approaches. The highest differences appear along the eastern Mediterranean coastline.

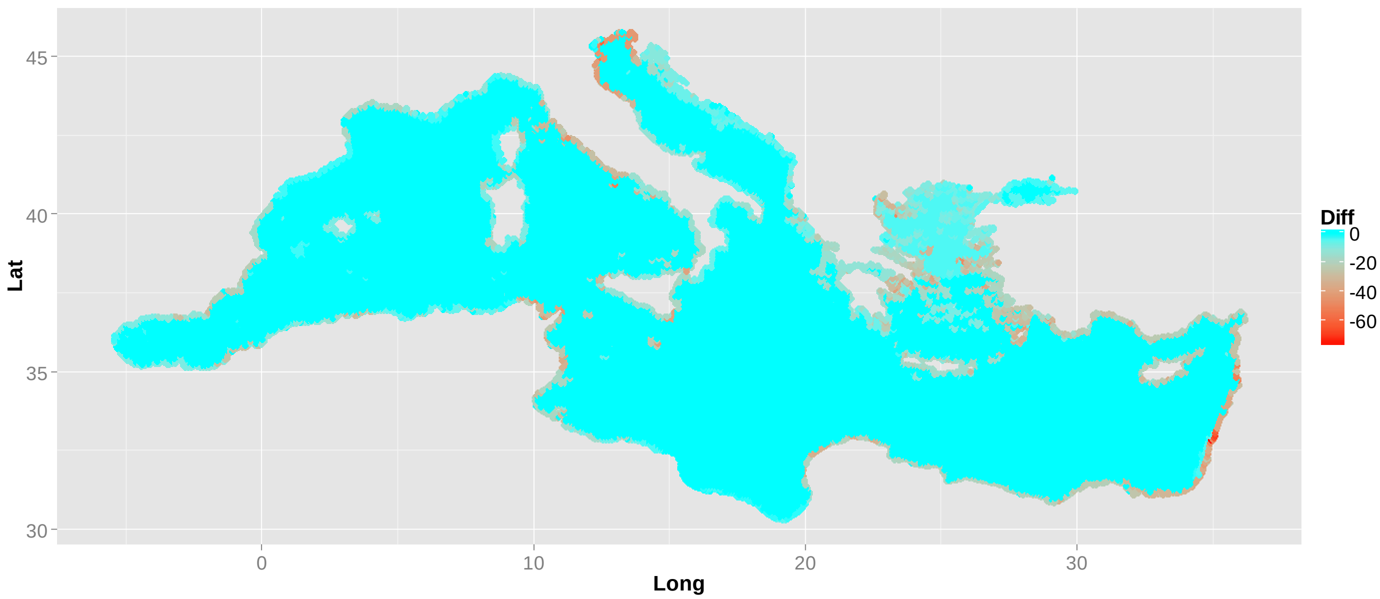

Figure S7. Mapping the spatial pattern of differences (Diff) in CIMPAL magnitude between the two decision-making strategies. The uncertainty-averse method provides always lower values than the precautionary approach.