# AN UPDATED ASSESSMENT OF NON-INDIGENOUS SPECIES ALONG THE ALGERIAN COAST (WESTERN MEDITERRANEAN) IN 2025

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**Abstract.** This study provides an updated and critically evaluated inventory of non-indigenous species (NIS) along the Algerian coast in the Western Mediterranean Sea. The analysis integrates data from the national marine biodiversity database (BANBIOM), peer-reviewed literature, technical reports, and validated unpublished observations. In total, 130 valid records, 460 sightings listed from 76 localities, and 60 species enriched the national previous NIS list established in 2018. The species added to the first NIS assessment come mainly from the literature review. The current NIS list is dominated by true aliens and cryptogenic species. The number of invasive species has considerably increased since 2017. *Callinectes sapidus, Sphoeroides pachygaster, Percnon gibbesi, Lagocephalus sceleratus, Physalia physalis* and other species have also extended their distribution area along the Algerian coast. While *Fibrocapsa japonica, Kyphosus vaigiensis, Portunus segnis* and *Pseudonereis anomala* were reported for the first time in the southwestern Mediterranean subregion. Fish (25%) and Algae (21%) dominate the NIS composition, followed by crustaceans (20%) and polychaetes (11%), collectively accounting for approximately 77% of total richness. Additionally, new taxonomic groups have been recorded, including Porifera, Echinodermata and Ascidiacea reflecting an increasing diversification of NIS along the Algerian coast. The increasing proportion of established and invasive species suggests an ongoing transition from introduction to successful colonization. These findings highlight the growing influence of bioinvasions on marine biodiversity in the Western Mediterranean and emphasize the need for standardized monitoring, improved data validation, and regional management strategies.

**Key words:** biodiversity, bioinvasions, inventory, Algeria, Mediterranean

## 1. INTRODUCTION

### 1.1. General context of the Mediterranean Sea: Anthropogenic pressures and the role of non-indigenous species

Considered as one of the most complex marine ecosystems, the Mediterranean Sea is affected by several human-caused pressures such as climate change and bio-invasions (Boero & Bernardi, 2014; Coll *et al.*, 2010; Mannino *et al.*, 2017). NIS have lately been recognized as a serious concern that has the potential to cause substantial changes in the structure and function of marine biodiversity (Occhipinti-Ambrogi & Savini, 2003; Kalogirou, 2011; Kalogirou *et al.*, 2012; Katsanevakis *et al.*, 2014; Orlando-Bonaca *et al.*, 2019; Zenetos & Galanidi, 2020; Casoli *et al.*, 2021), affecting the food web and ecosystem process (Aurellado *et al.*, 2021; Ben Rais Lasram & Mouillot 2009; Doney *et al.*, 2012; Kalogirou *et al.*, 2012; Mayfield *et al.*, 2021; Reise *et al.*, 2006). In addition, NIS are impacting human health (Bentur *et al.*, 2008; Katikou *et al.*, 2009) and inducing losses and economic concern (Cook *et al.* 2016; Kleitou *et al.*, 2021; Lovell *et al.*, 2006; Mayfield *et al.*, 2021). The latter arises mainly from competition for space with native species (Cook *et al.*, 2016; Wallentinus & Nyberg, 2007) and is well documented in the Mediterranean (Oliverio & Taviani, 2003; Marampouti *et al.*, 2021). Indeed, the number of species classified as non-indigenous and exploited in the Mediterranean is constantly increasing (Katsanevakis *et al.*, 2020; Zenetos *et al.* 2012; Mahklouf & Shakman 2021; Marampouti *et al.* 2021). In recent years, Mediterranean scientists have considerably increased their knowledge of NIS, and national inventories are being set up in southern Mediterranean and Middle East North Africa (MENA) countries, such as Morocco (Selfati *et al.*, 2017; Chartosia *et al.*, 2018; El Kamcha *et al.*, 2020), Algeria (Bensari *et al.*, 2020; Grimes *et al.*, 2018; Hussein & Bensahla, 2019), Tunisia (Ounifi-Ben Amor *et al.* 2016; Sghaier *et al.*, 2016), Libya (Bazairi *et al.*, 2013; Al Mabruk *et al.*, 2018; Rizgalla *et al.* 2019; Shakman *et al.*, 2019; Abdulrraziq *et al.*, 2021), Lebanon (Bitar *et al.*, 2017; Harmelin, 2014; Bitar & Ali Badreddine, 2021), Syria (Ammar, 2019; Ammar 2004; Hassan *et al.*, 2008; Ibrahim *et al.*, 2005; Ali, 2018), Egypt (Halim & Rizkalla, 2011; UNEP/MAP-RAC/SPA, 2017; Halim & Abdel Messeih, 2016) and Turkey (Turan *et al.*, 2018; Turan, 2020; Çinar, 2015; Çinar *et al.*, 2011). The potential of NIS to spread elsewhere proves their impact on biological diversity, ecosystem structure, and functioning (Essl *et al.*, 2020; Petrocelli *et al.*, 2020; Casoli *et al.*, 2021; Riera *et al.*, 2021). Similarly, there is a growing scientific interest and works linking thermal anomalies to the proliferation of species which are sensitive to temperature variations (Wilson *et al.*, 2020). For the purpose of this study, species are classified according to standard NIS terminology. *True aliens* are non-native organisms, introduced by human activity, that establish and proliferate in a new habitat (Cervera *et al.*, 2004; Junoy & Castelló, 2003). *Range-expanding species* are native organisms that naturally extend their geographical range in response to environmental changes, particularly climate change, without direct human-mediated introduction (Bédry *et al.*, 2021). *Cryptogenic species* are those of uncertain origin that cannot be unambiguously classified as native or introduced (Chan *et al.*, 2019). *Casual species* appear sporadically in a new habitat without forming self-sustaining populations (Sghaier *et al.*, 2016), while *vagrant species* are temporary visitors occurring outside their normal range (Matailanas, 1984). Established species successfully reproduce and maintain stable populations in the new environment (Tsiamis *et al.*, 2020), whereas invasive species are established NIS that spread and cause measurable ecological, economic, or health harm (SPA/RAC, 2020).

### 1.2. Regional context: the Algerian coast and the Western Mediterranean

Algeria's coastal position between the temperate climate of central Europe and the arid climate of northern Africa makes it particularly vulnerable to global climate change (Khelil *et al.*, 2019), which is considered as one of the species introduction facilitators in the Mediterranean (Ben Rais Lasram & Mouillot, 2009). The marine species composition of the Western and Eastern basins of the Mediterranean is heterogeneous. The Mediterranean Sea has become a genuine hotspot of marine bio-invasions, primarily due to anthropogenic introductions through vectors such as the Suez Canal, ballast water discharge, and maritime traffic (Mannino *et al.*, 2017; Pirkenseer, 2020; Bédry *et al.*, 2021), rather than natural biogeographic range expansions. Algeria's 2148-kilometers coastline, extending from the Alboran Sea (Atlantic waters) to the Tunisian Sea, constitutes a relevant case study for bio-invasions in the Western Mediterranean. Difficulties in new species identification, reporting, and distribution mapping, combined with limited data sharing, create uncertainties in NIS datasets and challenges in assembling harmonized data at the national and regional level (Zenetos *et al.*, 2017; Pavlidou *et al.*, 2019; Mannino & Balistreri, 2021). The massive mediatization of the "killer alga" *Caulerpa taxifolia* (Vahl) C. Agardh invasion in the 1990s is seen to have increased scientific investigations on NIS (Zenetos *et al.*, 2010); in the case of Algeria, several species of poisonous fish have known similar interest, such as the pufferfish *Lagocephalus sceleratus*, due to their supposed impact on fisheries. The present study aims to provide an updated and critically evaluated inventory of NIS along the Algerian coast (Western Mediterranean), building upon the first national baseline established by Grimes *et al.* (2018). Specifically, it documents new species records and occurrence localities, analyzes temporal and spatial distribution patterns, and assesses the current establishment and invasion status of NIS, in order to support regional monitoring and biodiversity management strategies.

## 2. MATERIALS AND METHODS

### 2.1. Data compilation

The updated inventory of non-indigenous species (NIS) along the Algerian coast was compiled using multiple data sources, including:

- the national marine biodiversity database (BANBIOM);
- peer-reviewed scientific literature;
- technical reports and project outputs;
- validated unpublished observations and expert communications.

All records were standardized to include information on species identity, geographic location, date of observation, source, and, when available, habitat and depth.

### 2.2. Data validation and filtering

Species identification was verified by taxonomic experts and cross-checked against international taxonomic databases (*e.g.*, WoRMS - World Register of Marine Species). Records were retained only when supported by verifiable metadata (location, date, and source). Duplicate entries and uncertain identifications were excluded. Unpublished and personal observations were included only when supported by expert validation and consistent with known species distributions**.**

### 2.3. Spatial and temporal analysis

The Algerian coast was subdivided into three sectors: western, central, and eastern. Spatial patterns were analyzed based on the distribution of first records and total occurrences. Temporal trends were assessed using the year of first record and cumulative number of species over time, allowing identification of periods of accelerated NIS detection.

## 3. RESULTS AND DISCUSSION

### 3.1. General overview

The Algerian coast presently hosts 130 NIS distributed over 10 taxonomic groups. As displayed in figure 2b, Fishes account for 25%, Macrophyta for 21%, Crustacea for 19%, and Polychaeta 11%. The groups' hierarchy remains the same compared to 2017. However, this study records three new taxonomic groups, namely: Porifera, Echinodermata and Ascidiacea. According to Grimes (personal data), NIS represent approximately 3% of the total known marine biodiversity of Algerian waters. True alien and cryptogenic species are strongly dominating this inventory with 72% and 23%, respectively (Fig. 2a). Species of Indo-Pacific origin dominate the stock of NIS identified along the Algerian coast (Fig. 2c).

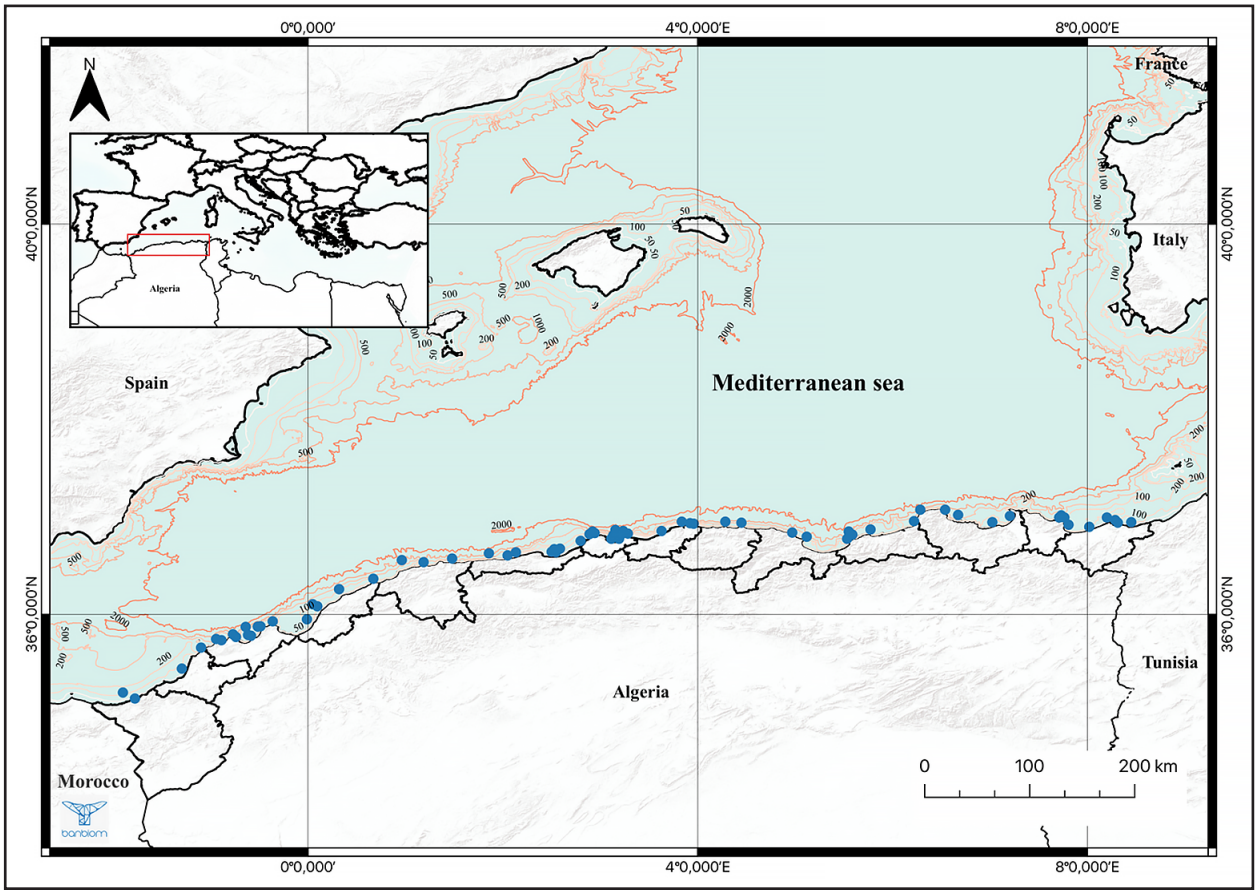


**Fig. 1.** Locations of NIS sightings along the Algerian coast.

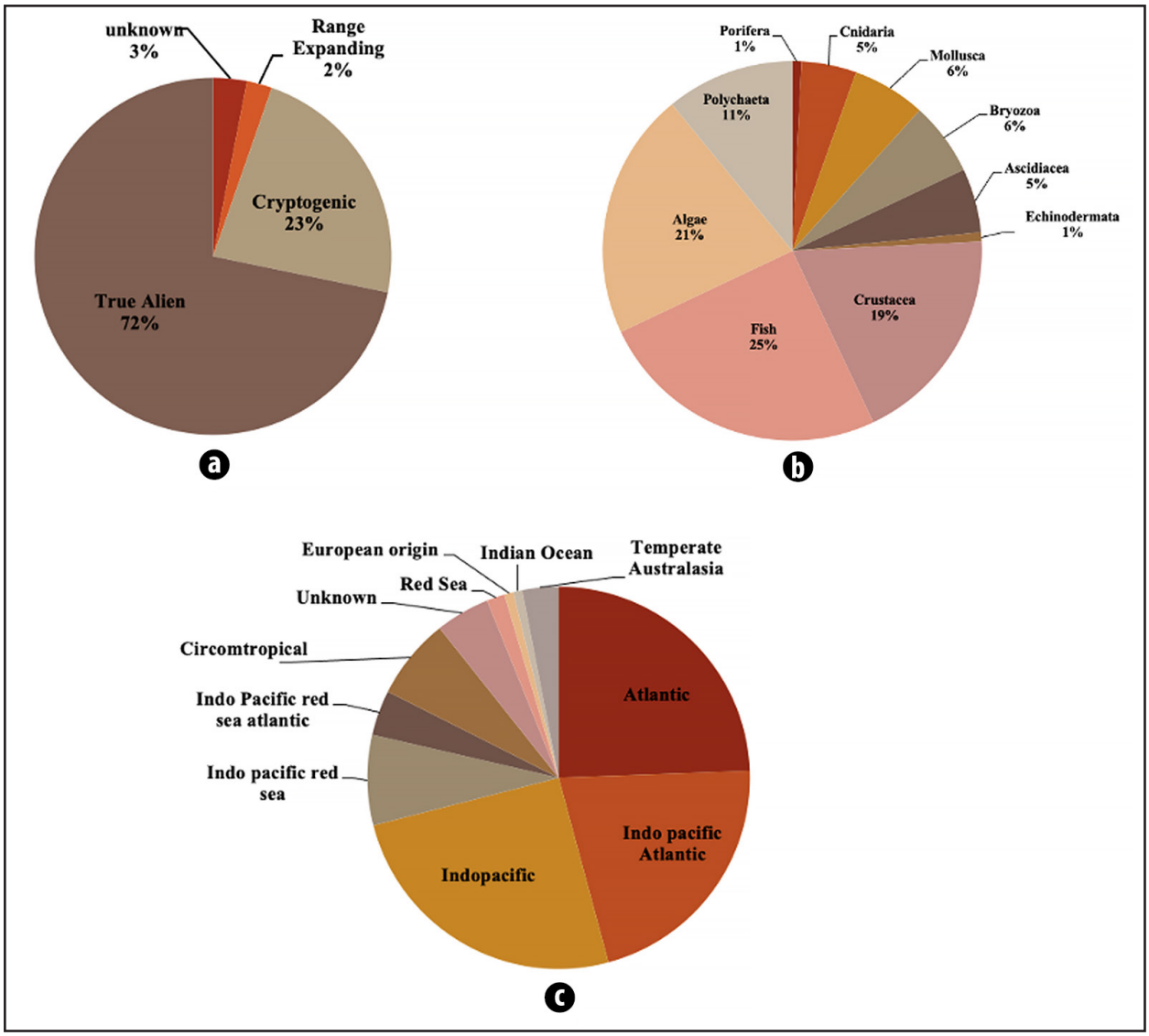


**Fig. 2.** Non-indigenous species status (a), taxonomic distribution rate (b), and their origin (c).

The previous national NIS baseline (Grimes *et al.*, 2018) listed 70 species from 69 localities. The present study adds 60 new NIS records, raising the total to 130 species along the Algerian coast. In addition, 140 new occurrence records and three previously undocumented taxonomic groups (Porifera, Echinodermata, and Ascidiacea) are reported (Tables 1 and 2). Furthermore, twenty new localities of NIS occurrence have been identified. In the last seven years, several species have extended their geographic distribution, such as *Callinectes sapidus* (Benabdi *et al.*, 2019; Ragkousis *et al.*, 2020; Kara & Chaoui, 2021; Hamida & Kara, 2021). This is also the case of *Percnon gibbesi* (Bada & Derbal, 2018; Menail *et al.*, 2019; CNRDPA, unpublished), *Paraleucilla magna* (Bachetarzi *et al.*, 2019; Bensari *et al.*, 2020; Bensari *et al.*, 2025) and *Physalia physalis* with several reports in 2021. Since the national NIS assessment by Grimes *et al.* (2018) covering the period 1834–2017 and documenting 70 species from 72 localities, a significant number of subsequent publications have reported new alien and non-indigenous species along Algerian coastal waters (Bachetarzi *et al.*, 2019; Benabdi *et al.*, 2019; Benali *et al.*, 2019; Kousteni *et al.*, 2019; Mokrane *et al.*, 2019; Bensari *et al.*, 2020; Benzait *et al.*, 2020; Mezali *et al.*, 2020; Kara & Bourehail, 2020; Kara & Chaoui, 2021; Kurt *et al.*, 2021; Bakalem *et al.*, 2020; Bouraoui *et al.*, 2023; Kacimi, 2023; Bensari *et al.*, 2025). A total of 30 scientific publications have reported either new NIS or new occurrences of previously reported species, thus confirming the spatial extension of their range. It is important to highlight that a range of historical scientific documents were also consulted to update the Algerian NIS list (Hassam, 1991; Oulmi, 1991; Mezali & Semroud, 1997; Bakalem, 2008; Grimes, 2010; Cheniti *et al.*, 2018; Mezali & Thandar, 2014). The growing scientific interest in NIS along Algerian waters is noteworthy: 77% of relevant publications were authored exclusively by Algerian scientists, excluding works addressing NIS only indirectly.

During the last decades, 40 species have been sighted for the first time along the Algerian coast, 30 of which occurred during the last seven years (Fig. 3), mainly due to the increased scientific awareness of the ecological and economic impacts of introduced species on native biodiversity and marine ecosystem services.

### 3.2. Origin of species

The eastern Mediterranean basin is a receptacle for species originating mainly from the Red Sea and the Indo-Pacific, while the western Mediterranean basin is a receptacle for NIS migrating from all oceans and seas (Oral, 2010). The latter and the Algerian basin, in particular, are directly subject to a flow of NIS from the Atlantic (Quignard, 2011; Quignard & Tomasini, 2000). The Indo-Pacific biogeographic region, the Indian Ocean and the Red Sea are the main biogeographic areas of origin of NIS for the Western Mediterranean basin according to Tsiamis *et al.* (2018). This pattern mirrors that observed in other southern Mediterranean countries. Along the Algerian coast, NIS predominantly originate from West and Central Indo-Pacific (25%), North Temperate Pacific (20%) and the Tropical Atlantic (10%). Overall, more than half (56%) of NIS recorded along the Algerian coast originate from tropical and subtropical regions of the Indian, Pacific, and Atlantic Oceans.

### 3.3. New locations in Algeria

Grimes *et al.* (2018) identified 69 NIS occurrence localities along the Algerian coast. The present study confirms more than 40 additional localities distributed across all three coastal sectors (Fig. 4). New records span the western sector (*e.g.*, Honaine, Port of Beni Saf, Ain Turck, Port of Mostaganem), the central sector (*e.g.*, Bouharoun, Douaouda, Ain Taya, Djinet, Aguelli), and the eastern sector (*e.g.*, Oued Z'hor, Cap Rosa, El Kala, El Mellah Lake, Grand Phare de Jijel). The complete list of new localities is illustrated in figure 4.

### 3.4. Geographic distribution

The distribution of NIS sightings along the Algerian coast remains uneven. In the 2017 assessment (Grimes *et al.* 2018), most records (48%) were concentrated in the central subregion, followed by the western (25%) and eastern (20%) sectors; 7.6% of records lacked a precise location. The general distributional pattern observed in 2018 is maintained in the current dataset, with only minor changes introduced by the new sightings (Fig. 5). The central area accounts for almost half (47%) of the years of first record and total NIS occurrences (Fig. 5), while the percentages of first records and occurrences of NIS is almost the same in western (17%) and eastern (33%) Algerian waters.

**Table 1.** Evolution of main NIS characteristics along the Algerian coast between 2017 and 2025

| Parameter | Descriptor | State in June 2017 Grimes *et al.* (2018) | State in 2025 (Present study) |
|---|---|---|---|
| Total number of NIS | | 70 | 130 |
| Number of sites | | 69 | 107 |
| Number of geographic areas | | 25 | 45 |
| Status | True aliens<br>Range expanding<br>Cryptogenic<br>Vagrant/Unknown | 39 (55.7%)<br>18 (25.7 %)<br>11 (15.7%)<br>2 (2.9%) | 94 (72%)<br>3 (2%)<br>30(23)<br>4(3%) |
| Composition of taxonomic groups | Fish<br>Algae<br>Crustacea<br>Polychaeta<br>Mollusca<br>Cnidaria<br>Bryozoa<br>Porifera<br>Echinodermata<br>Ascidiacea | 27 (38.57%)<br>21 (30%)<br>8 (11.43%)<br>5 (7.14)<br>4 (5,71%)<br>3 (4.29%)<br>2 (2.86%) | 32 (25%)<br>27 (21%)<br>26 (20%)<br>14 (11 %)<br>8(6%)<br>6(4%)<br>8(6%)<br>1 (1%)<br>1 (1%)<br>7 (5%) |
| Total number of occurrences | 348: 64.9 % macroalgae | | |
| Geographic distribution | West (25%), Centre (48%), East (20%), Unknown (7%) | | |
| Established species | | 5 species | |
| Invasive species | *Asparagopsis armata, A. taxiformis, Caulerpa cylindracea* | | |

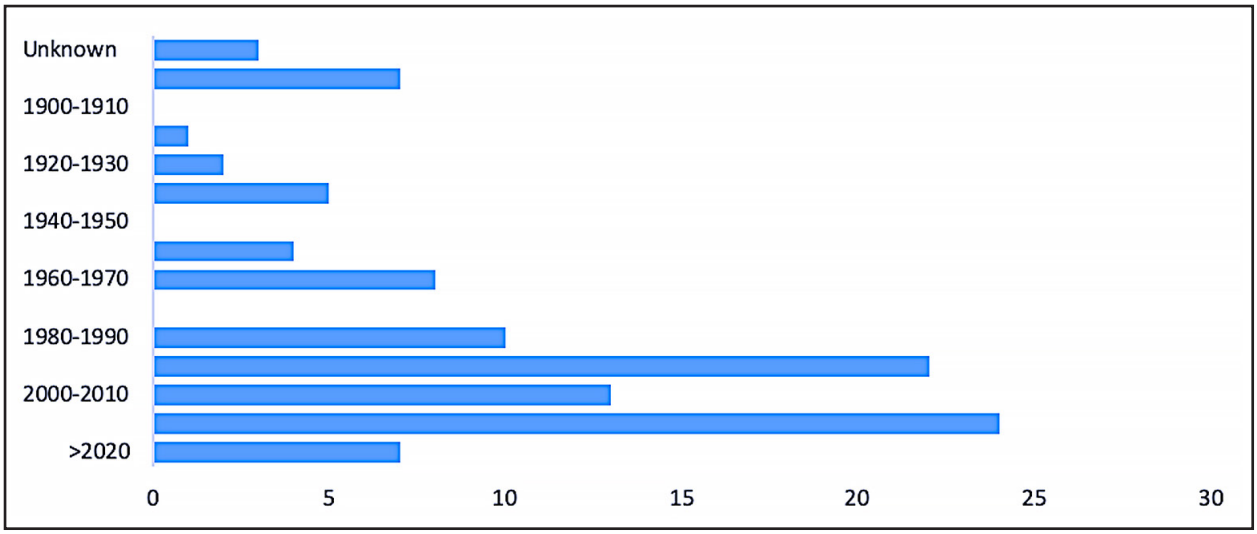


**Fig. 3.** Year of the first sighting of Non-Indigenous Species along Algerian waters.

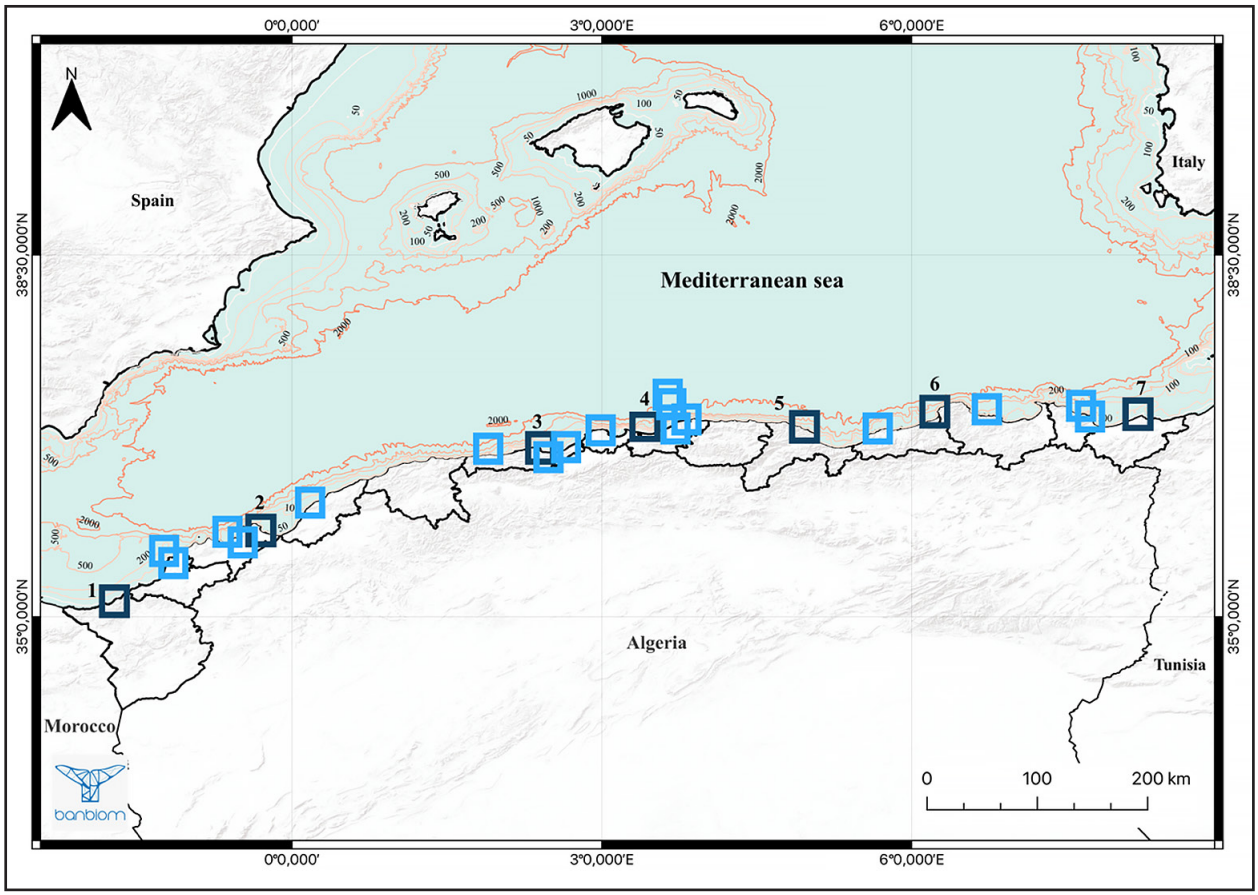


**Fig. 4.** Map of NIS records along the Algerian coast. *Legend*: dark blue - new first reports of NIS (from 2017 to 2025); light blue - previous localities of first sightings.

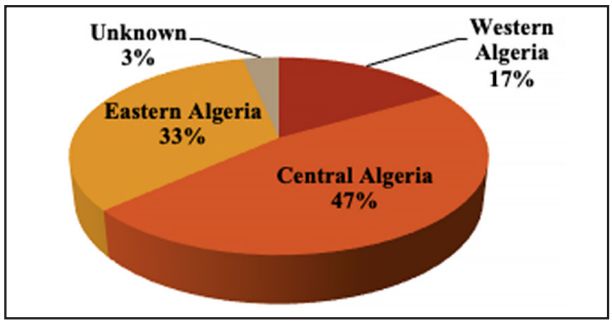


**Fig. 5.** Geographic distribution of NIS in Algerian waters (Situation of March 2025).

The vast majority of sightings (88 % of the total records) belong to Macrophyta (226 records) and Fish (79 records) (Fig. 6).

Algiers, Tipaza, Oran and Annaba are the areas with the highest number of sightings of NIS. These four zones host 74% of the total number of the sightings (Fig. 7). This situation results from the combination of the effort of scientific exploration and the density of shipping, considering that the ports of Alger, Oran and Annaba are the most important in terms of exchanges.

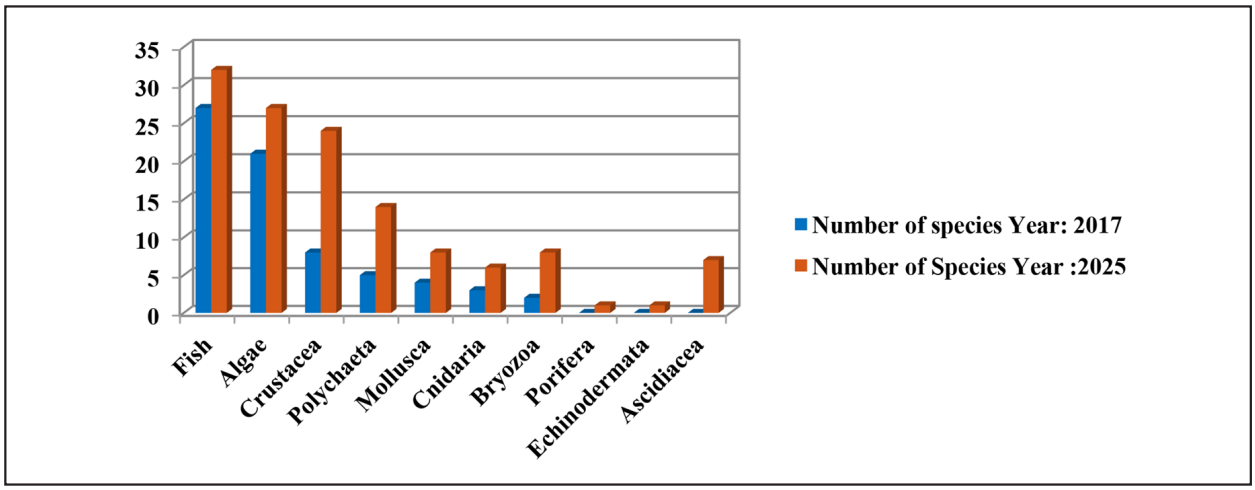


**Fig. 6.** Evolution of the distribution of NIS among taxonomic groups between 2017 (Grimes *et al.*, 2018) and 2025 (present study).

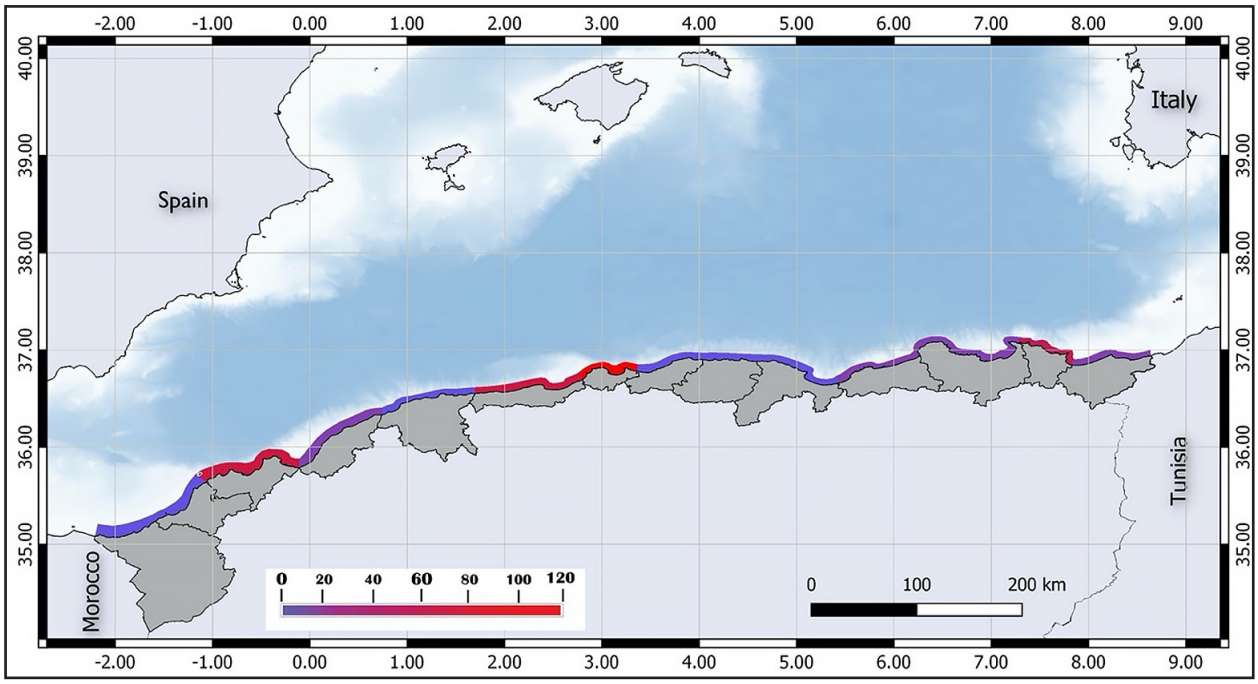


**Fig. 7.** Number of NIS sightings in the Algerian waters.

**Table 2**. List of NIS along the Algerian coast (situation, September 2025) (*: species recorded post 2017)

| Species scientific name | Status | State of establish | Phylum | Year | Area | Authors | Origin |
|---|---|---|---|---|---|---|---|
| *Amathia verticillata* | Alien | Invasive | Bryozoa | 1848 | Rais Hamidou (Algiers) | Ramos *et al.*, *in* PNUE/PAM-CAR/ASP (2016) | Western Atlantic, Caribbean Sea |
| *Bugulina stolonifera* | Cryptog. | Casual | Bryozoa | 1955 | Bay of Bousmail | Gauthier (1955) as *Bugula avicularia* | Tropical and subtropical Area, Indo-Pacific |
| *Bugulina fulva** | Cryptog. | Casual | Bryozoa | 1966 | Gulf of Oran | Prenant & Bobin (1966) | Atlantic, Gulf of Mexico |
| *Clytia linearis* | Alien | Invasive | Cnidaria | 1955 | Bay of Bousmail | Picard (1955) | Circumtropical |
| *Eucheilota paradoxica* | Alien | Casual | Cnidaria | 1986 | Unknown | Kerzabi (2004) | Tropical Atlantic, Western Indo-Pacific, Central Indo-Pacific |
| *Cirrholovenia tetranema** | Alien | Casual | Cnidaria | 2014 | Algiers bay | Kherchouche & Hafferssas (2020) | Indo-Pacific |
| *Kantiella enigmatica** | Alien | Casual | Cnidaria | 2016 | Algiers bay | Kherchouche (2021) | Indo-Pacific |
| *Oculina patagonica* | Cryptog. | Invasive | Cnidaria | 2005 | Habibas Islands | Sartoretto *et al.* (2008) | Southern Western Atlantic, Western North Atlantic |
| *Physalia physalis** | Alien | Invasive | Cnidaria | 2021 | from Beni Saf to Skikda | Bachouche *et al.* (2022) | Tropical and subtropical areas: Atlantic, Indo-Pacific |
| *Alpheus inopinatus* | Alien | Establ. | Arthropoda | 1999 | Gulf of Ghazaouet | Grimes *et al.* (2016) | Western Indo-Pacific, Red Sea |
| *Alpheus rapacida* | Alien | Establ. | Arthropoda | 1997 | Gulf of Oran | Grimes *et al.* (2016) | Western Indo-Pacific, Central Indo-Pacific |
| *Callinectes sapidus** | Alien | Invasive | Arthropoda | 2018 | Z'hor River (Gulf of Jijel) | Benabdi *et al.* (2019) | Tropical Atlantic, Temperate Northwest Atlantic, Western Atlantic (Atlantic Coast of America) |
| *Elasmopus pectenicrus* | Cryptog. | Establ. | Arthropoda | 1985 | Bay of Algiers | Bakalem & Dauvin (1992) | Tropical and Subtropical Indo-Pacific, Red Sea, Tropical and Subtropical Western Atlantic |
| *Eocuma sarsii* | Alien | Casual | Arthropoda | 1996-1997 | Port of Arzew | Grimes (2010) | Temperate Southern Africa, Western Indo-Pacific |
| *Glabropilumnus laevis* | Alien | Establ. | Arthropoda | 1999 | Gulf of Ghazaouet | Grimes *et al.* (2016) | Western Indo-Pacific |
| *Linguimaera caesaris** | Alien | Establ. | Arthropoda | 1988 | Bay of Bou Ismail | Bakalem & Dauvin (1992) as *Hamimaera hamigera* | Western Indo-Pacific |
| *Megabalanus tintinnabulum* | Alien | Question. | Arthropoda | 1996 | Bay of Annaba | Grimes (2010) | Tropical Eastern Atlantic, Western Indo-Pacific |
| *Penaeus japonicus* | Quest. | | Arthropoda | 2004 | Tenes | Massutí *et al.* (2004a) | Western Indo-Pacific, Central Indo-Pacific, Temperate Northern Pacific |
| *Percnon gibbesi* | Cryptog. | Invasive | Arthropoda | 2010 | Gulf of Skikda | Bouzaza *in* Katsanevakis *et al.* (2011) | Tropical Atlantic, Tropical Eastern Pacific, Temperate Northwest Atlantic |
| *Neomysis integer** | Alien | Casual | Arthropoda | 1996 | Gulf of Arzew | Grimes (2010) | European origin |

Table 2 (continued)

| Species scientific name | Status | State of establish | Phylum | Year | Area | Authors | Origin |
|---|---|---|---|---|---|---|---|
| *Monocorophium sextonae** | Question. | Casual | Arthropoda | 1998 | Port of Oran and Gulf of Ghazaouet | Grimes (2010) | Atlantic |
| *Pseudomma affine** | Alien | Casual | Arthropoda | 1997 | Port of Arzew and Gulf of Ghazaouet | Grimes (2010) | North Atlantic |
| *Pseudodiaptomus australiensis* | Alien | Establ. | Arthropoda | 2016 | Annaba Bay, | Ounissi *et al.* (2016) | Southern Indo-West Pacific waters |
| *Pseudodiaptomus arabicus* | Alien | Establ. | Arthropoda | 2016 | Annaba Bay, | Ounissi *et al.* (2016) | Indian Ocean |
| *Paracartia grani** | Alien | Establ. | Arthropoda | 2018 | Bay of Algiers and bay of Bouismail | Melak & Haferssas (unpublished) | Atlantic |
| *Portunus segnis** | Alien | Invasive | Arthropoda | 2022 | Aouka and Bazoul beach, Jijel | Bouraoui *et al.* (2023) | Western Indian Ocean, Red Sea, Persian Gulf, eastern African coast extending to Pakistan and south to Madagascar and Mauritius |
| *Acanthurus monroviae* | Alien | Invasive | Chordata | 2001 | Ain Benian, Sidi Fredj | Hemida *et al.* (2004) | Eastern Tropical and Subtropical Atlantic |
| *Synagrops japonicus* | Quest. | Establ. | Chordata | 2011 | Gulf of Annaba | Hannachi *et al.* (2015) | Indo - Western Pacific |
| *Atherinomorus forskalii* | Alien | Casual | Chordata | 2004 | Bay of Bousmail | Massutí *et al.* (2004a) | Indo-Pacific, Red Sea |
| *Carcharhinus altimus* | Alien | Establ. | Chordata | 1996 | Algiers | Hemida & Labidi (2001) | Indo-Pacific, Tropical and Subtropical Atlantic |
| *Carcharhinus falciformis* | Alien | Establ. | Chordata | 1996 | Eastern Algeria | Hemida & Labidi (2001) | Indo-Pacific, Red Sea, Tropical and Subtropical Atlantic, Eastern Atlantic |
| *Acropoma japonicum* | Alien | Casual | Chordata | 2011 | Gulf of Annaba | Hannachi *et al.* (2015) | Indo-West Pacific (Western Pacific: Japan, East China Sea and South China Sea) |
| *Dicologlossa hexophthalma* | Alien | Establ. | Chordata | 2004 | Gulf of Arzew, Bay of Bou Ismail | Massutí *et al.* (2004b) | Eastern Tropical Atlantic |
| *Ephippion guttifer* | Alien | Establ. | Chordata | 1933 | Ténès, Bou Haroun | Dieuzeide (1933) | Eastern Tropical Atlantic |
| *Etrumeus golanii* | Alien | Casual | Chordata | 2017 | Cherchell | Kassar & Hemida, *in* Stamouli *et al.* (2017) | Indian, Southern, Eastern and Western Pacific, Red Sea, Eastern and Western Atlantic |
| *Fistularia commersonii* | Alien | Invasive | Pisces | 2008 | Gulf of Skikda | Kara & Oudjane (2009) | IP, Western Indo-Pacific, Central Indo-Pacific, Eastern Indo-Pacific |
| *Galeoides decadactylus* | Question. | | Pisces | 1927 | Gulf of Oran | Dieuzeide (1927) | Eastern Tropical Atlantic |

*Table 2 (continued)*

| Species scientific name | Status | State of establish | Phylum | Year | Area | Authors | Origin |
|---|---|---|---|---|---|---|---|
| *Gephyroberyx darwinii* | Alien | Casual | Pisces | 1961 | Tamentfoust (Bay of Algiers) | Dieuzeide & Roland (1958) | Eastern and Western Tropical Atlantic, Indo-Pacific |
| *Halosaurus ovenii* | Alien | Casual | Pisces | 1960 | Cherchell | Dieuzeide (1963) | Eastern Tropical Atlantic, Western Tropical Atlantic |
| *Hemiramphus far* | Alien | Establ. | Pisces | 2010 | Collo | Kara *et al.* (2012) | Western Indo-Pacific, Central Indo-Pacific, Red Sea |
| *Hyperoglyphe perciformis* | Alien | Casual | Pisces | 2015 | Surcouf | M. Benabdi personal communication (2015) | North Western Atlantic, European Eastern Atlantic |
| *Lagocephalus sceleratus* | Alien | Invasive | Pisces | 2013 | El Kala, Annaba | Refes & Semahi (2014) | Western Indo-Pacific, Central Indo-Pacific, Red Sea |
| *Mobula japanica* | Alien | Establ. | Pisces | 2014 | Algiers | Hemida *et al.* (2016) | Temperate aeras: Atlantic, Pacific Africa Eastern Atlantic, Indo-Pacific |
| *Pagellus bellottii* | Alien | Invasive | Pisces | 1960 | Algiers | Dieuzeide (1960) | Tropical and Subtropical: Africa Eastern Atlantic |
| *Pisodonophis semicinctus* | Alien | Casual | Pisces | 1954 | Cherchell | Dieuzeide & Roland (1957) | Tropical Eastern Atlantic |
| *Pomadasys stridens* | Alien | Casual | Pisces | Unknown | Algeria | Chalabi (1999) | Western Indo-Pacific |
| *Psenes pellucidus* | Alien | Casual | Pisces | 1950 | Bay of Bou Ismail | Dieuzeide (1955) | Tropical and Subtropical Atlantic, Indo- Western Pacific |
| *Seriola carpenter** | Cryptog. | Casual | Pisces | 2018 | Western Algeria | Hemida *et al.* (2018) | Eastern Southern Tropical Atlantic: Morocco to Angola |
| *Siganus luridus* | Alien | Casual | Pisces | Unknown | Algeria | Chalabi (1999) | Western Indo-Pacific, Red Sea |
| *Solea senegalensis* | Cryptog. | Establ. | Pisces | 1979 | Gulf of Annaba, El Kala | Alili & Marinaro (1986) | Tropical and subtropical Atlantic |
| *Sphoeroides pachygaster* | Cryptog. | Casual | Pisces | 2009 | Chetaibi, Seraidi | Hemida *et al.* (2009) | Tropical and Subtropical Atlantic, Indo-Pacific |
| *Sphyraena viridensis* | Alien | Casual | Pisces | 2003 | Gulf of Annaba | Kara & Bourehail (2003) | Eastern Central Atlantic |
| *Sphyraena flavicauda** | Alien | Casual | Pisces | 2019 | Annaba | Kara (2019) *in* Kara et Bourahail (2020) | Western and Central Indo-Pacific Red Sea |
| *Symphurus ligulatus* | Alien | Casual | Pisces | 2003 | Algeria | Massutí *et al.* (2003) | Africa Eastern Atlantic (Mauritania to Angola) |
| *Trachyscorpia cristulata* | Alien | Casual | Pisces | 1960 | Gulf of Ghazaouet | ISTPM (1982) | Africa Eastern Atlantic (Morocco to Senegal), European Eastern Atlantic |
| *Urogymnus asperrimus* | Alien | Establ. | Pisces | 1996 | Algiers | Hemida *et al.* (2007) | Indo-Western Pacific, Red Sea, Eastern Atlantic: Senegal to Gulf of Guinea |
| *Kyphosus vaigiensis** | | Casual | Pisces | 2013 | Annaba | Groud *et al.* (2021) | Circumtropical |
| *Acanthophora nayadiformis* | Cryptog. | Establ. | Rhodophyta | 1990 | Sidi Fredj, Tipasa | Seridi (1990) | Indo-Pacific, Red Sea, Tropical and Subtropical Western Atlantic |

*Table 2 (continued)*

| Species scientific name | Status | State of establish | Phylum | Year | Area | Authors | Origin |
|---|---|---|---|---|---|---|---|
| *Anotrichium furcellatum* | Cryptog. | Casual | Rhodophyta | 1843 | Bay of Algiers | Durieu *in* Feldmann-Mazoyer &Meslin (1939) as *A. furcellatum* | Indo-Pacific, Tropical and Subtropical Western Atlantic |
| *Antithamnion amphigeneum* | Alien | Casual | Rhodophyta | 1989 | Bay of Algiers | Verlaque & Seridi (1991) as *A. algeriensis* | Temperate Australasia |
| *Antithamnionella boergesenii* | Cryptog. | Casual | Rhodophyta | 1937 | Port of Algiers | Mazoyer & Feldmann (1937) as *A. elegans* | Indo-Pacific, Tropical and Subtropical Western Atlantic, Eastern Atlantic: Morocco- Mauretania |
| *Antithamnionella elegans* | Cryptog. | Establ. | Rhodophyta | 1936 | Bay of Algiers | Mazoyer & Feldmann (1937) | Indo-Pacific, Western Atlantic (USA to Mexico), Eastern Atlantic: Morocco to Gulf of Guinea |
| *Asparagopsis armata* | Alien | Invasive | Rhodophyta | 1923 | Algeria | Sauvageau (1925) | Temperate Australasia, cosmo |
| *Asparagopsis taxiformis* | Alien | Invasive | Rhodophyta | 1939 | Bordj El Bahri | Feldmann & Feldmann (1939) | Temperate Australasia, Indo-Pacific |
| *Bonnemaisonia hamifera* | Alien | Invasive | Rhodophyta | 1967 | Dellys | Boudouresque (1969) as *Trailliella intricata* | Temperate Northern Pacific Indian Ocean |
| *Caulerpa chemnitzia* | Cryptog. | Invasive | Chlorophyta | 2015 | El Djemila | Lamouti in Verlaque *et al.* (2015) | Indo-Pacific, Tropical and Subtropical Western Atlantic, Red Sea |
| *Caulerpa cylindracea* | Alien | Invasive | Chlorophyta | 2005 | Surcouf, Bordj El Bahri | Ould Ahmed & Meinesz (2007) as *C. racemosa var. cylindracea* | Temperate Australasia IP |
| *Caulerpa taxifolia var. distichophylla** | Alien | Invasive | Chlorophyta | 2018 | Surcouf Annaba | Di Martino & Stancanelli *in* Kousteni *et al.* (2019) | |
| *Chondria coerulescens* | Cryptog. | Establ. | Rhodophyta | 1893 | Gulf of Oran | Debray (1893) | European Eastern Atlantic |
| *Codium fragile* | Alien | Establ. | Chlorophyta | 1990 | Surcouf Boudouaou El Bahri | Seridi (1990) | P Northern Western Pacific, European Eastern Atlantic, Tropical and Subtropical Western Atlantic |
| *Colaconema codicola* | Alien | Casual | Rhodophyta | 1990 | Bay of Algiers | Seridi (1990) | At Temperate Northern Pacific, North Eastern Atlantique |
| *Colpomenia peregrina* | Alien | Casual | Ochrophyta | 1967 | El Marsa | Boudouresque & Boudouresque (1969) | Temperate Northern Pacific, Temperate Australasia, IP |
| *Thalassiosira decipiens** | Alien | Casual | Ochrophyta | 2013-2014 | Port of Annaba | Cheniti *et al.* 2018 | Atlantic |
| *Griffithsia corallinoides* | Alien | Invasive | Rhodophyta | 1834 | Gulf of Annaba | Steinheil (1834) as *Ceramium corallium* | European origin, European Eastern Atlantic |
| *Hypnea spinella* | Alien | Casual | Rhodophyta | 1990 | Tipasa | Seridi (1990) as *H. cervicornis* | Circumtropical |
| *Lophocladia lallemandii* | Alien | Casual | Rhodophyta | 1938 | El Marsa | Feldmann & Feldmann (1938) | Central and Western Indo-Pacific, Temperate Northern Pacific, Red Sea |

*Table 2 (continued)*

| Species scientific name | Status | State of establish | Phylum | Year | Area | Authors | Origin |
|---|---|---|---|---|---|---|---|
| *Melanothamnus harveyi* | Alien | Casual | Rhodophyta | 1990 | Bay of Algiers | Seridi (1990) as *Polysiphonia mottei* | Northern Western Pacific, European Eastern Atlantic, Tropical and Subtropical Western Atlantic |
| *Pachymeniopsis lanceolata* | Alien | Establ. | Rhodophyta | 2003 | Bordj El Kiffan | Seridi (2007) as ex *Grateloupia* | Temperate Northern Pacific (Japan, Korea) |
| *Polysiphonia atlantica* | Cryptog. | Casual | Rhodophyta | Unknown | Algeria | Verlaque *et al.* (2015) | North Atlantic, North Pacific (Japan) |
| *Sargassum muticum** | Alien | Invasive | Ochrophyta | 2018 | Sidi Fredj, Cherchell | Benali *et al.* (2019) | Temperate Northern Pacific, Northwest Pacific |
| *Actinoptychus splendens** | Cryptog. | Casual | Ochrophyta | 2014 | Port of Annaba | Cheniti *et al.* (2018) | Western and Eastern Atlantic Indo-Pacific |
| *Coscinodiscus lineatus** | Cryptog. | Casual | Ochrophyta | 2014 | Port of Annaba | Cheniti *et al.* (2018) | Western and Eastern Atlantic, Pacific |
| *Ulva lactuca* | Cryptog. | Establ. | Chlorophyta | 1834 | Algiers | Steinheil (1834) *in* Montagne (1846) as *U. fasciata* | Indo-Pacific, Circumtropical |
| *Fibrocapsa japonica** | Alien | Establ. | Ochrophyta | 2017 | Arzew Gulf | Ali *et al.* (2020) | Temperate aeras: Atlantic, Pacific |
| *Aplysia dactylomela** | Cryptog. | Invasive | Mollusca | 2018 | Surcouf, Annaba | Di Martino & Stancanelli *in* Kousteni *et al.* (2019) | Circumtropical, Tropical and Subtropical Atlantic Atlantic Warm Temperate Waters, Indo-Pacific |
| *Bursatella leachii* | Alien | Invasive | Mollusca | 2008 | Sidi Fredj | Refes (2012) | Circumtropical- subtropical, Central and Western Indo-Pacific, Red Sea, Tropical Atlantic |
| *Mercenaria mercenaria* | Alien | Establ. | Mollusca | 1994 | Habibas Islands | Grimes & Kaidi (1995) | Temperate North West Atlantic |
| *Pinctada imbricata radiata* | Alien | Casual | Mollusca | 2010 | El Kala | Refes (2012) | Western Indo-Pacific, Red Sea |
| *Taningia danae* | Alien | Casual | Mollusca | 2003 | Bench of Alidade Habibas Island | Quetglas *et al.* (2006) | Western Atlantic (Mexico), Indo-Pacific, European Eastern Atlantic (Portugal, Spain) |
| *Echinolittorina punctata** | Rex | Establ. | Mollusca | 1862 | Sidi Fredj, Algiers Bay | Weinkauff (1862) | Tropical and Subtropical Atlantic Africa |
| *Procardium indicum** | Alien | Establ. | Mollusca | 1840 | Cape Rosa (El Kala) | Petit (1840) | Africa Tropical and Subtropical Atlantic |
| *Aricidea (Aricidea) fragilis** | Cryptog. | Casual | Annelida | 1996 | Gulf of Oran | Grimes (2010) | Western Atlantic (USA, Mexico) |
| *Ficopomatus enigmaticus* | Alien | Establ. | Annelida | 1997 | Gulf of Skikda | Grimes (2010) | Temperate Australasia |
| *Hydroides dirampha** | Alien | Establ. | Annelida | 1981 | Port of Algiers | Bakalem & Romano (1985) | Cosmopolitan Circumtropical, Tropical Atlantic Western and Central Indo-Pacific |
| *Hydroides elegans** | Alien | Establ. | Annelida | 1988 | Bay of Bou Ismail | Hassam (1991); Oulmi (1991) | Circumtropical, Western and Central Indo-Pacific, Temperate Australasia |
| *Hydroides dianthus** | Cryptog. | Establ. | Annelida | 1981 | Unknown | Bakalem & Romano (1985) | Western Atlantic (USA, Mexico) |

Table 2 (continued)

| Species scientific name | Status | State of establish | Phylum | Year | Area | Authors | Origin |
|---|---|---|---|---|---|---|---|
| *Lumbrineris perkinsi* | Alien | Casual | Annelida | 1986 | Bay of Fetzara (Skikda) | Bakalem (2008) as *Lumbrineris inflata* Moore, 1911 | Western Indo-Pacific, Central Indo-Pacific, Tropical Atlantic |
| *Metasychis gotoi* | Alien | Establ. | Annelida | 1988 | Bay of Bou Ismail | Grimes (2010) | Central Indo-Pacific, Temperate Northern Pacific, Red Sea |
| *Notomastus aberans* | Alien | Casual | Annelida | 1997 | Gulf of Oran | Grimes (2010) | Western Indo-Pacific, Red Sea |
| *Pista unibranchia* | Alien | Establ. | Annelida | 1984 | Bay of Algiers | Bakalem (2008) | Western Indo-Pacific |
| *Polydora hoplura** | Alien | Casual | Annelida | 1996 | Bay of Annaba | Grimes (2010) | European origin |
| *Spirobranchus kraussii** | Alien | Casual | Annelida | 2018 | Port of Beni Saf | Bitar, Pers.Comm. | Temperate Southern Africa Western and Central Indo-Pacific |
| *Pseudonereis anomala** | Alien | Casual | Annelida | 2021 | Gulf of Skikda | Kurt *et al.* (2021) | Western Indo-Pacific, Red Sea/Indo-Pacific |
| *Branchiomma bairdi** | Alien | Establ. | Annelida | 2021 | Port of Algiers | Bensari *et al.* (2025) | Western Atlantic – Bermuda, Central Florida, Caribbean Sea, Atlantic Panama. |
| *Branchiomma luctuosom** | Alien | Establ. | Annelida | 2021 | Port of Algiers | Bensari *et al.* (2025) | Indo-Pacific |
| *Paraleucilla magna** | Alien | Invasive | Porifera | 2018 | Port of Algiers, Pisan Island (Bejaia) | Bachetarzi *et al.* (2019) | Western Atlantic, Tropical and Subtropical Atlantic |
| *Cymadusa filose** | Cryptog. | Establ. | Arthropoda | 1910 | Port of Annaba | Chevreux (1910) | Indo-Pacific |
| *Chaunax suttkusi** | Rex. | Casual | Chordata | 1997 | Sentinelle Bank (East Alg. coast) | Ragonese & Giusto (1997) | Eastern Atlantic: Açores to Angola, Western Atlantic: South Carolina to Rio Grande Plateau (Brasil) |
| *Necora puber** | Cryptog. | Casual | Crustacea | 1999 | Bay of Algiers | Grimes (2010) | Northwestern Atlantic |
| *Paractaea rufopunctata** | Alien | Casual | Arthropoda | 1950 | Bay of Bouismail | Dieuzeide (1950) | Indian ocean, Tropical Eastern Pacific Temperate Northern Pacific |
| *Botryllus schlosseri** | Cryptog. | Establ. | Ascidiacea | 2020 | Port of Arzew | Bensari *et al.* (2020) | Atlantic, Indo-Pacific |
| *Clavelina lepadiformis** | Alien | Establ | Ascidiacea | 2021 | Port of Algiers | Kacimi (2023) | Northeast Atlantic |
| *Styela plicata** | Alien | Establ. | Ascidiacea | 2021 | Port of Algiers | Kacimi (2023) | Western Pacific |
| *Botrylloides niger** | Alien | Establ. | Ascidiacea | 2021 | Port of Algiers | Bensari *et al.* (2025) | Western Atlantic |
| *Botrylloides violaceus** | Alien | Establ. | Ascidiacea | 2023 | Port of Algiers | Bensari *et al.* (2025) | Northwest Pacific |

*Table 2 (continued)*

| Species scientific name | Status | State of establish | Phylum | Year | Area | Authors | Origin |
|---|---|---|---|---|---|---|---|
| *Polyclinum constellatum** | Alien | Establ | Ascidiacea | 2024 | Port of Algiers | Bensari *et al.* (2025) | Indian Ocean |
| *Styela canopus** | Cryptog | Casual | Ascidiacea | 2024 | Port of Algiers | Bensari *et al.* (2025) | Atlantic, Indo-Pacific, Australia –red sea |
| *Bugula neritina** | Cryptog. | Casual | Bryozoa | 2020 | Port of Arzew | Bensari *et al.* (2025) | Indo-Pacific |
| *Tricellaria inopinata** | Alien | Establ. | Bryozoa | 2021 | Port of Algiers | Kacimi (2023) | Indo-Pacific |
| *Schizoporella errata** | Cryptog. | Casual | Bryozoa | 2022 | Port of Algiers | Bensari *et al.* (2025) | |
| *Watersipora subtorquata** | Cryptog. | Casual | Bryozoa | 2023 | Port of Algiers | Kacimi (2023) | |
| *Celleporaria brunnea** | Alien | Establ. | Bryozoa | 2023 | Port of Algiers | Bensari *et al.* (2025) | Northeastern Pacific – British Columbia to Ecuador |
| *Zeuxo coralensis** | Alien | Establ. | Crustacea | 2020 | Port of Arzew | Bensari *et al.* (2020) | Circumtropical. Western Indo-Pacific, Tropical Atlantic |
| *Paracerceis sculpta** | Alien | Establ. | Crustacea | 2020 | Port of Arzew | Bensari *et al.* (2020) | Subtropical Temperate Southern Africa |
| *Jassa slatteryi** | Cryptog. | Casual | Crustacea | 2021 | Port of Algiers | Kacimi (2023) | Northeastern Pacific |
| *Jassa marmorata** | Alien | Establ. | Crustacea | 2023 | Port of Algiers | Kacimi (2023) | North Atlantic Ocean |
| *Paranthura japonica** | Alien | Establ. | Crustacea | 2023 | Port of Algiers | Kacimi (2023) | Northwest Pacific Ocean |
| *Balanus trigonus** | Alien | Establ. | Crustacea | 2024 | Port of Algiers | Bensari *et al.* (2025) | Indo-Pacific |
| *Godiva quadricolor** | Alien | Establ. | Mollusca | 2020 | Port of Arzew | Bensari *et al.* (2020) | Western Indo-Pacific, Temperate Southern Africa Atlantic, Temperate Australasia |
| *Holothuria (Roweothuria) arguinensis* | Alien | Casual | Echinodermata | 2014 | Algiers, Boumerdes, Mostaganem | Mezali & Thandar (2014) | North Atlantic |

### 3.5. Status of invasion

Approximately 15% of non-indigenous species have acquired invasive status over the past decade along the Algerian coast. Of these, 13 acquired this status after 2018, indicating a rapid establishment process (Fig. 8). Among these species, 12 were included in the previous list (2017): *Amathia verticillata, Clytia linearis, Oculina patagonica, Percnon gibbesi, Acanthurus monroviae, Fistularia commersonii, Lagocephalus sceleratus, Pagellus bellottii, Bursatella leachii, Asparagopsis armata, A. taxiformis, Griffithsia corallinoides.*

Moreover, 10 new NIS recorded post 2017 have acquired an invasive status along the Algerian coast: *Bonnemaisonia hamifera, Caulerpa chemnitzia, Caulerpa cylindracea, Caulerpa taxifolia var. distichophylla, Sargassum muticum, Physalia physalis, Aplysia dactylomela, Paraleucilla magna Portunus segnis, Callinectes sapidus.* About 40% of the species are now established.

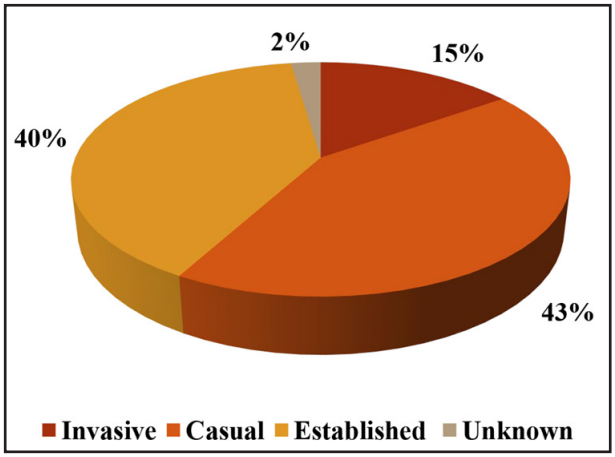


**Fig. 8.** Status of NIS along the Algerian coast.

### 3.6. New first records

**Chlorophyta**

- *Caulerpa taxifolia var. distichophylla* (Sonder) Verlaque, Huisman & Procaccini, 2013 (in Jongma *et al.*, 2013) - First recorded along the Algerian coast in 2018 at Surcouf (central coast) and Annaba (eastern coast) (Di Martino & Stancanelli, 2019). Invasive status.

**Ochrophyta**

- *Fibrocapsa japonica* S. Toriumi & H. Takano, 1973 - First Algerian record confirmed by Fani *et al.* (2014) and Ali *et al.* (2020) in the Gulf of Arzew. First record in the southwestern Mediterranean (Fani *et al.*, 2009). Established status.
- *Thalassiosira decipiens* (Grunow) *E.g.* Jørgensen, 1905 - Antarctic diatom, likely transported by ballast water. First reported in Algeria in ballast water discharged in the port of Annaba in 2013–2014 (Cheniti *et al.*, 2018). Casual status.
- *Sargassum muticum* (Yendo) Fensholt, 1955 - First reported near Cherchell (Rocher Blanc, 36°37'N; 2°14'E) and Sidi Fredj in 2015-2017 (Benali *et al.*, 2019). Drifting specimens; not yet considered established. Casual status.
- *Actinoptychus splendens* (Shadbolt) Ralfs in Pritchard, 1861 - First Algerian record in ballast water discharged in the port of Annaba (Cheniti *et al.*, 2018). Casual status.
- *Coscinodiscus lineatus* Ehrenberg, 1839 - First reported in Algeria in 2013–2014 in ballast water at the port of Annaba (Cheniti *et al.*, 2018). Casual status.

**Bryozoa**

- *Schizoporella errata* (Waters, 1878) - Cryptogenic species; first verified Algerian record from Algiers Port (Bensari *et al.*, 2025), correcting previous unsubstantiated citations. Casual status.
- *Watersipora subtorquata* (d'Orbigny, 1852)- Global port distribution via shipping vectors. First Algerian record from Arzew Port (Kacimi, 2023). Casual status.

**Echinodermata**

- *Holothuria (Roweothuria) arguinensis* Koehler & Vaney, 1906 - First recorded in three Algerian localities: Tamentfoust (Algiers), Figuier-plage (Boumerdes), and Stidia (Mostaganem) (Mezali & Thandar, 2014). More recently recorded at several additional sites along the coast (Mezali *et al.*, in press). North Atlantic origin, entering via the Strait of Gibraltar. Found on rocky or sandy substrate, including Posidonia oceanica meadows. Casual status.

**Crustacea Malacostraca**

- *Callinectes sapidus* Rathbun, 1896 - The blue crab was first reported in August 2018 at Oued El Zhor (Jijel coast; 36°55'N, 6°15'E) (Benabdi *et al.*, 2019). Subsequently, recorded at multiple sites along the eastern and western coasts. Breeding observed at Oued El Zhor up to 800 m from the sea. Introduction vector is likely ballast water (Nehring, 2011). Considered invasive and established in several estuarine and lagoonal habitats (Kara & Chaoui, 2021; Benabdi, pers. com.).
- *Portunus segnis* (Forskål, 1775) - Indo-Pacific species that invaded the Mediterranean via the Suez Canal. First Algerian record by Bouraoui *et al.* (2023) at two beaches near Jijel, representing the westernmost Mediterranean distribution limit. Invasive status.
- *Zeuxo coralensis* Sieg, 1980 - Circumtropical tanaidacean. First Algerian record in 2020 on a ship hull and tire in the port of Arzew (Bensari *et al.*, 2020). Established status.
- *Paracerceis sculpta* (Holmes, 1904) - Northeast Pacific isopod, first Mediterranean record in Tunisia (1978). First Algerian record in 2020 at the port of Arzew on a tire and fishing vessel hull (Bensari *et al.*, 2020). Established status.
- *Linguimaera caesaris* Krapp-Schickel, 2003 - First Algerian record in 1988 in Bay of Bou Ismail as Hamimaera hamigera (Bakalem and Dauvin 1992). Taxonomic revision places this record under Linguimaera caesaris. Probable introduction via the Red Sea or by ships. Established status.

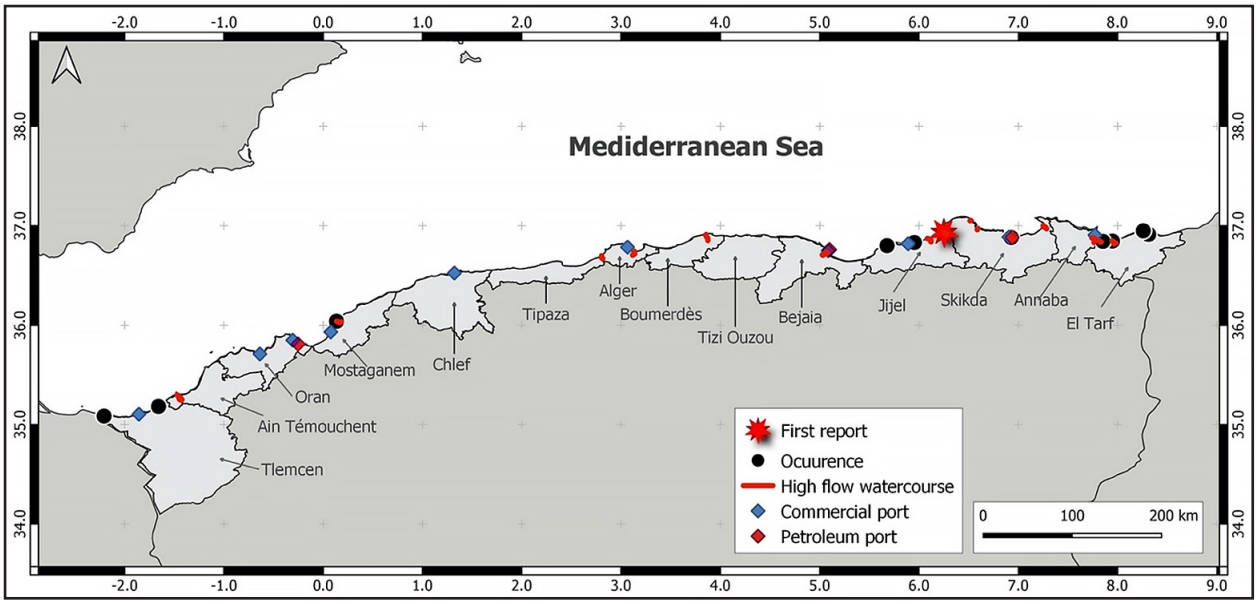


**Fig. 9.** Distribution map of *C. sapidus* reports from the Algerian coast since their first report in 2018.

- *Paractaea rufopunctata* (H. Milne Edwards, 1834) - First reported in the Bay of Bou Ismail (Dieuzeide, 1950). Casual status.
- *Cymadusa filosa* Savigny, 1816 - First Algerian record in the port of Annaba (Chevreux, 1910). Established status.
- *Neomysis integer* (Leach, 1814) - Northeast Atlantic mysid. First Algerian record in 1997 in Arzew Gulf (Grimes, 2010). Established status.
- *Necora puber* (Linnaeus, 1767) - Northwest Atlantic origin. First Algerian record in Algiers Bay in 1999 (Grimes 2010). Established status in the western Mediterranean.
- *Monocorophium sextonae* (Crawford, 1937) - Atlantic origin. First Algerian record in 1998 in the Port of Oran and Gulf of Ghazaouet (Grimes, 2010). Casual status.
- *Pseudomma affine* G.O. Sars, 1870 - North Atlantic mysid. First Algerian record in 1997 in the port and gulf of Arzew (Grimes, 2010). Casual status.
- *Paracartia grani* Sars G.O., 1904 - First Algerian record in 2018 in harbour waters of Algiers and Bou Ismail bays. Affinity for polluted environments. Herculean origin. Established status.

**Mollusca**

- *Aplysia dactylomela* Rang, 1828 - Cryptogenic species. First Mediterranean record in 2002 (Lampedusa, Italy). First Algerian record in 2018 at Annaba and Surcouf (Algiers) during snorkelling surveys (Di Martino & Stancanelli, 2019). Invasive status.
- *Echinolittorina punctata* (Gmelin, 1791) - Tropical Atlantic littorinid gastropod, an indicator of Mediterranean tropicalisation. First Algerian record in 1862 (Weinkauff). Most recent record at Rachgoun Island in 2016. Also reported at Surcouf and Annaba in 2018 (Di Martino & Stancanelli, 2019). Established status.
- *Godiva quadricolor* (Barnard, 1927) - First Algerian record in 2020 at the port of Arzew, identified by its distinctive blue, yellow and orange-striped cerates (Bensari *et al.*, 2020). Established status.
- *Procardium indicum* (Lamarck, 1819) - First Algerian record at Cape Rosa (El Kala) at 37 m depth (Petit, 1840). Subsequently recorded at Sidi-Fredj, Mostaganem, Oran, and Annaba. Established status.

**Polychaeta**

- *Aricidea (Aricidea) fragilis* Webster, 1879 - Cryptogenic species of West Atlantic origin. First Algerian record in the Bay of Algiers in 1985 at 10 m depth (Bakalem, 2008). Casual status.
- *Hydroides dianthus* (Verrill, 1873) - First Algerian record in the Port of Algiers in 1981–1982 (Bakalem & Romano, 1985). Recent molecular evidence suggests the species may be native to the Mediterranean; its NIS status is debated (Sun *et al.*, 2017; Zenetos & Galanidi, 2020). Established status.
- *Hydroides dirampha* Mörch, 1863 - Circumtropical, native to the Caribbean. First Algerian record at the Port of Algiers in 1981 (Bakalem & Romano, 1985). Established and widespread throughout the Mediterranean. Established status.
- *Hydroides elegans* (Haswell, 1883) - First Algerian record in 1988 at Bou Ismail Bay (Hassam, 1991; Oulmi, 1991). Established throughout the Mediterranean, particularly invasive in the Levantine Sea. Origin unknown. Established status.
- *Polydora hoplura* Claparède, 1868 - Spionid polychaete, originally described from the Gulf of Naples. First Algerian record in 1996 at the Port of Annaba (Grimes, 2010). Casual status.

- *Spirobranchus kraussii* (Baird, 1864) - Native to the Caribbean. First Algerian record in 2018 at the Port of Beni Saf (Bitar, pers. comm.). Casual status.
- *Pseudonereis anomala* Gravier, 1899 - Western Indo-Pacific and Red Sea origin (Lessepsian). First recorded along the Algerian coast in 2017 at Stora (Gulf of Skikda; 36°53'N, 6°52'E) (Kurt *et al.*, 2021). First record for the western Mediterranean. Casual status.

**Porifera**

- *Paraleucilla magna* Klautau, Monteiro & Borojevic, 2004 - The first recorded alien and invasive calcareous sponge in the Mediterranean. First Algerian record in 2018 at the Port of Algiers and Pisan Island (Bejaia) between 2 and 20 m depth (Bachetarzi *et al.*, 2019). Subsequently confirmed at Arzew Port in 2019 (Bensari *et al.*, 2020). Invasive status.

**Pisces**

- *Seriola carpenter* Mather, 1971 - Atlantic species. First Algerian record in March 2018 in Oran, captured by an angler (Hemida *et al.*, 2018). Casual status.
- *Chaunax suttkusi* Caruso, 1989 - First Mediterranean record in 1997 near the Sentinelle Bank (eastern Algerian coast) (Ragonese *et al.*, 1997). Casual status.
- *Kyphosus vaigiensis* (Quoy & Gaimard, 1825) - First Algerian record in 2013 in Annaba (Groud *et al.*, 2021). Also, the first record for the southwestern Mediterranean. Casual status.
- *Sphyraena flavicauda* Rüppell, 1838 - Indo-West Pacific yellowtail barracuda. First Algerian record in February 2019, caught by fishermen at Chétaibi (eastern coast) (Kara & Bourehail, 2020). Casual status.

**Ascidiacea**

- *Botryllus schlosseri* (Pallas, 1766) - Cryptogenic for the Mediterranean. First Algerian record in 2020 in the port of Arzew, very abundant in almost all samples, also recorded in the port of Algiers (Bensari *et al.*, 2020). Established status.
- *Bugula neritina* (Linnaeus, 1758) - Cryptogenic, Indo-Pacific origin, spread globally by ships. First Algerian record in 2020 at the port of Arzew (Bensari *et al.*, 2020). Established status.

**Cnidaria**

- *Physalia physalis* (Linnaeus, 1758) - The Portuguese man-of-war was first observed along the Algerian coast on March 25th, 2021, near Andalouses beach (Oran; 35°42'N, 0°54'W), followed by multiple citizen science reports along the coast (Bachouche *et al.*, 2022). Invasive status.
- *Cirrholovenia tetranema* Kramp, 1959 - Indo-Pacific leptomedusa. First Algerian record from Algiers Bay (Kherchouche & Hafferssas, 2020). Casual status.
- *Kantiella enigmatica* Bouillon, 1978 - Indo-Pacific anthomedusa. Known in Algeria from a single record from Algiers Bay (Kherchouche, 2021). Casual status.

### 3.7. New occurrences

The presence of the flat crab *Percnon gibbesi* along the Annaba coasts (between Lever de l'Aurore Beach and Cap de Garde: (36°32'40.08"N - 7°27'42.75"E; 36°34'49.68"N - 7°28'22.08"E) was confirmed in 2016 while free diving on small mixed bottoms (pebbles, faults, blocks, caves) between 0 - 2 m (Bada & Derbal, 2018; Menail *et al.*, 2019). The population observed in this area (822 individuals) is mainly composed of medium (48.93%) and large (41.82%) individuals. Small individuals are present and represent only 9.24% of the overall population and the limit cephalothoracic lengths measured range from 6.2 (female) (Bada & Derbal, 2018) to 41.05 mm (male) (Menail *et al.*, 2019). These metric values are higher than those described in the different populations observed in many Mediterranean localities (Relini *et al.*, 2000, Thessalou-Legaki *et al.*, 2006; Azzurro *et al.*, 2011; Sghaier *et al.*, 2011). This species was reported in 2017 in the western Algerian coast (La madrague beach: 35°46'02.2" N 0°49'06.6"W) between 1 and 3m depth (Hussein *et al.*, 2020) and Habibas islands at 2 m depth (SPA/RAC, 2020). Two new records of *Sphoeroides pachygaster* have been made on 17/02/2020 and 05/05/2020, respectively in Damous (Central coast) and Oran (Westren coast) by Hussein *et al.* (2020), while 17 other signallings have been made from January to August 2014 in different areas (Annaba, Zemmouri, Tipaza, Tizi Ouzou, Boumerdès, Port of Mostaganem, Collo, between Oureah and Stidia, Sidi Ledjdoub) (Lt: 13,1 to 50 cm and Wt : 79.6 to 1400 g) by CNRDPA (unpublished).

### 3.8. Correction from the previous baseline

- *Synagrops japonicus* (Döderlein, 1883) - Previously reported as *Acropoma japonicum* (Grimes *et al.*, 2018; Hannachi *et al.*, 2015). Twenty juveniles observed west of the Gulf of Annaba in 2011–2012 at Beaches Belvedere and Aïn Achir (36°33'N, 7°27'E). Recurrent presence of juveniles in June–July over two consecutive years suggests successful reproduction. Introduction likely via ship ballast or hull fouling.
- *Caulerpa chemnitzia* (Esper) J.V. Lamouroux, 1809 - First Mediterranean record from Algeria in 2015 (Verlaque *et al.*, 2015; Benabdi *et al.*, 2019), confirmed at La madrague (36°47'N, 2°53'E) at 0.5 m depth on rocky bottom. A non-aggressive Lessepsian alga, subsequently recorded in Tunisia (2016) and Lebanon. Invasive status.
- *Lagocephalus lagocephalus* (Linnaeus, 1758) was first recorded in Algerian waters in 1953 at the Bay of Bou Ismail (Dieuzeide, 1955), not in 2014 as mistakenly cited in Grimes *et al.*, (2018). New records (2014): Azzefoun, Chlef, and Larhat (CNRDPA, unpubl.); specimens 33.1–36.5 cm TL, 295–680 g. *L. sceleratus*: first Algerian record on 14 December 2013 at El Kala (Kara *et al.*, 2015); additional records in Oran Bay and Bou-Ismail Bay in 2014 (42.8 and 68.5 cm TL by bottom trawl). *Ephippion guttifer*: first recorded at Ténès (Dieuzeide, 1933); a 41.3 cm, 1327 g specimen collected by gillnet on 14 July 2014 at 40 m depth off Cherchell. *Sphoeroides pachygaster*: 19

specimens collected 2014–2020 by bottom trawl and gillnet (30–70 m) along the Algerian coast; first record at Chétaibi–Seridi (Annaba) in November 2008.

- *Metasychis gotoi* (Izuka, 1902) - First Algerian record was in Bay of Bou Ismail (August 1988, 64–105 m; Hassam, 1991; Oulmi, 1991; Bakalem *et al.*, 2020), not in Gulf of Oran as stated in Grimes *et al.*, (2018).
- *Lumbrineris perkinsi* Carrera-Parra, 2001 - First Algerian record in Bay of Fetzara (February 1990, fine sandy bottom, 13–15 m; Bakalem, 2008). Previously recorded as *L. inflata* in the Mediterranean (Giangrande *et al.*, 1981; Çınar 2009). Questionable NIS status given its eastern Pacific distribution.
- *Eucheilota paradoxica* Mayer, 1900 - Atlantic and Indo-Pacific leptomedusan. First Mediterranean record in the Adriatic Sea (1976). Reported along the Algerian coast (Kerzabi, 2004; Kherchouche & Hafferssas, 2020), where it has become a common species in the central region. Casual status.

### 3.9. Species with uncertain NIS status

**Crustacea**

- *Dosima fascicularis* (Ellis & Solander, 1786) - Seven specimens stranded on the Jijel coast (eastern Algeria) in April 2018 (Mokrane *et al.*, 2019). Not normally present in the Mediterranean; its occurrence likely reflects passive drift from the Atlantic rather than establishment. Uncertain status.
- *Sphaeroma venustissimum* Monod, 1931 - First Algerian record in the Bay of Bou Ismail (1966–1967; Le Gall, 1969). Originally considered alien (Zenetos *et al.*, 2010) but subsequently removed from NIS lists, as its presence in the Mediterranean may reflect natural range expansion via the Strait of Gibraltar rather than human-mediated introduction.

**Fish**

- *Alectis alexandrina* (Geoffroy Saint-Hilaire, 1817) - Single specimen caught near Annaba in 2003 by trawl at 50–100 m (Hemida *et al.*, 2005). Eastern Central Atlantic species, rare in the Mediterranean. Uncertain status (Crocetta *et al.*, 2015).
- *Dagetichthys lusitanicus* (de Brito Capello, 1868) - Atlantic sole, first Mediterranean record in 1960 (Catalan coast). Reported in western Algeria as *Synaptura lusitanica* (Golani *et al.*, 2002). Established NIS in the Mediterranean.
- *Kyphosus sectatrix* (Linnaeus, 1758) - Atlantic and Indo-Pacific species, rare in the western Mediterranean. First Algerian record in June 2003 in the Gulf of Annaba the only Mediterranean record of multiple individuals captured together (Hemida *et al.*, 2004). Uncertain status.
- *Lesueurigobius sanzi* (de Buen, 1918) - Atlantic–Mauritanian goby. First Algerian record in 2004 on the central and western coast during demersal surveys (Massuti *et al.*, 2004a). Uncertain status.
- *Isurus paucus* Guitart, 1966 - Longfin mako shark with worldwide tropical–warm temperate distribution. First Algerian record: two specimens caught on 16 October 2001 at Beni Saf (Hemida & Capapé, 2008). Considered cryptogenic in the Mediterranean (Zenetos *et al.*, 2010).
- *Lobotes surinamensis* (Bloch, 1790) - Cosmopolitan tripletail, increasingly observed in the Mediterranean. First Algerian record in 2002 at Annaba fish market (Hemida *et al.*, 2003). Range-expanding status uncertain (Tiralongo *et al.*, 2018).

**Echinodermata**

- *Oestergrenia digitata* (Montagu, 1815) is originating from the North East Atlantic. According to Clark (1922), a specimen of *Oestergrenia digitata* was recorded in the Mediterranean Sea. It is reported in the gulf of Skikda, Algeria on June 1996, on muddy sand bottom, at 75-80m depth, when 2 individuals were collected during an Oceanographic campaign aboard the "M.S. Benyahia" Oceanographic Research Vessel (Mezali & Semroud, 1997). *Oestergrenia digitata* has been also reported in the Bay of Algiers from January-Ferbruary 1977 (Bakalem, 1979) on fine sandy bottom, at 10 m depth (Bakalem, 2008) and in Bou-Ismail Bay in 1988 (Hassam, 1991; Oulmi, 1991; Bakalem *et al.*, 2020) on fine sands, silted sands, sandy muds and silted gravels muds.
- *Parastichopus regalis* (Cuvier, 1817) belongs to the family of Stichopodidae (Clark, 1992; Maggi & González-Wangüemert, 2015). This species is distributed in the East Atlantic [from the Angola (Cherbonnier, 1965) to Northern Ireland, including the Canary Islands and the Azores. It was found the first time in Algeria at Sidi-Medjdoub (Mostaganem) (36°0.032'N, 0°1.456'E) (Benzait *et al.*, 2020). This non-endemic species is recorded in the Mediterranean since the 19th century (Cuvier, 1817), being reported throughout the Algerian coast (Khodja *et al.*, 2021). The family Stichopodidae is represented in the Mediterranean Sea by the genus Parastichopus, which includes two non-endemic species: *Parastichopus tremulus* (Gunnerus, 1767) and *Parastichopus regalis* (Cuvier, 1817)."

## 4. CONCLUSION

Between 1834 and December 2017, 348 NIS occurrence records were reported from 69 localities along the Algerian coast (Grimes *et al.*, 2018). The present updated assessment adds 71 new occurrence records, raising the total to 419 occurrences and 130 NIS species. The study documents the rapid range expansion and establishment of NIS across a wide variety of habitats, including soft and hard substrates, insular, benthic and pelagic environments, marine protected areas, Posidonia oceanica meadows, coralligenous habitats, and anthropized areas at various depths. The number of taxonomic groups represented has also increased, reflecting broader NIS diversification along the Algerian coast.

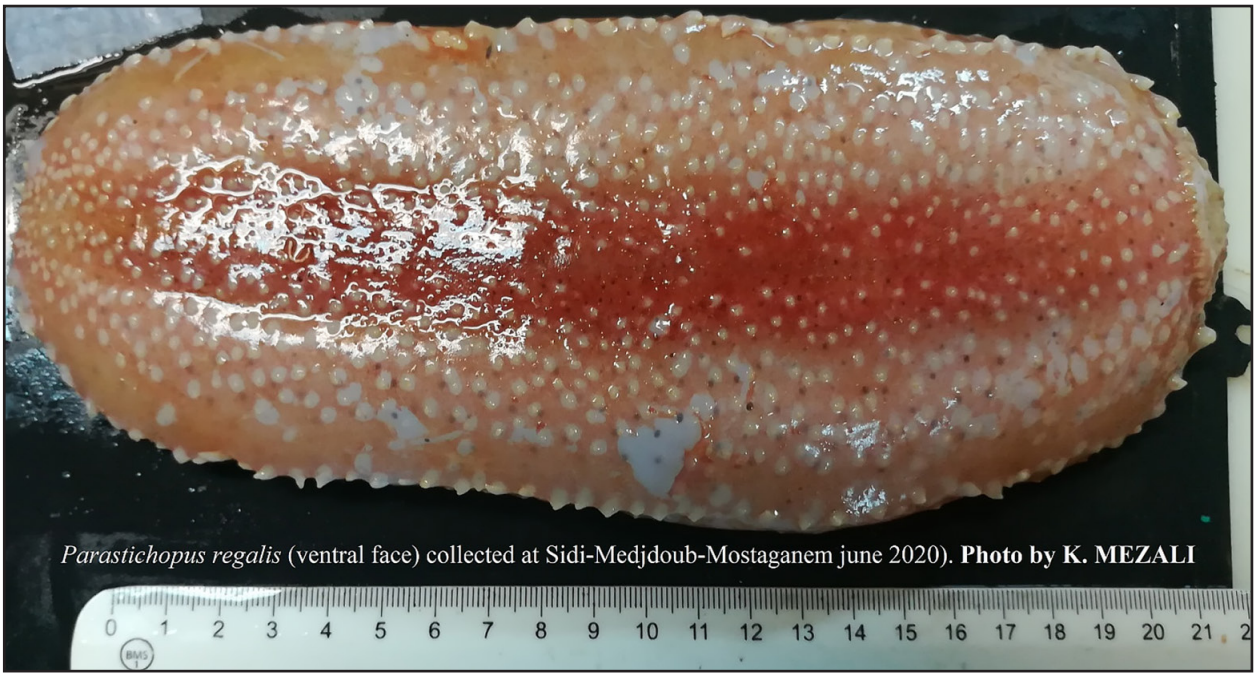


**Fig. 10.** *Parastichopus regalis* collected on June, 2020 from Sidi Medjdoub site (Mostaganem province, Algeria) (36°0.032'N, 0°1.456'E) at 49 m depth (Picture: Karim. Mezali)

The most rapidly expanding non-native species are the macroalgae *Caulerpa cylindracea*, *Asparagopsis armata* and *A. taxiformis*, while the blue crab *Callinectes sapidus* is expanding dramatically along the Algerian coast.

Scientific expertise on NIS in Algeria remains limited, and inter-institutional networking is insufficient. Standardization of monitoring protocols is urgently needed to ensure that data can be meaningfully compared across studies. Both this study and the previous baseline (Grimes *et al.*, 2018) reveal persistent knowledge gaps for several taxonomic groups, particularly Cnidaria, Bryozoa, Echinodermata, Porifera, Sipuncula, and Myzozoa. Moreover, NIS data remain scarce in several ecologically important areas along the Algerian coast, including the coasts of Tlemcen, Aïn Témouchent, Chlef, Boumerdès, Tizi Ouzou, Béjaïa, and Skikda, where NIS data are particularly scarce.

Despite recent research and monitoring efforts, NIS along the Algerian coast remain significantly understudied given their multiple ecological, economic, and social consequences. New scientific projects and monitoring programmes recently launched in Algeria are expected to provide a clearer picture of NIS distribution and invasion dynamics along the coast. Realistic assessments of future biological invasions can only be achieved by systematically examining the drivers of NIS spread and establishment, as well as the responses of native biodiversity and sensitive habitats to ongoing invasions. Biological invasions are inherently complex social–ecological phenomena, and coordinated, interdisciplinary research is strongly recommended to address this challenge effectively.

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