

LA COMUNITÀ INTERNAZIONALE

Rivista Trimestrale della Società Italiana per l'Organizzazione Internazionale

QUADERNO 35



## FRAGILE SEAS

Uncertainties in the Maritime Domains and  
New Analytical Frameworks for  
Future Regional Governance Crises

Claudia Battiferri, Mario Boffo, Ildebrando Ceolin, Giacomo Di Capua,  
Irene Falso, Aldo Pigoli, Carmine Soprano

EDITORIALE SCIENTIFICA  
Napoli



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SOCIETÀ ITALIANA PER L'ORGANIZZAZIONE  
INTERNAZIONALE

QUADERNI (Nuova Serie)

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SOCIETÀ ITALIANA PER L'ORGANIZZAZIONE INTERNAZIONALE

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Il presente progetto è stato realizzato con il contributo dell'Unità per l'Analisi, la Programmazione, e la Documentazione Storica – Direzione Generale per gli Affari Politici e la Sicurezza Internazionale del Ministero degli Affari Esteri e della Cooperazione Internazionale, ai sensi dell'art. 23 – bis del DPR 18/1967.

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*This project is realized with the support of the Unit for Analysis, Policy Planning, and Historical Documentation - Directorate General for Political Affairs and International Security of the Italian Ministry of Foreign Affairs and International Cooperation, in accordance with Article 23 – bis of the Decree of the President of the Italian Republic 18/1967.*

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Via San Biagio dei Librai, 39  
89138 - Napoli  
ISBN 979-12-235-0762-9

## SUMMARY

|                                                                                                                 |    |
|-----------------------------------------------------------------------------------------------------------------|----|
| IRENE FALSO – Introduction .....                                                                                | 7  |
| CHAPTER 1                                                                                                       |    |
| CLAUDIA BATTIFERRI, ILDEBRANDO CEOLIN, GIACOMO DI CAPUA – Theoretical Framework: Defining Sea Fragility .....   | 13 |
| CHAPTER 2                                                                                                       |    |
| GIACOMO DI CAPUA, ALDO PIGOLI, CARMINE SOPRANO – The Sea Fragility Framework .....                              | 37 |
| CHAPTER 3                                                                                                       |    |
| CLAUDIA BATTIFERRI, MARIO BOFFO – Analysing Fragility Through the Red Sea Case.....                             | 59 |
| GIACOMO DI CAPUA, ALDO PIGOLI, CARMINE SOPRANO – Conclusions. Policy Implications and Strategic Takeaways ..... | 91 |



## INTRODUCTION

IRENE FALSO

The vulnerabilities and challenges that characterise the maritime domain affect a wide range of strategic, political, and economic interests. The effects of the uncertainties caused by these challenges have an impact on what this research defines as a ‘wider Mediterranean’, namely an interconnected geopolitical space comprising the Mediterranean, the Black Sea, the Middle East, the Gulf, the Red Sea, the Gulf of Guinea, and extending towards both the Arctic and the Indo-Pacific. Rather than constituting separate geopolitical theatres, these maritime spaces are increasingly connected through flows of trade, energy, migration, information, and security dynamics, creating a system of interdependent maritime regions whose vulnerabilities are mutually reinforcing. Despite the growing strategic relevance of these interconnected maritime domains, existing analytical frameworks remain overwhelmingly state-centric and provide only limited tools for assessing fragility within maritime systems. While substantial progress has been made in the study of State Fragility, equivalent approaches capable of analysing vulnerability, exposure, and governance capacity at the maritime and regional level remain largely absent. This gap is particularly significant given the central role that maritime spaces now play in global security, economic stability, and geopolitical competition. The scientific significance of defining the concept of the “wider Mediterranean” stems from the central role this geographical area plays in contemporary geopolitical balances. From this perspective, security in the Mediterranean represents a necessary precondition for European security and, consequently, for stability across two broader strategic arenas: the transatlantic and Indo-Pacific regions.

The relevance of the wider Mediterranean therefore derives not only from its geographical position, but also from its function as a strategic junction linking multiple maritime systems whose dynamics increasingly transcend traditional regional boundaries. This need is particularly acute in the new international landscape, in which Europe urgently needs to reinvent and reaffirm its role in geographical areas

that lie outside its traditional sphere of interest. Furthermore, a new policy for the Mediterranean should be based on a clear European dimension, geared towards strengthening the common foreign and defence policies of the member states. The current international context is characterised by a multiplicity of interconnected crises driven by institutional, political, economic, social, environmental, geopolitical, and religious factors. These challenges affect maritime security in different ways, ranging from the safety of navigation and maritime trade routes to the protection of critical subsea infrastructure. Consequently, these conflicts have repercussions not only at a regional level but also globally, often affecting the wider Mediterranean and undermining its security and stability. For instance, tensions in the Red Sea (exacerbated by the asymmetric warfare waged by the Houthis), instability in the South Caucasus affecting strategic energy and transport corridors, and the growing strategic competition in the Indo-Pacific (particularly involving China, the United States, and regional allies such as Japan) paint a picture of an increasingly fragmented and contested geopolitical landscape, with repercussions on a global scale. As far as the Red Sea is concerned, Italy and Europe have significant strategic interests there and are already taking steps to protect them. For example, Operation Aspides, launched by the European Union in February 2024, illustrates the growing importance attributed by European actors like Italy to the protection of maritime routes and critical maritime infrastructure in the Red Sea.

The underwater domain similarly represents an area of growing strategic, economic, and geopolitical importance. The Mediterranean is home to a dense network of submarine cables, which are increasingly becoming the object of strategic competition among regional and extra-regional powers. The Mediterranean, therefore, is particularly significant in this regard because of its geographical position, which serves as a hub and point of connection between three continents. Consequently, the regional scenarios of the wider Mediterranean are united by common challenges relating to the Security of Sea Lines of Communication (SLOCs), the protection of critical underwater infrastructure, territorial disputes, processes of maritime territorialisation, and the projection of power by regional actors. These dynamics demonstrate the increasing interconnectedness of maritime spaces that have traditionally been analysed as geographically distinct. As a result, the wider Mediterranean must be

understood not only through the dynamics of the Mediterranean basin itself, but also through those of adjacent and interconnected maritime regions whose developments directly affect its security and stability. It is therefore a priority to analyse, through an integrated approach, both the destabilising factors within each regional scenario and their trans-regional interconnections, while taking into account the presence of all actors involved, from traditional to emerging ones. Common vulnerabilities connect the regional scenarios of the wider Mediterranean.

For this reason, there is a clear need to systematically identify, assess, and anticipate potential areas of vulnerability and fragility in international and regional security, starting from the central role of the seas as new focal points of governance, particularly in light of the aforementioned growing centrality of maritime domains. While existing approaches have largely focused on maritime threats and security challenges, they have devoted comparatively less attention to the structural conditions that make maritime regions vulnerable to disruption and instability. Nevertheless, reviews of existing doctrine and analytical frameworks highlight the lack of suitable methodologies for assessing fragility in maritime domains at either the national or international level. Although organisations such as the Organisation for Economic Co-operation and Development (OECD) have developed influential frameworks for assessing State Fragility, no equivalent framework currently exists for evaluating fragility in marine-regional systems and interconnected maritime spaces through a maritime lens. Therefore, the project aims to address the methodological gap in the analysis of regional fragility with a focus on the maritime dimension, seeking to develop a new methodological approach to the analysis of risk factors and related exposure in the regional governance of coastal states in the field of maritime security through the creation of the “Sea Fragility Framework” (SFF). Building upon existing literature, this research aims to outline the conceptual and operational definition of the ‘fragile sea’ within existing analytical frameworks. In particular, the research project draws on the literature on state fragility and existing analytical frameworks relating to the fragility of governance structures in order to define a new framework for assessing the fragility of the sea. The SFF has been designed to support the evaluation of existing research on maritime vulnerabilities across different regions, identifying the dimensions that contribute to maritime fragility and translating them

into measurable indicators for future assessment. The review of doctrine was used to identify certain existing gaps in research regarding the analysis of fragile seas in the fields of regionalism, maritime security, international security, international affairs, transport, energy, governance and human rights, amongst others.

This project aims to conduct an integrated interdisciplinary analysis, developed through a system of concentric analyses. It seeks to establish a permanent and systematic platform for discussion, capable of identifying the vulnerabilities of each region and opportunities for cooperation between states. This could help to foster the creation of effective governance in each relevant area.

The analysis will focus on maritime vulnerabilities and risk factors, as well as the economic, social, institutional and politico-military challenges facing coastal states. The analysis also covers the effects of the climate crisis on the marine environment (temperature, sea level, prospects for coastal cities, sustainable fishing, invasion of alien species); the impact of migration flows; and the security of communications and data transmission. As illustrated in the Red Sea case study, the project thus also aims to develop policy proposals and recommendations on the aforementioned issues within the context of Italy's approach to international cooperation in the stabilisation of regional crises and a more effective use of diplomatic, political, legal, economic and military instruments, with a view to contributing to the decision-making processes of the Italian state system.

This study began with a systematic review of the relevant literature, using predefined inclusion and exclusion criteria to develop a harmonised definition of maritime fragility, risk areas, exposure indices, and resilience capacity. The literature review and conceptualisation of maritime fragility will be presented in the first chapter of this paper, together with a detailed explanation of the methodology employed.

The second chapter, on the other hand, will present the SFF, translating the conceptual foundations developed in this research into an operational assessment tool. Drawing upon the multidimensional approach adopted by the OECD State Fragility framework, the SFF examines seven key domains: Economic, Environmental, Political, Military Security, Social-Institutional, Legal-Enforcement, and Technological.

Finally, in the third chapter of this paper, the SFF analytical framework will be applied to the case study of the Red Sea, providing

a comprehensive assessment of regional governance fragility, exposure to risk factors, and systematic vulnerabilities, while also developing policy recommendations relevant to Italy and its partners operating within the wider Mediterranean.



## CHAPTER 1

### THEORETICAL FRAMEWORK: DEFINING SEA FRAGILITY

CLAUDIA BATTIFERRI, ILDEBRANDO CEOLIN, GIACOMO DI CAPUA

SUMMARY: 1. Theoretical framework: defining sea fragility. – 1.1. From Sea Security to Sea Fragility. – 1.2. Theoretical roots: from State Fragility to Sea Fragility. – 1.3. Conceptualizing Sea Fragility. – 1.4. Exposure, resilience and governance. – 1.5. Limits and conceptual cautions. – 2. Methodology. – 2.1. Mapping existing frameworks. – 2.2. Limitations of current evaluation frameworks. – 2.3. Towards a novel Sea Fragility Framework (SFF). – 2.4. The role of the SFF in the Italian maritime policy. – 2.5. The SFF in the wider Mediterranean.

1. In recent years, the maritime domain has increasingly been represented within political and strategic discourse as a space characterized by instability, vulnerability, and fragmentation. Contemporary debates on maritime security no longer portray the sea merely as a neutral environment for trade and connectivity, but rather as a contested and fragile domain exposed to geopolitical competition, environmental degradation, governance deficits, and transnational insecurity<sup>1</sup>. Strategic analyses of the Mediterranean and other maritime regions have progressively emphasized the growing interaction between regional conflicts, migration pressures, climate risks, critical infrastructures, and economic interdependence<sup>2</sup>. Similar dynamics have been observed across the Persian Gulf, the Red Sea<sup>3</sup>, the Black Sea<sup>4</sup>, the Arctic<sup>5</sup>, and the Indo-Pacific<sup>6</sup>, where maritime

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<sup>1</sup> B. GERMOND, *The Geopolitical Dimension of Maritime Security*, in *Marine Policy*, 2015, 137 ff.

<sup>2</sup> M. CECCORULLI, *Maritime Security in the Mediterranean*, London-New York, 2022; J. SUÁREZ-DE VIVERO et al., *Forecasting Geopolitical Risks: Oceans as Source of Instability*, in *Marine Policy*, 2017, 19 ff.

<sup>3</sup> A. VIDAL RIBE, *Securing the Seas: A Comparative Analysis of Emirati and Saudi Foreign Policies in the Red Sea*, M.A. Thesis, Georgetown University, Washington (DC), 2022.

<sup>4</sup> B. KARADENIZ, *Security and Stability Architecture in the Black Sea*, in *Perceptions*, Winter 2007.

<sup>5</sup> J. JOKELA (ed.), *Arctic Security Matters*, European Union Institute for Security Studies (EUISS), Paris, 2015.

<sup>6</sup> NATO, *Regional Perspectives Report on the Indo-Pacific*, Norfolk, Virginia (USA), 2022; A. SÁNCHEZ-CACICEDO, *India Matters? Maritime Security, Governance and Commerce*

security is increasingly shaped by geopolitical competition, economic interdependence, and governance challenges. Importantly, these dynamics are rarely confined to a single maritime basin. The Italian geopolitical concept of the *Mediterraneo allargato* reflects the recognition that the Mediterranean is embedded within a broader maritime continuum extending eastward through the Red Sea, the Gulf region, and the Indian Ocean, and westward toward the Atlantic and the Gulf of Guinea<sup>7</sup>. Energy flows, maritime trade routes, migration corridors, environmental pressures, and security challenges transcend conventional regional boundaries, creating a highly interconnected maritime space in which instability in one basin can generate cascading effects across others<sup>8</sup>.

At the same time, such interconnectedness does not eliminate the need for analytical boundaries. For the purpose of assessment and comparison, maritime regions must be treated as identifiable units of analysis, characterized by specific geographical, political, economic, and governance features. The Mediterranean, the Gulf of Guinea, the Red Sea, the Arctic, or the Indo-Pacific each display distinct configurations of risks, actors, and institutional arrangements. Consequently, maritime basins can be understood as analytically bounded yet functionally interconnected systems: while each region possesses its own dynamics of vulnerability and governance, these dynamics are increasingly shaped by processes operating across a wider maritime space<sup>9</sup>. This dual perspective allows maritime fragility to be examined at the regional level without overlooking the transregional linkages that connect individual basins within broader geopolitical and geoeconomic networks. In this regard, the Mediterranean can be conceptualized as a “fragile sea”, affected by geopolitical instability, environmental pressures, weak governance

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in the Indo-Pacific, European Union Institute for Security Studies (EUISS), Paris, 2023.

<sup>7</sup> SENATO DELLA REPUBBLICA, CAMERA DEI DEPUTATI, MINISTERO DEGLI AFFARI ESTERI E DELLA COOPERAZIONE INTERNAZIONALE, *Osservatorio di Politica internazionale, Strategie di collegamento dell’Indo-Pacifico al Mediterraneo allargato*, Roma, 2023.

<sup>8</sup> J. SAMAAN, *Securing European Interests from the Mediterranean to the Persian Gulf: Rethinking EU Strategic Autonomy at Sea*, in *Euromesco Papers* n. 68, 2018, available online; G. DAGA, P. P. RAIMONDI (eds.), *Mediterranean Transitions from the Gulf to the Sahel: The Role of Italy and the EU*, IAI Research Studies 11, Roma, 2024.

<sup>9</sup> P.M.E. VOLTEN, B. TASHEV, *Establishing Security and Stability in the Wider Black Sea Area*, in NATO Science for Peace and Security Series- E: Human and Societal Dynamics, Amsterdam, 2007; D. RUSU, *Regionalisation in the Black Sea Region: a comparative analysis of regionalisation at the borders of the EU*, M.A. Thesis, Central European University, Budapest, 2010.

structures, fragile or failed coastal States, non-state actors, and vulnerabilities linked to maritime infrastructures, energy security, and commercial routes<sup>10</sup>. Similarly, studies on maritime security and ocean governance have highlighted how maritime spaces are increasingly shaped by geopolitical rivalry, competition over marine resources, irregular migration, human trafficking, and legal fragmentation<sup>11</sup>. Nevertheless, despite the growing recognition of these dynamics, maritime vulnerability remains conceptually fragmented across different strands of scholarship and policy analysis. Security studies tend to focus on threats and deterrence, governance literature emphasizes institutional capacity and cooperation, environmental approaches highlight climate and ecological risks, while legal scholarship concentrates on regulatory gaps and jurisdictional disputes<sup>12</sup>. As a result, although the symptoms of maritime fragility are widely acknowledged, a coherent analytical framework capable of integrating these dimensions into a unified conceptualization of maritime fragility remains largely absent. This conceptual gap is partly rooted in the predominance of maritime security frameworks, which have traditionally focused on threats and their management rather than on the structural conditions that generate vulnerability<sup>13</sup>. Understanding this distinction requires moving from the concept of Sea Security to that of Sea Fragility.

1.1. Traditional approaches to maritime governance have generally relied upon the concept of *Sea Security*, primarily understood in terms of territorial control, deterrence, naval power, and

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<sup>10</sup> *Mediterraneo allargato: un mare fragile tra geopolitica, sicurezza ed energia*, Dialogo Diplomatico n. 250, 2024.

<sup>11</sup> C. WIRTH, *Ocean Governance, Maritime Security and the Consequences of Modernity in Northeast Asia*, in *The Pacific Review*, XXV, 2, 2012, 57 ff., available online; B. GERMOND, *The Geopolitical Dimension of Maritime Security*, in *Marine Policy*, cit.; D. DALAKLIS, B.S. SEKER, *Contemporary Maritime Security Challenges: Human Trafficking and Migrant Smuggling at Sea*, in *Geopolitica*, 2016, 135 ff.

<sup>12</sup> G.E. VAN HOOK, *Maritime Security Consortiums*, in S. JASPER (ed.), *Conflict and Cooperation in the Global Commons: A Comprehensive Approach for International Security*, George Town, 2012, 173 ff.; J. LOU, *Application of Interim Measures by the International Tribunal for the Law of the Sea*, in *International Journal of Criminal Justice Science*, XVIII, 2, 2023, available online; V. LYMPEROPOULOS, *Regional Maritime Security Limitations under UNCLOS*, in *The Review of Contemporary Scientific and Academic Studies*, IV, 2, 2024, available online.

<sup>13</sup> B. GERMOND, *The Geopolitical Dimension of Maritime Security*, in *Marine Policy*, cit.; M. CECCORULLI, *Maritime Security in the Mediterranean*, cit.

the protection of strategic maritime infrastructures and trade routes<sup>14</sup>. Maritime security frameworks have historically focused on hard security dimensions, including military presence, freedom of navigation, border control, counter-piracy operations, and the protection of sea lines of communication<sup>15</sup>. From this perspective, insecurity is commonly associated with identifiable threats requiring containment or deterrence through State-centered security mechanisms.

Although such approaches remain essential in understanding contemporary maritime competition, they appear insufficient to explain the structural vulnerabilities affecting maritime systems. Existing maritime security frameworks often fail to account for institutional weakness, governance fragmentation, environmental degradation, cumulative exposure to risks, and the inability of maritime actors to adapt to prolonged instability. Maritime security is not solely determined by military control, but also by broader governance dynamics and geopolitical interdependencies<sup>16</sup>.

The concept of *Sea Fragility* seeks to overcome these limitations by shifting the analytical focus from threat-centered security toward systemic vulnerability. In this perspective, fragility does not coincide merely with the existence of threats, but rather with the structural inability of maritime regional systems to absorb, manage, and adapt to their effects over time<sup>17</sup>. Consequently, the concept of Sea Fragility incorporates analytical dimensions such as exposure, governance capacity, resilience, institutional adaptability, and infrastructural interdependence into the study of maritime regions.

## 1.2. The conceptual foundations of Sea Fragility can be traced to the extensive literature on State Fragility and fragile governance

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<sup>14</sup> M.A. LEFEBVRE DE SAINT GERMAIN et al., *Europe, Cooperating for a Naval Ambition*, in *Études Marines*, n. 21, Paris, 2022.

<sup>15</sup> G.E. VAN HOOK, *Maritime Security Consortiums*, in S. JASPER (ed.), *Conflict and Cooperation in the Global Commons: A Comprehensive Approach for International Security*, George Town, 2012, 173 ff.; S. CROUSEY, G. SCUTARU, H. HALEM, L. PACHIU, *The Battle for the Black Sea! The Importance of Freedom of Navigation and Energy Stakes*, New Strategy Centre, 2023, available online.

<sup>16</sup> C. WIRTH, *Ocean Governance, Maritime Security and the Consequences of Modernity in Northeast Asia*, cit.; B. GERMOND, *The Geopolitical Dimension of Maritime Security*, in *Marine Policy*, 2015, 137 ff.

<sup>17</sup> L. RÜTTINGER, *Climate and Fragility Risks: The Global Perspective*, Climate Diplomacy, Berlin, 2017, available online.

systems. Although definitions vary significantly across the literature, fragility is generally understood as a condition in which institutions lack the authority, legitimacy, resilience, or capacity necessary to govern effectively and respond to social, political, economic, environmental, or security-related pressures<sup>18</sup>. Contemporary approaches increasingly emphasize that fragility should not be interpreted exclusively as institutional collapse or armed conflict, but rather as a multidimensional condition emerging from the interaction between governance deficits, social exclusion, economic vulnerability, environmental stress, and insecurity<sup>19</sup>.

Within this debate, the framework developed by the Organisation for Economic Co-operation and Development (OECD) has played a particularly influential role in conceptualizing fragility through a multidimensional and systemic perspective. The OECD *States of Fragility* reports conceptualize fragility across interconnected political, societal, economic, environmental, and security dimensions, stressing the importance of resilience and institutional capacity in preventing systemic breakdowns<sup>20</sup>. Broader policy-oriented approaches have similarly linked fragility to development challenges, donor engagement, and state-building processes<sup>21</sup>. Fragility is therefore understood not as the consequence of a single factor, but as the outcome of interacting vulnerabilities operating simultaneously across multiple domains.

At the same time, several scholars have criticized the concept of State Fragility for its political instrumentalization and conceptual

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<sup>18</sup> U. HANNAN, H. BESADA, *Dimensions of State Fragility: A Review of the Social Science Literature*, Waterloo, 2007, available online; F. STEWART, G. BROWN, *Fragile States*, CRISE Working Paper n. 51, Oxford, 2009, available online; O. NAY, *Fragile and Failed States: Critical Perspectives on Conceptual Hybrids*, in *International Political Science Review*, 2013, 326 ff.; S. GRIMM et al., *Fragile States: Introducing a Political Concept*, in *Third World Quarterly*, XXXV, 2, 2014, 197 ff.; OECD, *States of Fragility 2025*, OECD Publishing, Paris, 2025, available online.

<sup>19</sup> O. AGBORSANGAYA-FITEU, *Governance, Fragility, and Conflict*, Report of the Social Development and Urban Development Families of the World Bank, Washington (DC), 2009; S. AÏTA, *Fragile States in the Middle East and North Africa*, Paris, 2018, available online.

<sup>20</sup> OECD, *States of Fragility 2025*, cit.

<sup>21</sup> D. CAMMACK, A. MCLEOD, A. R. MENOCAL, K. CHRISTIANSEN, *Donors and the “Fragile States” Agenda: A Survey of Current Thinking and Practice*, Report for the Japan International Cooperation Agency, London, 2006, available online; D. ANTEN et al., *The Political Economy of State-Building in Situations of Fragility and Conflict: From Analysis to Strategy*, A synthesis paper based on studies of Afghanistan, Democratic Republic of Congo, Guatemala, Kosovo and Pakistan, Clingendael Institute, 2012, available online. A. HOFFFLER, P. JUSTINO, *Aid and Fragile States*, in R.M. DESAI, S. DEVARAJAN, J.L. TOBIN (eds), *Handbook of Aid and Development*, Cheltenham, 2024, 225 ff.

ambiguity<sup>22</sup>. Rather than reproducing rigid classifications of “fragile” or “failed” States, this paper adopts the analytical logic underpinning multidimensional fragility frameworks and adapts it to the maritime domain. The objective is not to replicate State Fragility indexes mechanically, but rather to adapt their systemic and multidimensional logic to the specific characteristics of maritime governance systems<sup>23</sup>. Unlike States, maritime regions are not defined by a single sovereign authority, fixed territorial boundaries, or clearly delineated governance structures. Instead, they are characterized by overlapping jurisdictions, interconnected coastal and maritime spaces, transnational flows of people, goods, energy, and information, as well as the coexistence of public, private, and international actors<sup>24</sup>. Moreover, maritime systems are shaped by factors that have no direct equivalent in traditional State Fragility frameworks, including the strategic relevance of maritime chokepoints, the vulnerability of critical maritime infrastructure and subsea assets, dependence on sea lines of communication, competition over marine resources, and the governance challenges arising from shared or contested maritime spaces<sup>25</sup>. Consequently, the proposed concept of Sea Fragility seeks to reinterpret the analytical foundations of fragility in a way that captures the unique vulnerabilities, interdependencies, and governance dynamics that characterize “Marine Regional Systems” (MRS). These systems may differ substantially in their geographical configuration and functional role within the global maritime system. Some are predominantly semi-enclosed regional seas characterized by dense interactions among coastal states, while others function primarily as strategic connectors linking major maritime basins or as large open-ocean systems shaped by global circulation and connectivity dynamics. Such diversity reinforces the need for a framework capable of assessing fragility

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<sup>22</sup> O. NAY, *Fragile and Failed States: Critical Perspectives on Conceptual Hybrids*, in *International Political Science Review*, 2013, 326 ff.; A. ANAM, *Security-Development Nexus and the Discourse of Fragile States*, in *Jurnal Hubungan Internasional*, 1, 2013, 18 ff., available online; S. GRIMM et al., *Fragile States: Introducing a Political Concept*, in *Third World Quarterly*, 2, 2014, 197 ff.; KRAUSE, *Framing (State) Fragility: The Construction of Imaginary Global Spaces*, in *Third World Quarterly*, 2024, 128 ff, available online.

<sup>23</sup> G. ASYLBEKKYZY et al., *Why Do We Still Measure State Fragility?*, UNU-MERIT Working Papers, 2023, available online.

<sup>24</sup> C. WIRTH, *Ocean Governance, Maritime Security and the Consequences of Modernity in Northeast Asia*, cit.; B. GERMOND, *The Geopolitical Dimension of Maritime Security*, cit.

<sup>25</sup> G. LOU, *Application of Interim Measures by the International Tribunal for the Law of the Sea*, cit.; V. LYMPEROPOULOS, *Regional Maritime Security Limitations under UNCLOS*, cit.; A. RYNN, B. P. NICKELS, *Enhancing Security in the Red Sea*, 2024, available online.

across different types of maritime systems while preserving analytical comparability.

Recent studies on maritime geopolitics have increasingly highlighted how geographically distant maritime regions may nevertheless form interconnected strategic spaces, linked through energy flows, maritime trade routes, critical infrastructures, environmental processes, and security dynamics. Such interdependencies suggest that vulnerabilities emerging in one maritime region can generate cascading effects across broader maritime systems, reinforcing the need for analytical frameworks capable of capturing fragility beyond the boundaries of individual seas or coastal jurisdictions. This perspective is particularly relevant when considering the growing strategic connections between the Mediterranean, the Gulf, the Red Sea, the Arctic, and the Indo-Pacific, which increasingly operate as components of wider maritime systems rather than isolated geopolitical theatres<sup>26</sup>.

Accordingly, Sea Fragility should not be understood as the maritime equivalent of State Fragility. Rather, it represents the adaptation of a multidimensional fragility perspective to maritime systems, where vulnerability emerges from the interaction between environmental, geopolitical, economic, legal, and governance-related pressures operating across interconnected maritime spaces<sup>27</sup>.

1.3 The conceptualization of *Sea Fragility* proposed in this paper builds upon both the literature on State Fragility and the growing body of scholarship addressing maritime insecurity, ocean governance, geopolitical instability, and environmental vulnerability<sup>28</sup>. Existing literature does not provide a single unified definition of maritime fragility; rather, it conceptualizes fragility through multiple interconnected dimensions that collectively contribute to the vulnerability of maritime systems.

Several studies emphasize the relationship between fragility and

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<sup>26</sup> A. PIGOLI, G. DI CAPUA, *Climate Change and Energy Security in the Arctic and the Mediterranean*, in *Arctic Connections. Arctic and Mediterranean: New Assets for Energy Security and Strategic Balances. The Italian and Norwegian Perspectives*, Quaderno n. 28 de “La Comunità Internazionale”, 2024, 13.

<sup>27</sup> L. RÜTTINGER, *Climate and Fragility Risks: The Global Perspective*, cit.; A. ØSTHANGEN, G. DORDONI, *Security and Defence in the Mediterranean and in the Arctic*, Quaderno n. 28 de “La Comunità Internazionale”, 2024; OECD, *States of Fragility 2025*, cit.

<sup>28</sup> C. WIRTH, *Ocean Governance, Maritime Security and the Consequences of Modernity in Northeast Asia*, cit.; B. GERMOND, *The Geopolitical Dimension of Maritime Security*, cit.; OECD, *States of Fragility 2025*, cit.

weak governance structures. Indeed, maritime fragility is frequently associated with institutional weakness, limited governance capacity, corruption, and ineffective law enforcement, particularly in maritime regions characterized by fragile coastal States and weak regional cooperation mechanisms<sup>29</sup>. Studies of the Gulf of Guinea further demonstrate how governance deficits, weak enforcement mechanisms, and limited institutional coordination contribute directly to maritime insecurity and maritime criminality<sup>30</sup>. Similarly, authors focusing on State Fragility identify fragility as the weakening of authority, legitimacy, and service provision capacity<sup>31</sup>. Such governance-centered approaches highlight how maritime insecurity often emerges from deficiencies originating on land and subsequently extending into the maritime domain.

Other contributions conceptualize fragility through geopolitical and strategic instability. Maritime spaces become fragile when geopolitical competition, contested maritime routes, militarization, and dependence on external actors undermine regional stability and cooperative governance<sup>32</sup>. In this perspective, fragility is linked not only to the presence of conflict, but also to the securitization of maritime spaces and the inability to maintain the sea as a cooperative and regulated domain.

Studies focusing on the Mediterranean, Indo-Pacific, Arctic, Black Sea, and Red Sea regions particularly underline how strategic

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<sup>29</sup> D. CAMMACK, A. MCLEOD, A. R. MENOCAL, K. CHRISTIANSEN, *Donors and the "Fragile States" Agenda: A Survey of Current Thinking and Practice*, cit.; J. CORTE-REAL, *Maritime Security in the Gulf of Guinea: Threats and Challenges*, in *Negócios Estrangeiros*, 2022, 61 ff.; H. AUFFRET, A. WALSH, *Context and Stakeholder Analysis of Maritime Security and Justice in the Gulf of Guinea*, DCAF, 2023, available online.

<sup>30</sup> CHATHAM HOUSE, *Maritime Security in the Gulf of Guinea*, Chatam House (TheRoyal Institute of international Affairs), London, 2013, available online; E. LOPEZ-LUCIA, *Fragility, Violence and Criminality in the Gulf of Guinea*, in GSDRC, Birmingham, 2015, available online; G.N. GASU, *Maritime Security and Defense in the Gulf of Guinea: Issues, Challenges and Prospects*, in *Cavendish University Law Journal*, 2023, 1 ff., available online.

<sup>31</sup> F. STEWART, G. BROWN, *Fragile States*, cit.; O. NAY, *Fragile and Failed States: Critical Perspectives on Conceptual Hybrids*, cit.; G. ASYLBEKKYZY et al., *Why Do We Still Measure State Fragility*, cit.; K. KRAUSE, *Framing (State) Fragility: The Construction of Imaginary Global Spaces*, cit.

<sup>32</sup> C. WIRTH, *Ocean Governance, Maritime Security and the Consequences of Modernity in Northeast Asia*, cit.; B. GERMOND, *The Geopolitical Dimension of Maritime Security*, cit.; S. AÏTA, *Fragile States in the Middle East and North Africa*, cit.; D. CANNON, A. ROSSITER, *The "Indo-Pacific": Regional Dynamics in the 21st Century's New Geopolitical Center of Gravity*, in *Raising Powers Quarterly*, 2, 2018, 1ff., available online; J. SAMAAN, *Securing European Interests from the Mediterranean to the Persian Gulf*, cit.

chokepoints, competition for marine resources, and rival geopolitical agendas contribute to systemic maritime vulnerability<sup>33</sup>.

A third strand of literature highlights the environmental and climatic dimensions of fragility. Climate change, environmental degradation, water insecurity, unsustainable extraction of marine resources, and ecological stress are increasingly understood as “fragility multipliers” capable of intensifying pre-existing political, economic, and security vulnerabilities<sup>34</sup>. More broadly, research has increasingly portrayed climate change as a threat multiplier capable of amplifying governance deficits, resource competition, and security challenges in fragile maritime regions<sup>35</sup>. Within maritime regions, ecological pressures directly affect human security, economic sustainability, migration dynamics, and geopolitical competition, thereby reinforcing broader governance fragilities.

Additional scholarship stresses the transnational and multi-dimensional nature of maritime fragility. Human trafficking, irregular migration, piracy, illicit trafficking, forced labor at sea, and legal fragmentation reveal the limits of existing governance systems and international legal frameworks<sup>36</sup>.

Legal scholars have additionally highlighted the growing complexity of maritime governance under United Nations Convention on the Law of the Sea (UNCLOS), including disputes over

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<sup>33</sup> I.O. LESSER, *Global Trends, Regional Consequences: Wider Strategic Influences on the Black Sea*, ICBSS Publications, 4, 2007, available online; P. VOLTEN, B. TASHEV, *Establishing Security and Stability in the Wider Black Sea Area*, cit.; C. MARKETOS, *Hellenic Countries' Role in the New Eastern Mediterranean–Persian Gulf Geostrategic “Great Game” and Region-Building*, Institute of Energy for SE Europe (IENE), 2022, available online; A. VIDAL RIBE, *Securing the Seas: A Comparative Analysis of Emirati and Saudi Foreign Policies in the Red Sea*, cit.; S. CROUSEY, G. SCUTARU, H. HALEM, L. PACHIU, *The Battle for the Black Sea! The Importance of Freedom of Navigation and Energy Stakes*, cit.

<sup>34</sup> J. JOKELA (ed.), *Arctic Security Matters*, cit.; C. E. WERRELL, F. FEMIA, T. STERNBERG, *Did We See It Coming? State Fragility, Climate Vulnerability, and the Uprisings in Syria and Egypt*, in *SAIS Review of International Affairs*, 2015, 29 ff.; L. RÜTTINGER, *Climate and Fragility Risks: The Global Perspective*, cit. E. CASINI, F. DEIANA, *L'Artico e il Mediterraneo: convergenze strategiche di due mari in tempesta*, MedOr, 2023, available online.

<sup>35</sup> C. E. WERRELL, F. FEMIA, T. STERNBERG, *Did We See It Coming? State Fragility, Climate Vulnerability, and the Uprisings in Syria and Egypt*, cit.; L. RÜTTINGER, *Climate and Fragility Risks: The Global Perspective*, cit.; A.N. BENI, N. MARRINER, A. SHARIFI, J. AZIZPOUR, K. KABIRI, M. DJAMALI, A. KIRMAN, *Climate Change: A Driver of Future Conflicts in the Persian Gulf Region?*, in *Helyon*, 2, 2021, available online.

<sup>36</sup> G. DALAKLIS, F. SEKER, *Maritime Security Challenges: Human Trafficking and Migrant Smuggling at Sea Contemporary*, cit.; V. LYMPEROPOULOS, *Regional Maritime Security Limitations under UNCLOS*, cit.; R. STRATING et al., *Human Rights at Sea: The Limits of Inter-State Cooperation in Addressing Forced Labour on Fishing Vessels*, in *Marine Policy*, 2024.

jurisdiction, provisional measures, maritime boundary controversies, and persistent limitations in maritime law enforcement across regional context<sup>37</sup>. In these cases, fragility emerges from the interaction between transnational risks and insufficient institutional coordination across governance levels.

Taken together, these perspectives suggest that maritime fragility cannot be reduced to a single security threat or governance deficit. Instead, it should be understood as a multidimensional condition generated by the interaction of geopolitical, security and military, environmental, institutional, economic, legal, and societal vulnerabilities operating simultaneously within maritime spaces<sup>38</sup>. While the literature offers diverse interpretations of the concept, a common pattern emerges across these approaches: maritime fragility is consistently associated with the convergence of exposure to trans-boundary pressures and insufficient governance capacity to manage them effectively. Building on these insights, this paper conceives the maritime system as an integrated set of physical spaces, actors, infrastructures, governance mechanisms, and strategic functions whose interdependencies both generate and amplify conditions of fragility<sup>39</sup>. It encompasses maritime and coastal spaces, ports, shipping routes, seabed resources, offshore infrastructures, communication cables, and marine ecosystems, together with the institutional and non-institutional actors operating within them, including coastal States, regional organizations, private stakeholders, shipping industries, and multilevel governance arrangements.

As suggested by the preceding analysis, maritime fragility cannot be adequately understood through the condition of individual coastal States alone. To address this limitation, this paper adopts the concept of a “Marine Regional System” (MRS) introduced above. The concept captures the fact that maritime vulnerabilities rarely originate within a single jurisdiction, but they emerge from interactions among multiple coastal States, transnational networks, critical infrastructures, environ-

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<sup>37</sup> J. LOU, *Application of Interim Measures by the International Tribunal for the Law of the Sea*, in *International Journal of Criminal Justice Sciences*, 2, 2023, 57 ff., available online; V. LYMPEROPOULOS, *Regional Maritime Security Limitations under UNCLOS*, cit.

<sup>38</sup> B. GERMOND, *The Geopolitical Dimension of Maritime Security*, cit.; L. RÜTTINGER, *Climate and Fragility Risks: The Global Perspective*, cit.; OECD, *States of Fragility 2025*, cit.

<sup>39</sup> C. WIRTH, *Ocean Governance, Maritime Security and the Consequences of Modernity in Northeast Asia*, cit.; A. ØSTHAGEN, G. DORDONI, *Security and Defence in the Mediterranean and in the Arctic*, cit.

mental systems, and governance arrangements operating within a shared maritime space. Unlike the narrower notion of a maritime region, a MRS emphasizes functional interdependence, overlapping jurisdictions, transnational linkages, fragmented governance structures, and systemic interactions that transcend political and geographical boundaries<sup>40</sup>. This perspective enables maritime spaces to be analysed as interconnected regional systems whose vulnerabilities are shaped not only by the capacities of individual States but also by the dynamics that connect them. It is particularly relevant in regions such as the Red Sea, where fragility arises from the interplay of geopolitical instability, infrastructural dependency, environmental degradation, migration dynamics, and fragmented regional governance<sup>41</sup>, issues that are examined in greater depth in Chapter 3.

In this sense, the MRS constitutes the primary unit of analysis of Sea Fragility, in the same way that the State constitutes the primary unit of analysis in traditional fragility frameworks.

For the purpose of this paper, *Sea Fragility* may therefore be defined as “the condition in which the cumulative exposure of a MRS to environmental, economic, geopolitical, legal, or security-related pressures and risk areas exceeds the collective capacity of institutions, infrastructures, and relevant actors to govern, manage, absorb, and adapt to such pressures, thereby generating systemic vulnerabilities that compromise the security, connectivity, sustainability, and effective governance of the maritime domain”.

Such a definition shifts the analytical focus from isolated maritime threats to the structural vulnerability of interconnected maritime systems, integrating governance fragility, geopolitical instability, environmental stress, infrastructural dependence, and transnational insecurity within a single multidimensional analytical framework.

1.4. Building upon the multidimensional understanding of fragility discussed above, the proposed definition of Sea Fragility rests upon three interconnected analytical pillars: exposure, governance

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<sup>40</sup> G.E VAN HOOK, *Maritime Security Consortiums*, cit.

<sup>41</sup> A. VIDAL RIBE, *Securing the Seas: A Comparative Analysis of Emirati and Saudi Foreign Policies in the Red Sea*, cit.; A. RYNN, B. P. NICKELS, *Enhancing Security in the Red Sea*, cit.

capacity, and resilience<sup>42</sup>. Together, these dimensions capture the relationship between the pressures affecting a maritime system and its ability to respond effectively.

First, exposure refers to the degree to which maritime systems are subjected to disruptive pressures and cumulative risks. These may include geopolitical competition, territorial disputes, climate-related shocks, environmental degradation, migration crises, disruptions to commercial and energy flows, transnational organized crime, and illegal maritime activities<sup>43</sup>. In this regard, climate change can be understood as a particularly significant “fragility multiplier”, as it interacts with and intensifies pre-existing social, economic, political, and governance vulnerabilities, thereby increasing the overall susceptibility of maritime systems to instability<sup>44</sup>. Similarly, studies on migration and maritime trafficking underline how instability ashore frequently translates into maritime insecurity and governance pressures at sea<sup>45</sup>.

Second, governance capacity concerns the ability of institutions and maritime actors to coordinate, regulate, monitor, and enforce governance effectively across multiple scales. This includes surveillance systems, legal enforcement, regional cooperation mechanisms, maritime domain awareness, and public-private coordination<sup>46</sup>.

Third, resilience refers to the ability of maritime systems as a whole to absorb shocks, adapt to prolonged instability, recover from disruption, and maintain functional continuity over time. Whereas governance capacity concerns the ability of institutions and actors to coordinate and respond to risks, resilience concerns the broader

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<sup>42</sup> U. HANNAN, H. BESADA, *Dimensions of State Fragility: A Review of the Social Science Literature*, cit.; OECD, *States of Fragility 2025*, cit.

<sup>43</sup> C. MARKETOS, *Hellenic Countries' Role in the New Eastern Mediterranean–Persian Gulf Geostrategic “Great Game” and Region-Building*, cit.; *Regional Perspectives Report on the Indo-Pacific*, NATO, 2022, available online; A. VIDAL RIBE, *Securing the Seas: A Comparative Analysis of Emirati and Saudi Foreign Policies in the Red Sea*, cit.; G. DAGA, P. P. RAIMONDI (eds.), *Mediterranean Transitions from the Gulf to the Sahel: The Role of Italy and the EU*, cit.

<sup>44</sup> C. E. WERRELL, F. FEMIA, T. STERNBERG, *Did We See It Coming? State Fragility, Climate Vulnerability, and the Uprisings in Syria and Egypt*, cit.; L. RÜTTINGER, *Climate and Fragility Risks: The Global Perspective*, Adelphi, Berlin, cit.

<sup>45</sup> P. KRISHNAKUMAR, T. INDUMATHI, *Pull and Push Factors of Migration*, in *Global Management Review*, 4, 2014, 8 ff.; D. DALAKLIS, B.S. SEKER, *Maritime Security Challenges: Human Trafficking and Migrant Smuggling at Sea Contemporary*, cit.

<sup>46</sup> G.E. VAN HOOK, *Maritime Security Consortiums*, cit.; O. AGBORSANGAYA-FITEU, *Governance, Fragility, and Conflict*, cit.; V. LYMPEROPOULOS, *Regional Maritime Security Limitations under UNCLOS*, cit.

capacity of the marine-regional system to continue functioning despite such risks<sup>47</sup>. Fragility therefore emerges not from the mere presence of risks, but when exposure to such risks systematically exceeds the collective capacity for governance, adaptation, and recovery<sup>48</sup>.

1.5. Despite its analytical usefulness, the concept of Sea Fragility cannot be considered fully comparable to traditional notions of State Fragility. Unlike States, maritime regions do not possess unified sovereignty, stable territorial boundaries, centralized governance structures, or homogeneous institutional arrangements<sup>49</sup>. Maritime domains are instead characterized by overlapping jurisdictions, hybrid public-private governance systems, transnational interdependencies, and the coexistence of State and non-State actors operating across variable geographical scales<sup>50</sup>.

Moreover, the very notion of “maritime region” remains politically and geographically contested, lacking a universally accepted legal or analytical definition<sup>51</sup>. This fluidity complicates attempts to establish rigid classifications or universal indicators comparable to existing State Fragility indexes. For this reason, the concept proposed in this paper does not seek to create a rigid codification similar to the OECD fragility framework<sup>52</sup>. Rather, it aims to provide a flexible analytical category capable of interpreting contemporary maritime vulnerabilities and governance deficits. The core conceptual innovation therefore lies not in claiming that the sea is inherently insecure, but in recognizing that certain maritime systems become structurally fragile when exposure to risks exceeds their collective capacity for governance, adaptation, and resilience. Sea Fragility is therefore conceived as a condition of systemic imbalance between pressures and response capacities, rather than as a simple

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<sup>47</sup> U. HANNAN, H. BESADA, *Dimensions of State Fragility: A Review of the Social Science Literature*, cit.; F. STEWART, G. BROWN, *Fragile States*, cit.; OECD, *States of Fragility 2025*, cit.

<sup>48</sup> L. RÜTTINGER, *Climate and Fragility Risks: The Global Perspective*, cit.; OECD, *States of Fragility 2025*, cit.

<sup>49</sup> O. NAY, *Fragile and Failed States: Critical Perspectives on Conceptual Hybrids*, cit.; S. GRIMM et al., *Fragile States: Introducing a Political Concept*, cit.

<sup>50</sup> C. WIRTH, *Ocean Governance, Maritime Security and the Consequences of Modernity in Northeast Asia*, cit.; B. GERMOND, *The Geopolitical Dimension of Maritime Security*, cit.

<sup>51</sup> D. RUSU, *Regionalisation in the Black Sea Region*, cit.; B. GERMOND, *The Geopolitical Dimension of Maritime Security*, cit.

<sup>52</sup> G. ASYLBEKYZY et al., *Why Do We Still Measure State Fragility?*, cit.; OECD, *States of Fragility 2025*, cit.

accumulation of maritime threats or security challenges. The challenge therefore becomes identifying which dimensions, indicators, and governance variables are most relevant for assessing such imbalances across different marine-regional systems. The following section builds on the conceptualization developed above to propose a Sea Fragility Framework (SFF), providing a structured approach for identifying, assessing, and comparing fragility across maritime regions.

2. In order to comprehensively map existing notions and frameworks of Sea Fragility, a systematic literature review was conducted, following the PRISMA 2020 statement<sup>53</sup> for new systematic reviews of databases and registers, with the flow diagram reproduced in Figure 1. Records were screened from publicly available sources and digital libraries, including academic databases (e.g., Scopus, Web of Science, Google Scholar, JSTOR, HeinOnline) and institutional/grey-literature repositories (e.g., IRIS university repositories, OECD iLibrary, World Bank Open Knowledge Repository, SIPRI, Stable Seas). The search was conducted in both English and Italian, reflecting the bilingual composition of the Mari Fragili corpus and the Italian institutional and Mediterranean policy literature it draws on.

Records were retrieved using the keyword set indicated in the table below, combining a fragility cluster (state fragility, failed/weak states, fragility index, composite indicator, resilience) with a maritime governance cluster (maritime security, ocean/maritime governance, good order at sea, UNCLOS, IUU fishing, blue economy, maritime domain awareness), joined by Boolean operators across title, abstract, and keyword fields.

Table 1. Cluster and screening themes for the literature review

| Cluster                         | Themes screened                                                                                                                                                                                                    |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Maritime Security and Fragility | <ul style="list-style-type: none"> <li>• Maritime security in fragile states;</li> <li>• Impact of maritime fragility on global trade;</li> <li>• Defining maritime fragility: concepts and frameworks.</li> </ul> |
| Geopolitical Dynamics           | <ul style="list-style-type: none"> <li>• Geopolitical significance of the Mediterranean region;</li> <li>• Maritime conflicts in the Indo-Pacific;</li> </ul>                                                      |

<sup>53</sup> M. J. PAGE et al., *The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews*, BMJ, 71, 2021, available online.

|                                         |                                                                                                                                                                                                                                       |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                         | <ul style="list-style-type: none"> <li>• Energy security in the Mediterranean and beyond.</li> </ul>                                                                                                                                  |
| Transnational Research                  | <ul style="list-style-type: none"> <li>• Cross-regional maritime security frameworks;</li> <li>• Mediterranean-Arctic security connections;</li> <li>• Comparative studies on maritime governance.</li> </ul>                         |
| Environmental Impact and Climate Change | <ul style="list-style-type: none"> <li>• Climate change effects on maritime environments;</li> <li>• Sustainable fishing and marine biodiversity;</li> <li>• Underwater infrastructure and environmental security.</li> </ul>         |
| Technological Aspects                   | <ul style="list-style-type: none"> <li>• Submarine cable security and geopolitical implications;</li> <li>• Impact of technology on maritime governance;</li> <li>• Cybersecurity in maritime operations.</li> </ul>                  |
| Case Studies and Regional Analyses      | <ul style="list-style-type: none"> <li>• Case studies of maritime conflicts in the Red Sea;</li> <li>• Energy geopolitics in the Caspian Sea;</li> <li>• Straits and chokepoints in maritime security.</li> </ul>                     |
| Policy Recommendations and Frameworks   | <ul style="list-style-type: none"> <li>• Policy frameworks for maritime security cooperation;</li> <li>• Governance models for fragile maritime states;</li> <li>• Best practices for regional maritime collaboration.</li> </ul>     |
| Historical Context                      | <ul style="list-style-type: none"> <li>• Historical maritime trade routes and conflicts;</li> <li>• Evolution of maritime security policies in the Mediterranean;</li> <li>• Maritime governance through history.</li> </ul>          |
| International Law and Treaties          | <ul style="list-style-type: none"> <li>• Maritime law and fragile states;</li> <li>• Impact of international treaties on maritime security;</li> <li>• Legal frameworks governing underwater resources.</li> </ul>                    |
| Institutional Reports and Publications  | <ul style="list-style-type: none"> <li>• Reports from organizations like the OECD, NATO, and the UN on maritime security;</li> <li>• Publications from think tanks focused on international relations and maritime issues.</li> </ul> |

Inclusion required substantive engagement with either the conceptualisation and measurement of fragility or maritime governance frameworks. Exclusion criteria were applied at title, abstract and full-text stages (see Figure 1). Included records were de-

duplicated, and reasons for exclusion at full text were logged.

Out of the 1,180 records identified, a total of 46 studies were included in the literature review and informed the work documented in the following chapters.

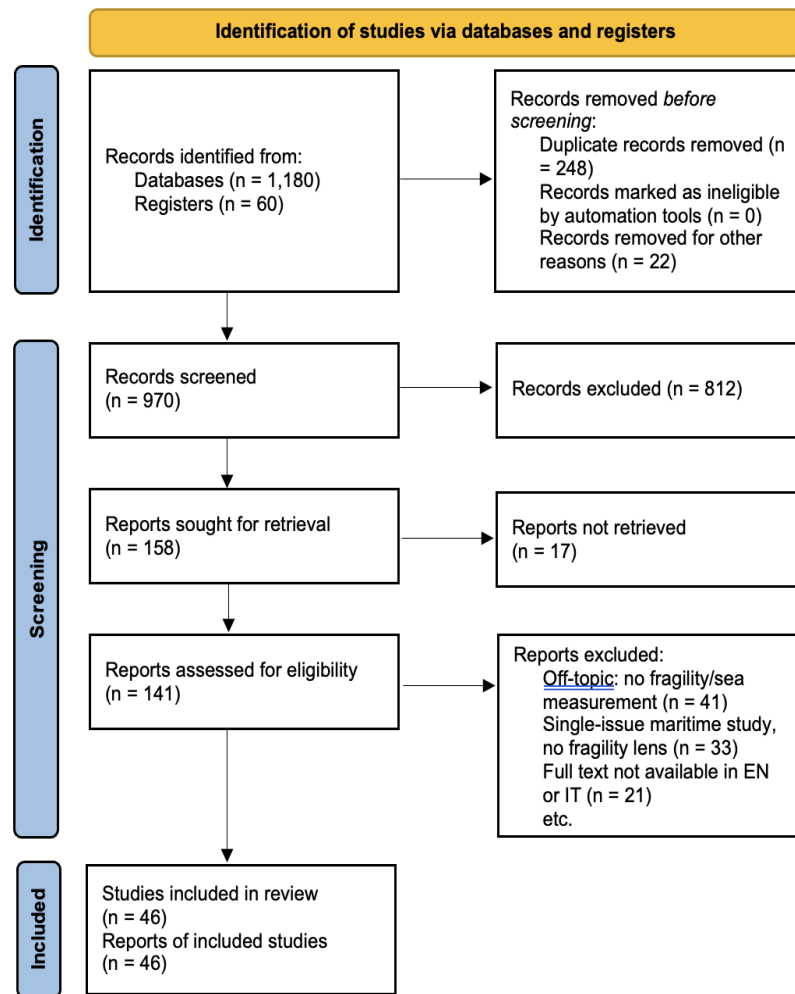


Figure 1. PRISMA 2020 flow diagram, adapted from Page, 2021<sup>54</sup>

2.1. The corpus surfaces two largely separate methodological traditions that the Sea Fragility Framework brings into contact: (i) state-fragility measurement (composite indices and index-evaluation

<sup>54</sup> M. J. PAGE et al., *The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews*, cit.

frameworks) and (ii) maritime security or ocean governance (legal, policy, and analytical frameworks).

A structured synthesis (Table 2) records, for each framework: domain focus, author/organization, and the parameters/dimensions it operationalizes. Frameworks were extracted from the included studies, coded by domain and by constituent parameters, and tabulated; where a framework defined explicit dimensions or indicators (e.g., FSI's 12 indicators, OECD's 44), these were recorded verbatim, and conceptual frameworks without an operational index (e.g., the "fragility syndrome") were coded by their proposed mechanisms.

| Framework                   | Domain focus                      | Author / Organisation                       | Included parameters / dimensions                                                                                                                                                                                                                                                                                            |
|-----------------------------|-----------------------------------|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fragile States Index (FSI)  | State fragility (composite index) | Fund for Peace                              | 4 categories × 3 indicators (12 total): cohesion (security apparatus, factionalised elites, group grievance); economy (decline, uneven development, human flight); polity (state legitimacy, public services, human rights/rule of law); society (demographic pressure, refugees/IDPs, external intervention); scored 0–120 |
| State Fragility Index (SFI) | State fragility (composite index) | Center for Systemic Peace (Marshall et al.) | 4 dimensions (security, political, economic, social), each scored on                                                                                                                                                                                                                                                        |

|                                              |                               |                                                           |                                                                                                                                             |
|----------------------------------------------|-------------------------------|-----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
|                                              |                               |                                                           | effectiveness and legitimacy; summed 0–25                                                                                                   |
| Fragile & Conflict-affected Situations (FCS) | Operational classification    | World Bank                                                | CPIA institutional/social score thresholds; presence of UN peacekeeping; large refugee flows; conflict-death thresholds                     |
| States of Fragility framework                | Multidimensional fragility    | OECD                                                      | 5 dimensions — economic, environmental, political, security, societal — across 44 indicators; PCA-derived weights; risk–resilience framing  |
| “Fragility syndrome”                         | Conceptual model of fragility | LSE-Oxford Commission on State Fragility                  | 5 interlocking mechanisms: contested legitimacy → weak taxation/services → security breakdown → narrow private sector → shock vulnerability |
| Framework-approach for index evaluation      | Meta-evaluation of indices    | Gisselquist (2014); applied in Asylbek kyzy et al. (2023) | Criteria for assessing concept–measurement fit, indicator sourcing, double-counting, time lag, signal vs. noise                             |

|                                                |                                |                                       |                                                                                                                        |
|------------------------------------------------|--------------------------------|---------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| UNCLOS (1982)                                  | Maritime legal order           | United Nations                        | Maritime zones and jurisdiction (territorial sea, EEZ, high seas), navigational rights, dispute-settlement mechanisms  |
| Maritime security matrix / “good order at sea” | Analytical maritime governance | Bueger & Edmunds                      | 4 interlinked dimensions: national security, marine environment, economic development, human security (“blue justice”) |
| EU Maritime Security Strategy (EUMSS)          | Regional policy framework      | European Union (2014; 2023 update)    | Maritime domain awareness, capacity-building, threat response, multilateral cooperation                                |
| Yaoundé Architecture                           | Regional cooperation framework | ECCAS / ECOWAS / GGC (Gulf of Guinea) | Information-sharing centres, zonal coordination, joint patrols, prosecution of maritime crime                          |
| Maritime Security Index                        | Composite maritime index       | Stable Seas (NGO)                     | Issue-area scoring across e.g. piracy, IUU fishing, trafficking, blue economy, rule of law at sea                      |

Several elements emerge as directly applicable to building a novel SFF. The multidimensional logic of fragility indices, spanning from cohesion to economy, polity, and society, maps well onto maritime governance, where dysfunction and fragility are equally

cross-thematic and cross-domain. OECD’s inclusion of an environmental dimension importantly stands out, as it complements more traditional notions of fragility and stability within State-focused scholarship. On the structure, Till’s “good order at sea” matrix already supplies a four-dimensional architecture that parallels fragility frameworks and is natively maritime. Existing frameworks further support the inclusion of both factual and institutional assessments within governance. For instance, within the framework of the Yaoundé Architecture (the maritime security framework established by West and Central African states in the Gulf of Guinea)<sup>55</sup>, fragility manifests as weak enforcement capacity, fragmented information-sharing, and limited prosecution, despite a formal cooperation framework.

Direct transfer and mapping of such frameworks onto Sea Fragility, however, posits several challenges. The quasi-unanimity of State-fragility indices is state-bounded and territorial. In contrast, sea fragility is inherently transboundary: it affects shared basins, the high seas, and mobile threats, creating a divergence in units of analysis. Further, maritime frameworks privilege states and national interest over individuals; the “human-rights blindness” of the law of the sea means human-security fragility is under-measured<sup>56</sup>. Last, maritime frameworks are largely threat-list or legal in form (UNCLOS<sup>57</sup>, EUMSS<sup>58</sup>) rather than quantified composite measures, hence describing risk without scoring fragility as a relationship between present and prospective risks versus resilience and absorptive capability<sup>59</sup>.

2.2. Albeit partially transferable to measure precursors of sea or state fragility, currently identified frameworks appear unfit and unequipped to measure sea fragility as composite, multi-dimensional frameworks. First, fragility appears to be ill- if not non-defined, as

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<sup>55</sup> H. YÜCEL, *Sovereignty and Transnational Cooperation in the Gulf of Guinea: How a Network Approach can Strengthen the Yaoundé Architecture*, *Scandinavian Journal of Military Studies*, 1, 2021, 146 ff.

<sup>56</sup> A. PETRIG, *Human Rights and Law Enforcement at Sea*, in B. Ryan and D. Guilfoyle (eds.), *Research Handbook on International Marine Environmental Law*, Routledge, London–New York, 2022, 12 ff.

<sup>57</sup> UNITED NATIONS, *United Nations Convention on the Law of the Sea (UNCLOS)*, Montego Bay, 1982.

<sup>58</sup> COUNCIL OF THE EUROPEAN UNION, *European Union Maritime Security Strategy (EUMSS)*, Brussels, 2014.

<sup>59</sup> G. TILL, *Seapower: A Guide for the Twenty-First Century*, IV ed., 2018, London.

measurement choices encode theoretical assumptions and fragility remains not operationalized as a full function<sup>60</sup>. Furthermore, the proliferation of stability or fragility indexes in adjacent fields leads to extremely volatile diagnostic spread, as indices such as FSI<sup>61</sup>, SFI<sup>62</sup>, FCS<sup>63</sup> and OECD<sup>64</sup> may agree on extreme cases (e.g., South Sudan or Somalia), but diverge substantially elsewhere due to different calibration on cut-off values, albeit measuring the same functions or values<sup>65</sup>. A related issue, drawn from Gisselquist's framework for index evaluation<sup>66</sup>, emerges as indices frequently cross-reference, possibly double-counting correlated indicators and producing noise in the measurement attempt that can lose complexity and proxies of the actual signal being measured.

Beyond these calibration and signal-detection problems, the identified frameworks remain conceptually thin precisely where a maritime reading of fragility would demand the greatest resolution. Human-security and equity dimensions are weakly represented, if at all: the dominant indices take the state as their unit of analysis and – mirroring the “human-rights blindness” diagnosed in the law of the sea<sup>67</sup> – subordinate the safety, livelihoods, and rights of individuals and coastal communities to aggregate metrics of state effectiveness and legitimacy. This shortcoming is particularly acute for Small Island Developing States (SIDS), whose fragility is overwhelmingly mediated by ocean dependence and climate exposure - variables that, with the partial exception of the OECD's environmental dimension, find no purchase in standard fragility instruments<sup>68</sup>.

A second, structural limitation is a legal-analytical mismatch in the maritime domain. UNCLOS and the regional architectures built upon it define obligations, jurisdictional zones, and cooperative duties, but they furnish no measurement instrument: they articulate what

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<sup>60</sup> G. ASYLBEKKYZY et al., *Why Do We Still Measure State Fragility?*, cit.

<sup>61</sup> FUND FOR PEACE, *Fragile States Index*, 2024.

<sup>62</sup> CENTER FOR SYSTEMIC PEACE, *State Fragility Index and Matrix*, 2023.

<sup>63</sup> *Classification of Fragile and Conflict-Affected Situations FY24*, WORLD BANK, 2023, available online.

<sup>64</sup> OECD, *States of Fragility 2022*, OECD Publishing, Paris, 2022, available online.

<sup>65</sup> R. M. GISSELQUIST, *Developing and Evaluating Governance Indexes: 10 Questions*, in *Policy Studies*, 5, 2014, available online, 513 ff.

<sup>66</sup> R. M. GISSELQUIST, *Developing and Evaluating Governance Indexes: 10 Questions*, cit.

<sup>67</sup> R. STRATING et al., *Human Rights at Sea: The Limits of Inter-State Cooperation in Addressing Forced Labour on Fishing Vessels*, cit.

<sup>68</sup> UNCTAD, *The Oceans Economy: Opportunities and Challenges for Small Island Developing States*, United Nations Publication, Geneva, 2014.

“good order at sea” ought to entail without supplying the means to score, weight, or rank its absence<sup>69</sup>. As normative and jurisdictional scaffolding, they can indicate where governance is contested or where claims overlap; yet, they cannot, on their own, quantify how fragile a given maritime space – or the governance arrangement covering it – actually is.

Taken together, these limitations point to a clear gap. There exists, at present, no integrated, quantifiable framework that treats sea fragility as a multidimensional property of maritime spaces and their governance, rather than as a by-product of littoral state fragility or a checklist of discrete maritime threats. It is this gap that the present study addresses, and that justifies the bespoke Sea Fragility methodology developed in the following section.

2.3 Building on the methodological approach presented above, the SFF was developed to assess the fragility of maritime regions. The methodology enabled the identification and selection of the indicators necessary to operationalize the concept of maritime fragility. Grounded on documented empirical evidence, the indicators collectively form the framework and provide the basis for a systematic and measurable assessment of maritime fragility. The Framework has been organized around seven domains – Economic, Environmental, Political, Military Security, Social/Institutional, Legal/Enforcement, and Technological – each capturing a distinct dimension through which fragility manifests in maritime regions. Within every domain, individual risk indicators have been paired with two analytical variables: exposure, which captures the degree to which a given maritime area is susceptible to those risks, and resilience, which reflects the capacity of states, institutions – both regional and global – to absorb, adapt to, and recover from crises. Moreover, since measurement scales vary across indicators according to the nature of the phenomenon being analysed, the scales were divided into continuous, categorical, and ordinal types to ensure the use of appropriate statistical methods and analyses for each indicator.

The SFF holds a key premise: maritime fragility is not a uniform condition. Fragility can be considered as a set of heterogeneous conditions whose repercussions vary considerably depending on the domain. In this sense, fragility has different structural determinants in

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<sup>69</sup> V. LYMPEROPOULOS, *Regional Maritime Security Limitations under UNCLOS*, cit.

each domain observed. This allows the Framework to analyse not only whether fragility is present in a given maritime region, but in which domains it is most severe, through which dynamics it becomes visible, and where governance intervention might act.

2.4 The SFF represents a key tool for Italian maritime policy. Italy's geographic position - with over 8,000 kilometers of coastline and a central location along the routes connecting the Indo-Pacific to the Atlantic region – makes the country one of the natural protagonists of global maritime governance. Under this lens, the SFF can contribute vastly to the Italian strategic role. Specifically, the SFF has been developed to support the triennial update of the *Piano del mare* 2026-2028<sup>70</sup>, assisting the development of country-specific strategic assessments for Italy's engagements, and providing the country with a structured basis for its governance framework.

Within this context, the Italian Navy (Marina Militare) represents a key stakeholder for the application of the SFF. The framework could serve as a valuable analytical tool, offering a comprehensive assessment of fragility across strategically relevant maritime regions. By systematically mapping the drivers and manifestations of fragility, the SFF would enhance strategic foresight, support operational planning, and contribute to a more informed allocation of resources in contexts characterized by uncertainty and evolving security challenges. In doing so, it could provide the Navy with a coherent understanding of the nature and dynamics of fragility in key maritime areas, effectively bridging academic analysis and operational practice.

2.5. The wider Mediterranean – understood as a system of interconnected basins stretching from the Arctic to the Indo-Pacific, encompassing the Black Sea, the Persian Gulf, the Red Sea, and the Gulf of Guinea – is not a single governance space but rather a layered architecture of overlapping regional frameworks, each with its own dynamics of fragility. The SFF is designed to function across these

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<sup>70</sup> Delibera del Comitato Interministeriale italiano per le Politiche del Mare (CIPOM) del 7 maggio 2026 sul Piano del Mare 2026-2028, in Gazzetta Ufficiale n. 149 del 30 giugno 2026 (Resolution of the Italian Interministerial Committee for Sea Policies (CIPOM) of 7 May 2026 on the 2026–2028 Sea Plan, published in the Official Gazette No. 149 of 30 June 2026).

regions and beyond, providing a common ground of analysis that allows for the comparison among different maritime basins worldwide while preserving their specificity. As a result, regional organizations, multilateral security arrangements, and bilateral cooperation frameworks can all be assessed through the SFF lens.

In this sense, the Red Sea stands out as the natural candidate for the framework's first full application. This basin represents an emblematic case as it concentrates a wide array of fragility dimensions: ongoing military conflict, critical chokepoints for global trade and energy security, environmental questions, contested legal jurisdictions, and the involvement of regional and extra-regional hegemonic actors. In this context, Italy emerges as an actor with strong strategic interests in the area, as demonstrated, among other initiatives, by its participation in Operation Aspides against the Yemeni armed political and military organization of the Houthis in the region.

Therefore, the Red Sea offers an ideal testing ground for the application of the SFF, as it combines local and transregional domains of fragility, showing the interaction between different areas of vulnerability and highlighting the interconnection among maritime basins. The application of this framework to the Red Sea allows for a comprehensive outlook of the vulnerability and resilience mechanisms of the region, providing insights that can support comparative analysis of other strategically significant maritime regions.

## CHAPTER 2

### THE SEA FRAGILITY FRAMEWORK

GIACOMO DI CAPUA, ALDO PIGOLI, CARMINE SOPRANO

SUMMARY: 2.1 Introduction to the Sea Fragility Framework. – 2.2 Marine Regional Systems. – 2.3 Architecture of the SFF. – 2.3.1 MRS sea 3fragility score. – 2.3.2 Domain fragility score. – 2.3.3 Exposure and resilience indicator and risk area scores. – 2.4 Selection of indicators. – 2.5 Data collection and proof of concept. – 2.6 Strengths, limitations and future developments.

2.1. As highlighted in Chapter 1, Sea Fragility – akin to state fragility – is framed in the literature as a multidimensional notion, requiring measurement and quantification of indicators across multiple domains. This posits a crucial challenge for practitioners seeking to leverage insights from basin-wide assessments of fragility to orient foreign policy decisions due to (a) the volume of data collection and analysis required to monitor fragility status and severity, (b) the complexity of methodological choices to quantify qualitative and abstract dimensions of vulnerability, and (c) the absence of recognised and validated fragility frameworks for water basins.

The SFF seeks to respond to the aforementioned challenges. First, by scoping state-of-the-art literature and open-source datasets, the framework provides discrete and quantified values for the underlying dimensions of sea fragility as currently understood by leading scholarship and policy organisations. Second, the SFF harmonises heterogeneous measures of fragility into cross-comparable indicators of resilience and exposure, streamlining the measurement and monitoring process for policy-makers. Indeed, a central objective of the SFF is to enable the comparative assessment of different maritime regions. Similar pressures may produce markedly different effects depending on the characteristics and response capacities of each maritime system. A common analytical framework is therefore required to assess these differences consistently and to compare maritime fragility across diverse regional contexts while preserving a shared methodological basis.

This chapter expounds the methodological apparatus underlying the SFF by illustrating the geographical scoping and choices behind

the SFF, version 1 (Section 2.2); the architecture of the Framework, including formulae to reduce qualitative multi-dimensional data into discrete values (Section 2.3); the criteria and process for indicators of exposure and resilience to fragility (Section 2.4); the methodological considerations behind the data collection and harmonization processes (Section 2.5); and the strengths, limitations, and future developments of the first version (Section 2.6).

2.2. A fundamental methodological challenge in the development of the SFF concerns the identification of the appropriate unit of analysis. Building upon the conceptual discussion presented in Chapter 1, the SFF, unlike existing fragility frameworks that almost exclusively assess sovereign states, focuses on maritime systems. The maritime domain is inherently transboundary: ecological processes, commercial routes, energy flows, maritime security, fisheries, critical infrastructures, and governance arrangements frequently extend beyond national jurisdictions and involve multiple public, private, and international actors. Consequently, maritime fragility cannot be adequately understood through state-centred approaches alone.

This study therefore adopts the concept of the Marine Regional System (MRS) as its primary unit of analysis. An MRS may be defined as a geographically identifiable maritime space characterised by relatively stable patterns of ecological interdependence, maritime connectivity, economic interaction, governance arrangements, and strategic relevance. Rather than representing simply a body of water, an MRS constitutes a functional maritime system in which environmental, political, economic, legal, technological and security dynamics interact and collectively shape the exposure and resilience of the region.

The adoption of MRS is fully consistent with the concept of Sea Fragility introduced in Chapter 1. As previously defined, Sea Fragility refers to the condition in which the cumulative exposure of a MRS to multiple environmental, economic, geopolitical, legal, technological, social, and security-related pressures exceeds the collective capacity of institutions, infrastructures, and relevant actors to govern, manage, absorb, and adapt to those pressures, thereby generating systemic vulnerabilities that compromise the security, connectivity, sustainability, and effective governance of the maritime domain.

Within this perspective, maritime fragility does not arise from a single source of vulnerability but from the interaction of multiple,

distinct risk areas affecting the functioning of the maritime system. This understanding is consistent with recent developments in maritime security studies, which increasingly recognise that many contemporary maritime challenges emerge and evolve at the regional level. Rather than being determined exclusively by the capabilities or vulnerabilities of individual coastal states, maritime outcomes are shaped by regional maritime complexes, interconnected security architectures, and transboundary governance mechanisms operating across shared maritime spaces.

As outlined in Chapter 1, the adoption of Marine Regional Systems as the units of analysis builds upon several complementary strands of academic and policy literature: marine scientists and ocean governance scholars have long emphasized the regional scale as the most appropriate level for understanding marine ecosystems and developing management strategies<sup>1</sup>. Moreover, international initiatives such as the United Nations Environment Programme (UNEP) Regional Seas Programme have further reinforced the importance of marine regions as meaningful units for environmental governance and policy coordination<sup>2</sup>.

MRS therefore provide the most appropriate analytical scale at which such risk areas can be identified, observed, and comparatively assessed.

The delimitation of MRS adopted in this study is primarily based on two internationally recognized sources: the International Hydrographic Organization (IHO) and the Marine Regions Database maintained by the Flanders Marine Institute (VLIZ). The IHO provides the most widely accepted geographical definitions of oceans, seas, gulfs, and related maritime spaces through its publication *Limits of Oceans and Seas* (S-23)<sup>3</sup>. The Marine Regions database complements this approach by providing standardized geospatial definitions and identifiers for marine areas used extensively in marine science, ocean governance, and spatial analysis<sup>4</sup>. Together, these sources constitute one of the most authoritative references currently

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<sup>1</sup> K. SHERMAN, A.M. DUDA, *Large Marine Ecosystems: An Emerging Paradigm for Fishery Sustainability*, in *Fisheries*, Vol. 24, No. 12, 1999.

<sup>2</sup> UNEP, *Regional Seas Strategic Directions 2017–2020*, Nairobi, 2016, available online.

<sup>3</sup> INTERNATIONAL HYDROGRAPHIC ORGANIZATION, *Limits of Oceans and Seas*, Special Publication No. 23 (S-23), 3rd ed., Monaco, 1953.

<sup>4</sup> FLANDERS MARINE INSTITUTE (VLIZ), *Marine Regions Database*, available online.

available for the identification and delimitation of maritime regions at the global level.

The global maritime system comprises a large number of MRS that could potentially be analysed through the SFF. The objective of this research, however, is not to assess every maritime region worldwide, but to develop a methodology capable of supporting comparative analysis across maritime systems characterised by different geographical, geopolitical and functional characteristics. Consequently, a reference sample of fifteen MRS was selected.

The selection was guided by three complementary criteria:

- First, each region had to constitute a geographically coherent maritime system recognised by international geographical classifications.
- Second, the selected regions had to display significant geopolitical, geoeconomic, environmental or maritime security relevance within the contemporary international system.
- Third, particular attention was devoted to the strategic interests of Italy and the European Union.

The selected MRS broadly correspond to the geopolitical space defined in Chapter 1 as the "Wider Mediterranean". While centred on the Mediterranean basin, the sample extends eastwards through the Red Sea, the Gulf of Oman, the Indian Ocean, and the Indo-Pacific, and westwards towards the Gulf of Guinea, while also incorporating the Arctic dimension. Additional European maritime regions, such as the North Sea and the Baltic Sea, were included because of their strategic relevance for European and Italian maritime interests and their value for comparative analysis.

The resulting sample therefore includes maritime regions that directly influence Italy's maritime security and strategic interests and, more broadly, the security, prosperity, and strategic environment of the European Union (EU) through their impact on international trade, energy supply, maritime connectivity, regional stability, environmental protection, and wider geopolitical dynamics.

Table 1. Selected Marine Regional Systems

| Marine Region        | Source     | Type                | Functional role      |
|----------------------|------------|---------------------|----------------------|
| Arabian Sea          | IHO        | Open Ocean Basin    | Basin                |
| Arctic Ocean         | IHO        | Open Ocean Basin    | Basin                |
| Baltic Sea           | IHO        | Regional Sea        | Semi-enclosed system |
| Black Sea            | IHO        | Regional Sea        | Semi-enclosed system |
| East China Sea       | IHO        | Regional Sea        | Transition Zone      |
| Gulf of Aden         | IHO / VLIZ | Strategic Connector | Connector            |
| Gulf of Guinea       | VLIZ       | Regional Sea        | Semi-enclosed system |
| Gulf of Oman         | VLIZ       | Hybrid System       | Transition Zone      |
| Mediterranean Sea    | IHO / VLIZ | Regional Sea        | Semi-enclosed system |
| Mozambique Channel   | IHO / VLIZ | Strategic Connector | Connector            |
| North Sea            | IHO        | Regional Sea        | Transition Zone      |
| Persian Gulf         | IHO        | Regional Sea        | Semi-enclosed system |
| Red Sea              | IHO / VLIZ | Regional Sea        | Connector            |
| South China Sea      | IHO        | Hybrid System       | Connector            |
| Western Indian Ocean | VLIZ       | Open Ocean Basin    | Basin                |

Although the selected MRS differ considerably in terms of geographical characteristics and strategic functions, they can be described through two complementary descriptive variables. The first, “Type”, classifies maritime regions according to their geographical configuration, distinguishing, for example, Regional Seas, Open Ocean Basins, Strategic Connectors and Hybrid Systems. The second, “Functional Role”, describes the principal function performed by each maritime region within the global maritime system, distinguishing between Basins, Semi-enclosed Systems, Connectors and Transition

Zones. These variables provide a common descriptive framework that facilitates comparison among maritime regions while highlighting their structural diversity.

It is important to emphasise that Type and Functional Role are not incorporated into the calculation of the SFF. Their purpose is exclusively descriptive and methodological. The SFF applies the same analytical structure to every MRS, thereby ensuring that fragility scores remain directly comparable regardless of the geographical nature of the maritime region being assessed.

Table 2. Type and Functional Role of MRS

| Type                 | Definition                                                                                                                                                |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Regional Sea         | Semi-enclosed or enclosed maritime area characterized by intensive interactions among coastal states and relatively well-defined geographical boundaries. |
| Open Ocean Basin     | Large, open maritime space with low geographical enclosure and predominantly oceanic dynamics.                                                            |
| Strategic Connector  | Maritime area whose primary geographical function is to connect larger maritime systems through key transit routes or chokepoints.                        |
| Hybrid System        | Maritime area combining characteristics of two or more geographical types, reflecting complex spatial and governance dynamics.                            |
|                      |                                                                                                                                                           |
| Functional Role      | Definition                                                                                                                                                |
| Basin                | Large maritime space where circulation, distribution of flows, and oceanic interaction represent the dominant functions.                                  |
| Semi-enclosed System | Maritime area characterized by strong internal interactions, ecological interdependence, and regionally concentrated governance dynamics.                 |
| Connector            | Maritime region whose principal function is linking different basins or regional systems, often concentrating trade, energy, and strategic flows.         |
| Transition Zone      | Maritime area situated between distinct maritime systems, characterized by overlapping influences, hybrid dynamics, and strategic complexity.             |

Within the broader reference sample, this study applies the SFF to four MRS:

- I. the Mediterranean Sea;
- II. the Red Sea;
- III. the Gulf of Oman; and
- IV. the Arctic Ocean.

This selection should not be interpreted as identifying the four most fragile maritime regions included in the reference sample. Rather, it reflects a deliberate balance between policy relevance and methodological representativeness.

From a policy perspective, these four maritime regions are of particular importance for Italy and the EU. The Mediterranean Sea represents Italy's primary geopolitical and geo-economic environment, where maritime security, migration, trade, energy supply, fisheries, environmental protection and regional governance converge. The Red Sea was selected because it constitutes one of the world's most strategic maritime corridors, where disruptions affecting freedom of navigation rapidly produce consequences for global trade and European economic security. The Gulf of Oman has become increasingly significant owing to its position at the interface between the Gulf region, the Arabian Sea and the wider Indian Ocean. Recent tensions surrounding the Strait of Hormuz have further demonstrated the strategic importance of this maritime transition zone for energy security, maritime connectivity and global supply chains. Finally, the Arctic Ocean represents an increasingly important maritime region as climate change, emerging navigation routes, resource competition and evolving governance arrangements progressively reshape the geopolitical landscape. Italy's growing diplomatic, scientific and institutional engagement in Arctic affairs further reinforces the strategic relevance of this region<sup>5</sup>.

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<sup>5</sup> Although the Arctic Ocean is treated as a single MRS for the purposes of the SFF, from a geopolitical and geostrategic perspective the Arctic may also be interpreted as comprising three partially distinct sub-regions: the Eurasian Arctic, where the Russian Federation exercises predominant influence over maritime spaces, critical infrastructure, shipping routes and resource development; the European Arctic, centred on the Nordic and Scandinavian countries and characterised by strong institutional cooperation and growing NATO and EU relevance; and the North American Arctic, encompassing Alaska (United States), northern Canada and Greenland, where Arctic governance increasingly intersects with North American security and transatlantic strategic interests. This subdivision reflects the growing differentiation of geopolitical dynamics across the circumpolar region rather than any formal geographical classification. See, for example, J. JOKELA (ed.), *Arctic Security Matters*, cit; M. BERGMANN et al., *Northern Connections: The European Arctic by 2035*, Center for Strategic

Methodological considerations also informed the selection of these four case studies. Together, they encompass four distinct maritime configurations represented within the reference sample: a semi-enclosed regional sea (Mediterranean Sea), a strategic maritime connector (Red Sea), a hybrid transition system (Gulf of Oman), and a large open-ocean basin (Arctic Ocean). This diversity enables the framework to be applied across maritime regions characterised by markedly different geographical settings, governance arrangements, strategic functions and patterns of exposure, thereby providing a robust demonstration of the comparative capabilities of the SFF.

The inclusion of the Gulf of Oman rather than the Persian Gulf reflects this methodological rationale. While both maritime regions are of considerable geopolitical importance, the Persian Gulf shares several structural characteristics with the Mediterranean Sea as a semi-enclosed regional maritime system. The Gulf of Oman, by contrast, constitutes a hybrid maritime transition zone linking the Gulf region with the Arabian Sea and the wider Indian Ocean. Its inclusion, therefore, increases the diversity of maritime configurations represented within the assessment while preserving the strategic relevance of the Gulf region for Italian and European maritime interests.

Overall, the fifteen MRS constitute the reference sample of the study, while the Mediterranean Sea, Red Sea, Gulf of Oman and Arctic Ocean form the assessment sample (proof of concept) to which the SFF is applied. This two-level structure combines a broader geographical perspective with an in-depth assessment of four strategically relevant and structurally diverse maritime regions.

2.3. In the light of the existing literature, as reviewed in Chapter 1, the proposed SFF has been organized around seven domains – Economic, Environmental, Political, Military Security, Social/Institutional, Legal/Enforcement, and Technological – each capturing a distinct dimension through which fragility manifests itself in maritime regions. Within every domain, individual risk indicators have been paired with two analytical variables: exposure, which captures the degree to which a given maritime area is susceptible to those risks, and resilience, which reflects the capacity of states and institutions – both regional and global, hence ultimately of the area itself – to

absorb, adapt to, and recover from crises. Moreover, since measurement scales vary across indicators according to the nature of the phenomenon being analysed, the scales were divided into continuous, categorical, and ordinal types to ensure the use of appropriate statistical methods and analyses for each indicator.

The proposed approach, as conceptually explained in Chapter 1, intends to strike a reasonable balance between each area's risk factors vis-a-vis its ability to cope with them. In so doing, the SFF aims to conduct a careful yet rigorous assessment of actual maritime fragility, in which resilience in any given MRS plays an equally important role as exposure.

In so doing, it is important to note that the proposed approach has potential to deliver SFF scores that might occasionally appear counter-intuitive – if not surprising – on the surface, when for instance compared to public opinion and/or media coverage regarding fragility in a certain MRS (as shown in the case of the Red Sea in Chapter 3). Such a careful balancing act between exposure and resilience represents, in fact, one of the most original contributions of the SFF to the existing literature on sea fragility. Additionally, the proposed approach, compared to others as reviewed in Chapter 1, should also be highly functional to its subsequent operationalization, as it shall better serve the purpose of presenting institutional decision-makers with the possibility of conducting a holistic assessment of sea fragility in any MRS. Ultimately, the proposed SFF architecture proves to be especially instrumental to informing any strategic, policy, and/or other operational implications of the analysis in a more balanced and rigorous manner.

2.3.1. Against this, for each MRS, it is proposed that the SFF be computed as the simple average of the domain fragility score for each of the above-mentioned seven domains (with  $i$  understood as running from Domain I through VII):

$$\text{Sea Fragility for MRS A} = \sum (\text{domain}_i)$$

The simple sum has been deemed preferable over the weighted one, in reflection of two equally important considerations. On the one hand, the assignment of weights by the authors would have been driven by a degree of arbitrariness, as the literature review conducted in Chapter 1 does not suggest that, in the specific context of sea

fragility, specific domains should be considered more significant than others and thus be attributed heavier weights. Such an approach could have, in turn, undermined the rigorousness of the SFF architecture, and ultimately jeopardized its credibility and thus applicability. On the other hand, in an attempt to maximize opportunities for practical applications of the framework, a simple summation should allow for better SFF comparability across MRS, and thus ultimately better reflect the fact that different fragility domains may, by their very nature, already weigh differently in certain maritime regions compared to certain others.

Given domain fragility scores will be computed on a 1-5 scale, as explained below, SFF scores – as simple sums of fragility domains – will subsequently operate on a 1.4-35 scale, rounded to one decimal digit. In turn, this will result in six broad categories of sea fragility, as explained in the table below.

To facilitate the interpretation of the MRS SFF score, the classification of the score bands in Table 3 is proposed.

Table 3. MRS Sea Fragility score bands

| Range       | Label       | Description                                                                                                          |
|-------------|-------------|----------------------------------------------------------------------------------------------------------------------|
| 1.4 – 3.5   | Very low    | Resilience broadly outweighs exposure across all domains.                                                            |
| 3.6 – 6.0   | Low         | Limited structural pressures are present, while resilience remains sufficient to contain identified exposure levels. |
| 6.1 – 8.1   | Medium      | Exposure exceeds resilience in several domains, indicating moderate structural fragility.                            |
| 8.2 – 14.0  | Medium-High | Multiple domains display significant structural exposure levels, many of them exceeding resilience capabilities.     |
| 14.1 – 21.0 | High        | Exposure outweighs resilience across most assessed domains, indicating widespread structural fragility.              |

|             |         |                                                                                                  |
|-------------|---------|--------------------------------------------------------------------------------------------------|
| 21.1 – 35.0 | Extreme | Structural vulnerabilities dominate the assessed domains, resulting in a critically fragile MRS. |
|-------------|---------|--------------------------------------------------------------------------------------------------|

Scoring bands are calibrated in function of the classification structure for exposure-resilience relationships across domains, whereby a MRS SFF score of 7.0 represents the centerpoint of the scoring distribution with an average domain fragility score of 1.0 for each of the 7 domains – entailing an average 1:1 ratio between exposure and resilience across the entire framework and thus a balanced – or *medium* – fragility. Upper and lower fragility bands are calibrated in function of ratio thresholds between average exposure and average resilience across domains. MRS SFF scores below 6.1–8.1 (corresponding, respectively, to an average 0.85:1 and 1.15:1 ratios between exposure and resilience across all domains), indicate an exceeding average resilience compared to assessed risk exposure. Specifically, a *low* fragility (3.6 – 6.0) signals an average resilience of 1.15 to almost 2.0 times larger than assessed risk exposure, while a *very low* fragility (1.4 – 3.5) indicates that resilience across assessed indicators exceeds on average risk exposure across domains by a factor of 2 or higher. Similarly, *medium-high* (8.2 – 14.0), *high* (14.1 – 21.0), and *extreme* (21.0 – 35.0) respectively indicate an average exposure of a magnitude of up to 2 times, 3 times, or larger compared to average assessed resilience across all 7 domains.

The scale is calibrated for a minimum score of 1.4, corresponding to a scenario of minimum exposure (1) and maximum resilience (5) across all assessed indicators and thus a domain fragility score of 0.20 for all 7 domains (hence 1.4 in total), and a maximum score of 35.0 indicating instead maximum exposure (5) and minimum resilience (1) across all indicators, resulting in a domain fragility score of 5.00 for all 7 domains (hence 35.0 in total).

2.3.2. Following from the above, it is proposed that each fragility domain score be computed as the simple average of the corresponding risk indicators, with the latter in turn reflecting the ratio between the corresponding exposure and resilience factor:

$$\text{Domain Fragility Score} = \text{avg}(\text{risk indicator}_1, \text{risk indicator}_2, \dots, \text{risk indicator}_i)$$

Importantly, the choice of a simple average at this stage is again intended to enhance the SFF rigorousness with regards to both accuracy and comparability. Conversely, the use of other functions – such as the maximum function – could have led to overemphasizing a single risk indicator relative to all other ones, potentially resulting in an overestimation of certain domain fragility scores and ultimately of the SFF itself. Additionally, again, the use of the maximum function could have undermined the possibility of conducting SFF comparisons across marine regions with different sea fragility profiles overall, whose domain fragility scores might have nevertheless appeared similar simply because they were driven, e.g., by one particular risk indicator (the one corresponding to the maximum value in the function), even where those indicators might have been conceptually different from one another.

2.3.3. Given risk indicators (based on a ratio between exposure and resilience, as explained below) are proposed to be computed on a 1-5 scale, risk area fragility scores – computed as a simple average of all risk indicators – will subsequently operate on a 0.2-5 scale.

Finally, as anticipated above and in line with the conceptual approach proposed in Chapter 1, it is proposed that, for each of the seven domains, the risk indicator be computed as the ratio between the corresponding factors of, respectively, exposure and resilience:

$$\text{Risk indicator for Domain } n = \sum_{i=1}^n \frac{\text{Exposure factor } i}{\text{Resilience factor } i}$$

where both exposure factor<sub>*i*</sub> and resilience factor<sub>*i*</sub> are assigned a discrete numerical value. To determine the numerical value of each exposure/resilience factor across the various risk domains, it is proposed that a 1-5 range be used. Where data are available on a continuous scale, the corresponding value shall be extracted from the relevant source as indicated in section 2.4 below, and subjected to harmonization to a 1-5 range if necessary. Where data are instead available on a categorical scale, the corresponding 1-5 value shall be used based on a standard Likert scale and again subjected to harmonization as necessary, whereby:

- 1 = very low or no exposure/resilience
- 2 = low exposure/resilience
- 3 = moderate exposure/resilience

4 = high exposure/resilience

5 = very high exposure/resilience

For detailed information on the harmonization process of continuous and categorical data to the discrete 1-5 scale, see Table 5<sup>6</sup>.

2.4. As established in Chapter 1, Sea Fragility arises where the cumulative exposure of a MRS exceeds its collective capacity for governance, adaptation, and recovery, articulated through three pillars: exposure, governance capacity, and resilience. Operationalising this apparatus requires translating those pillars into measurable indicators.

For the SFF, candidate indicators were extracted, for each of the seven domains, from the literature corpus reviewed in Chapter 1 and from the operational parameters of established instruments – notably the OECD *States of Fragility* dimensions, the Fragile States Index (FSI), the State Fragility Index, the "good order at sea" matrix, and the EU Maritime Security Strategy. Each candidate was mapped to an exposure or a resilience factor, consistent with the risk-indicator ratio in Section 2.3, and refined against four criteria.

*Relevance* required a documented diagnostic relationship to maritime exposure or resilience and, given the SFF's policy-oriented purpose, actionability for governance intervention. *Measurability* required that the phenomenon be quantifiable, or reducible to a defensible ordinal or categorical value, on the harmonised 1–5 scale. *Comparability* required consistent definition and measurement across all MRS, so that scores reflect genuine differences rather than artefacts of divergent national definitions. *Availability* required official, publicly available, periodically updated sources, ensuring reproducibility and future monitoring; a supplementary consideration, drawn from the index-evaluation literature, was the avoidance of double-counting between correlated indicators. Indicators were populated exclusively from recognised open-access datasets; full provenance – source, measurement scale, and harmonisation note – is documented in Table 5. The complete framework comprises the full population of 58 indicators across the seven domains: a granular, multi-indicator portrait of maritime fragility for full application once data coverage across all MRS is consolidated.

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<sup>6</sup> To view the table referred to, please consult the following link: <https://docs.google.com/spreadsheets/d/1Fbi9fyntBo0P9kiZfJwcnmubCOMOC4OJ-LnPPjv5pxM/edit?usp=sharing>

In the Economic domain, the reduced framework retains a measure of energy- and trade-flow concentration, operationalised through Herfindahl–Hirschman indices of supplier and route diversification. The literature reviewed in Chapter 1 consistently identifies dependence on sea lines of communication, chokepoint transit, and concentrated energy flows as the primary economic vector of maritime fragility, with disruptions to commercial and energy flows figuring among the core exposure pressures in the proposed definition of Sea Fragility. Concentration measures capture precisely this structural dependence, and parallel the economic dimensions of the OECD framework and the FSI, which treat economic vulnerability as constitutive of fragility.

In the Environmental domain, the framework retains a climate- and ecological-exposure measure. Here the reviewed scholarship is at its most convergent, documenting a sustained strand of literature characterising climate change as a “fragility multiplier” that interacts with and intensifies pre-existing political, economic, and governance vulnerabilities within maritime regions. The OECD's inclusion of an environmental dimension, singled out in the review as a distinctive advance over state-focused fragility instruments, provides the operational precedent for scoring environmental stress as a fragility dimension in its own right.

In the Political domain, the framework retains organised-violence event data drawn from conflict-event repositories. The state-fragility literature defines fragility centrally as the weakening of authority and legitimacy – the erosion operationalised by the polity components of the FSI and the State Fragility Index – while the maritime-security literature adds that geopolitical competition and contested maritime spaces undermine cooperative governance, and that instability ashore translates into insecurity at sea. Conflict-event data constitute the most direct, most widely validated measure of this nexus, with geo-referenced, globally consistent coverage that satisfies the comparability criterion more fully than perception-based governance indices.

In the Military Security domain, the framework retains the balance between maritime militarisation and the multinational naval presence available to contain it. This indicator directly instantiates the distinction, developed in Chapter 1, between Sea Security and Sea Fragility: the securitisation literature shows that militarisation and naval competition raise exposure, while the maritime-governance

literature (from the EU Maritime Security Strategy to deployments such as Operation Aspides) treats multinational naval cooperation as the principal resilience mechanism preserving freedom of navigation under stress. Measuring the two jointly, as a ratio, reflects the framework's core premise that fragility resides in the asymmetry between pressures and coping capacity.

In the Social/Institutional domain, the framework retains a forced-labour and human-trafficking prevalence measure. The literature identifies a systematic “human-rights blindness” in both the law of the sea and the dominant fragility indices, which subordinate the safety and rights of individuals and coastal communities to aggregate metrics of state effectiveness. The transnational strand of the reviewed literature – on trafficking, irregular migration, and forced labour at sea – shows that these phenomena expose the limits of existing governance systems, while the “blue justice” dimension of the good-order-at-sea matrix supplies the precedent for scoring human security as a constitutive maritime dimension. Retaining a prevalence measure deliberately corrects the blind spot the review diagnoses.

In the Legal–Enforcement domain, the framework retains an enforcement-capacity measure encompassing counter-piracy mechanisms, maritime domain awareness arrangements, and vessel-monitoring systems (AIS, LRIT, VMS). The choice rests on the consideration that UNCLOS and the regional architectures built upon it define obligations and cooperative duties but furnish no measurement instrument. The Gulf of Guinea literature on the Yaoundé Architecture sharpens the point empirically, since fragility manifests as weak enforcement capacity, fragmented information-sharing, and limited prosecution despite a formal cooperation framework. The corpus therefore supports measuring enforcement practice rather than legal form.

Unlike the other domains, the Technological domain currently includes a single risk area. This choice reflects a deliberate methodological decision rather than a conceptual limitation. During the literature review, several technological dimensions relevant to maritime fragility – including cyber threats, satellite navigation, maritime surveillance systems, autonomous shipping, and the digitalization of ports – were systematically assessed. However, none of these dimensions currently offer globally available, open-source, and region-specific datasets that ensure a consistent and comparable assessment across all MRS.

By contrast, submarine cable infrastructure represents a critical component of the global maritime system whose exposure and resilience can be measured using internationally recognized and openly accessible datasets. Consequently, Submarine Cable Infrastructure was retained as the sole technological risk area in the current version of the SFF. This approach prioritizes methodological robustness and cross-regional comparability over numerical symmetry among domains. As global maritime technological datasets continue to improve, additional technological risk areas may be incorporated into future versions of the framework.

2.5. Each indicator in the reduced framework was populated from official, publicly available datasets, selected for global coverage, methodological transparency, and periodic updating. To preserve comparability, values were drawn from the most recent year for which harmonised international data were available for all four assessment regions; the assessment is therefore cross-sectional. Raw values were converted to the common 1–5 scale through the harmonisation procedures in Table 3, combined into the exposure-over-resilience ratio, and aggregated by simple average at domain level. Source, measurement scale, and harmonisation note for every indicator are recorded in Table 5.

As proof of concept, a reduced version of the SFF comprising 9 indicators across 7 domains was calculated for four representative MRS (Red Sea, Mediterranean Sea, Arctic Ocean, Gulf of Oman) with different type and functional roles under the MRS classification system described in section 2.2 above. For the present proof of concept, the reduced framework retains, for each domain, only the risk areas most strongly and unequivocally supported by the reviewed literature. The choice is motivated by doctrinal coherence, since each domain score then rests on measures whose relationship to fragility is broadly agreed across scholarship, and by usability, since a lean configuration yields a transparent, readily communicable score. In the Economic domain, *Maritime routes & international trade* constitute the most direct measure of a maritime system's economic function, the corpus consistently identifying dependence on sea lines of communication and chokepoint transit as the primary economic vector of maritime fragility<sup>7</sup>. In the Environmental domain, the *Geographic*

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<sup>7</sup> B. GERMOND, *The Geopolitical Dimension of Maritime Security*, in *Marine Policy*,

*position of the basin*, assessed through ecosystem health, captures structural exposure – the regional basin being the ecological unit of analysis underpinning the MRS concept<sup>8</sup> – while *Climate change* captures the dynamic pressure characterised across the literature as a “fragility multiplier” that intensifies pre-existing political, economic, and governance vulnerabilities<sup>9</sup>. In the Political domain, the *Projection of coastal states as security guarantors* transposes to the maritime level the weakening of authority and legitimacy that is central to state-fragility scholarship, and which regional studies identify as the decisive variable of maritime order<sup>10</sup>. In the Military Security domain, *Piracy* – the most extensively documented maritime security threat in the corpus<sup>11</sup> – and *Maritime domain awareness*, identified as the foundational resilience capability<sup>12</sup>, are retained as

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2015, 137 ff., available online; S. CROUSEY, G. SCUTARU, H. HALEM, L. PACHIU, *The Battle for the Black Sea! The Importance of Freedom of Navigation and Energy Stakes*, Yorktown Institute, 2023, available online; J-L. SAMAAN, *Securing European Interests from the Mediterranean to the Persian Gulf: Rethinking EU Strategic Autonomy at Sea*, in *Euromesco Papers* n. 68, 2018, available online.

<sup>8</sup> E. LOPEZ-LUCIA, *Fragility, Violence and Criminality in the Gulf of Guinea*, in GSDRC, Birmingham, 2015, available online; UNEP, *Regional Seas Strategic Directions 2017–2020*, Nairobi, 2016, available online.

<sup>9</sup> C. E. WERRELL, F. FEMIA, T. STERNBERG, *Did We See It Coming? State Fragility, Climate Vulnerability, and the Uprisings in Syria and Egypt*, in *SARS Review of International Affairs*, 2015, 29 ff.; L. RÜTTINGER, *Climate and Fragility Risks: The Global Perspective*, Climate Diplomacy, Berlin, 2017, available online.; A.N. BENI, N. MARRINER, A. SHARIFI, J. AZIZPOUR, K. KABIRI, M. DJAMALI, A. KIRMAN, *Climate Change: A Driver of Future Conflicts in the Persian Gulf Region?*, in *Helyon*, 2, 2021, available online; A. PIGOLI, G. DI CAPUA, *Climate Change and Energy Security in the Arctic and the Mediterranean*, in *Arctic Connections. Arctic and Mediterranean: New Assets for Energy Security and Strategic Balances. The Italian and Norwegian Perspectives*, Quaderno n. 28 de “La Comunità Internazionale”, 2024, 13; OECD, *States of Fragility 2025*, OECD Publishing, Paris, 2025, available online.

<sup>10</sup> F. STEWART, G. BROWN, *Fragile States*, CRISE Working Paper n. 51, Oxford, 2009, available online; A. VIDAL RIBE, *Securing the Seas: A Comparative Analysis of Emirati and Saudi Foreign Policies in the Red Sea*, M.A. Thesis, Georgetown University, Washington (DC), 2022.; A. RYNN, B. P. NICKELS, *Enhancing Security in the Red Sea*, 2024, available online.

<sup>11</sup> G.E VAN HOOK, *Maritime Security Consortiums*, in S. JASPER (ed.), *Conflict and Cooperation in the Global Commons: A Comprehensive Approach for International Security*, George Town, 2012, 173 ff.; J. CORTE-REAL, *Maritime Security in the Gulf of Guinea: Threats and Challenges*, in *Negócios Estrategicos*, 2022, 61 ff.; G.N. GASU, *Maritime Security and Defense in the Gulf of Guinea: Issues, Challenges and Prospects*, in *Cavendish University Law Journal*, 2023, 1 ff., available online.

<sup>12</sup> EUROPEAN UNION, *European Union Maritime Security Strategy (EUMSS)*, Council of the European Union, Brussels, 2014; H. YÜCEL, *Sovereignty and Transnational Cooperation in the Gulf of Guinea: How a Network Approach can Strengthen the Yaoundé Architecture*, *Scandinavian Journal of Military Studies*, in *Scandinavian Journal of Military Studies*, 1, 2021, 146 ff.; H. AUFFRET, A. WALSH, *Context and Stakeholder Analysis of Maritime Security*

paired exposure and resilience measures, directly instantiating the risk-indicator ratio. In the Social/Institutional domain, *Labour exploitation in maritime industries* corrects the “human-rights blindness” diagnosed in both the law of the sea and the dominant fragility indices<sup>13</sup>. In the Legal–Enforcement domain, the *Applicability of UNCLOS* operationalises the mismatch between near-universal legal obligations and their contested application and enforcement<sup>14</sup>. Finally, in the Technological domain, *Submarine cable infrastructure* is the sole risk area for which globally available, open-source, region-specific data permit consistent cross-regional measurement, and whose strategic salience the literature directly attests<sup>15</sup>. The asymmetric distribution of risk areas across domains – two in the Environmental and Military Security domains, one elsewhere – reflects the density and convergence of the underlying literature rather than any judgement of relative importance, consistent with the unweighted architecture set out in Section 2.3.

Table 4 below reports the results: the Red Sea scores highest (10.8 out of 35.0), followed by the Mediterranean Sea (8.1), the Gulf of Oman (7.7), and the Arctic Ocean (4.3). Against the bands in Section 2.3, the Red Sea sits within the Medium-high band, the Mediterranean Sea and the Gulf of Oman within the Medium band, and the Arctic Ocean within the Low band. The four profiles illustrate how the exposure–resilience ratio, rather than exposure alone, governs the outcome.

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*and Justice in the Gulf of Guinea*, DCAF, 2023, available online.

<sup>13</sup> D. DALAKLIS, B.S. SEKER, *Contemporary Maritime Security Challenges: Human Trafficking and Migrant Smuggling at Sea*, in *Geopolitica*, 2016, 135 ff.; A. PETRIG, *Human Rights and Law Enforcement at Sea*, in B. RYAN, D. GUILFOYLE (eds.), *Research Handbook on International Marine Environmental Law*, London–New York, 2022, 12 ff.; R. STRATING et al., *Human Rights at Sea: The Limits of Inter-State Cooperation in Addressing Forced Labour on Fishing Vessels*, in *Marine Policy*, 2024.

<sup>14</sup> UNITED NATIONS, *United Nations Convention on the Law of the Sea (UNCLOS)*, Montego Bay, 1982; J. LUO, *Application of Interim Measures by the International Tribunal for the Law of the Sea*, in *International Journal of Criminal Justice Sciences*, 2, 2023, 57 ff., available online; V. LYMPEROPOULOS, *Regional Maritime Security Limitations under UNCLOS*, in *The Review of Contemporary Scientific and Academic Studies*, IV, 2, 2024, available online.

<sup>15</sup> G. DAGA, P. P. RAIMONDI (eds.), *Mediterranean Transitions from the Gulf to the Sahel: The Role of Italy and the EU*, IAI Research Studies 11, Roma, 2024; *Mediterraneo allargato: un mare fragile tra geopolitica, sicurezza ed energia*, Dialogo Diplomatico n. 250, 2024.

Table 4. Domain Fragility, SFF (reduced)

|                      | Red Sea | Mediterranean Sea | Gulf of Oman | Arctic Ocean |
|----------------------|---------|-------------------|--------------|--------------|
| Economic             | 1.67    | 1.67              | 2.50         | 0.20         |
| Environmental        | 0.67    | 0.67              | 0.63         | 0.46         |
| Political            | 1.50    | 1.00              | 1.00         | 0.25         |
| Military Security    | 0.42    | 0.45              | 0.93         | 0.67         |
| Social/Institutional | 1.00    | 1.00              | 1.00         | 0.50         |
| Legal – enforcement  | 3.00    | 2.50              | 1.00         | 0.25         |
| Technological        | 2.50    | 0.80              | 0.67         | 2.00         |
| TOTAL (out of 35.0)  | 10.8    | 8.1               | 7.7          | 4.3          |

The Red Sea's leading position is driven by the Legal-Enforcement (3.00) and Technological (2.50) domains: a weakly governed corridor bordered by fragile littoral states offers limited enforcement capacity, while dependence on a few Bab-el-Mandeb cable corridors leaves scant infrastructural redundancy. The most instructive result, however, is Military Security, where the Red Sea returns the lowest score of the sample (0.42) despite being, in public perception, the most militarily contested region. The apparent paradox is precisely the signal the framework is designed to surface: high military exposure is offset by the resilience supplied by the multinational naval presence in the basin. Fragility is suppressed not by the absence of threat, but rather by the presence of external coping capacity – a dependency whose withdrawal would sharply raise the score.

The Mediterranean Sea mirrors the Red Sea in the Economic and Environmental domains but diverges sharply in the Technological domain (0.80 against 2.50), where a dense, redundant cable network confers the resilience the Red Sea lacks; its Legal-Enforcement score remains elevated (2.50), reflecting migration and enforcement pressures only partially matched by regional governance capacity. The Gulf of Oman posts the highest Economic score of the sample (2.50), a direct reflection of concentrated energy-transit dependence on the Strait of Hormuz, and the highest Military Security score (0.93), where Hormuz-related tensions meet a less institutionalised naval-cooperation architecture than the Red Sea's with comparable exposure but significantly different resilience. The Arctic Ocean is the least fragile basin overall, its uniformly low scores reflecting limited conflict, trade, and migration exposure combined with stable coastal-state governance. Its single outlier – Technological (2.00) – is equally

diagnostic of sparse cable infrastructure yielding low redundancy, so even minimal exposure translates into elevated fragility. Low aggregate fragility does not preclude concentrated, domain-specific vulnerability.

For institutional users, by revealing where fragility concentrates and whether it is driven by exposure or by fragile resilience, the SFF supports the targeting of finite resources: in the Red Sea, toward enforcement capacity and cable redundancy rather than the naval assets already providing resilience; in the Gulf of Oman, toward energy- and supply-route diversification. Resilience-dependent scores – as in the Red Sea's military-security domain – further serve an early-warning function, flagging where stability is contingent on sustained external engagement. Applied over time and across regions, the framework offers a cross-comparable baseline for strategic prioritisation, of direct relevance to instruments such as Italy's *Piano del Mare*.

Two caveats apply. These scores derive from the reduced, single-indicator framework and demonstrate the coherence and comparative capacity of the architecture rather than a definitive ranking; and, consistent with Section 2.3, the contained Red Sea aggregate shows how a region of high public salience may register only moderate structural fragility once resilience is accounted for, a result examined in depth in Chapter 3 with a full SFF calculation.

2.6. The proposed approach inevitably presents strengths and areas for improvement, while naturally also offering opportunities for further research and/or future refinement.

With regards to limitations, it must be noted that, unless otherwise specified, the indicators included in the SFF were compiled using the most recent year for which comparable international data were available. This approach ensures that the assessment reflects the most up-to-date structural conditions of each MRS while maintaining consistency across the different data sources employed. The authors acknowledge that relying on a single reference year represents a common limitation of cross-sectional assessments, as it may not fully capture longer-term trends or temporal fluctuations. However, the use of historical averages would have reduced data comparability and timeliness, given the different publication cycles and data availability across international datasets. Since the primary objective of the SFF is to assess the current structural configuration of maritime fragility

rather than its historical evolution, the adoption of the latest available data provides the most appropriate balance between analytical robustness, comparability, and policy relevance.

As far as strengths are concerned, a key contribution of the SFF lies in its ability to provide a consistent basis for cross-regional comparison. By applying a common analytical structure to MRS with different geographical configurations, governance arrangements, strategic functions, and patterns of risk exposure, the framework enables similarities and differences in maritime fragility to be identified systematically.

This comparative perspective supports a better understanding of how similar risk areas may generate different levels of fragility depending on the structural characteristics and resilience of each maritime system. As such, the SFF provides both an analytical and policy-oriented tool for assessing and comparing maritime regions within a shared methodological framework.

Similarly, the SFF architecture as proposed in this chapter offers a careful balancing act between exposure and resilience, which represents one of the most original contributions of the SFF to the existing literature on sea fragility. Such an approach, compared to others as reviewed in Chapter 1, should also be highly functional to its subsequent operationalization, as it shall better serve the purpose of presenting institutional decision makers with the possibility of conducting a holistic assessment of sea fragility in any MRS. Ultimately, it is the authors' expectation that the proposed SFF architecture should prove to be especially instrumental to informing any strategic, policy-, and/or other operational implications of the analysis in a more balanced and rigorous manner.

Finally, the proposed SFF offers a number of areas for further refinement and/or future research. Based on data availability, and depending on the specific needs of decision-makers who will be involved in the operationalization of the SFF for policy purposes, consideration might be given to, for instance, applying weights to certain risk domains in the SFF formula, thus moving from a simple sum (as currently proposed) to a weighted one, and/or to adding further variables to the SFF technological domain (in addition to the one concerning *Submarine cable infrastructure*, as currently proposed). Such possible refinements should serve the purpose of further amplifying the "policy applicability" dimension of the SFF, and/or to reflect new advances in sea fragility-related data collected,

while maintaining the conceptual architecture of the framework unchanged.

## CHAPTER 3

### ANALYSING FRAGILITY THROUGH THE RED SEA CASE

CLAUDIA BATTIFERRI, MARIO BOFFO

SUMMARY: 3.1. Conceptualizing Sea Fragility in the Red Sea. – 3.2. Conclusion.

3.1. The Red Sea is one of the world's most strategically significant maritime regions. Located at the crossroads of Africa, West Asia, and the Indian Ocean, it lies along one of the principal tectonic fault systems of the Afro-Arabian Rift and stretches from the Bab el-Mandeb Strait to the Gulf of Suez, forming a natural boundary between northeastern Africa and the Arabian Peninsula. Its geographical configuration gives it strategic significance that extends well beyond the regional level. Tensions are evident in nearly all the countries bordering the Red Sea: in Egypt, due to the repercussions of the Gaza war; in Sudan, because of the conflict in Darfur; in Eritrea, owing to tensions with Ethiopia; in Syria, because of the uncertain political transition; and in Yemen, due to the ongoing conflict involving the Saudi-led international coalition. The intensification of regional tensions involving Israel, Iran, Lebanon, and the United States further contributes to the destabilization of West Asia – conventionally referred to as “the Middle East” in Western political and academic discourse – highlighting the Red Sea's extreme vulnerability to a multitude of interconnected geopolitical factors that produce widespread effects far beyond the immediate theaters of crisis<sup>1</sup>.

Much of the Red Sea's fragility derives from structural factors: its long history of conflicts and regional rivalries, the enduring centrality of the Israeli-Palestinian conflict, and the competition for control over the region's principal maritime communication routes. At the same time, this vulnerability is reinforced by the sea's own physical geography. Enclosed between the Suez Canal and the Bab el-Mandeb Strait, the Red Sea connects the Mediterranean Sea with the Gulf of

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<sup>1</sup> E. PAPASTAVRIDIS, *Red Sea Attacks and the International Response: An International Law Insight*, Hellenic Foundation for European and Foreign Policy (ELIAMEP), Athens, 2024, available *online*.

Aden and the Indian Ocean, making it one of the world's most important maritime trade and navigation corridors.

The combination of these geographical features and persistent geopolitical instability makes the Red Sea particularly vulnerable to disruptions capable of affecting both regional security and the continuity of the maritime routes that traverse it. This geographical configuration constitutes one of the basin's primary structural sources of exposure. The Red Sea's enclosed morphology, combined with the presence of two strategic chokepoints, creates a high concentration of maritime traffic and amplifies the potential systemic consequences of any disruption to freedom of navigation.

This vulnerability is especially evident at the Bab el-Mandeb Strait. Eritrea and Djibouti border its African shore, while Yemen lies on the Arabian Peninsula opposite them. At its narrowest point, between Ras Menheli in Yemen and Ras Siyyan in Djibouti, the strait measures approximately 30 kilometres. Of this distance, roughly 25 kilometres consist of the Dact el-Mayyun Channel, the principal shipping lane running offshore from Perim Island<sup>2</sup>.

Perim Island (Mayyun) constitutes one of the most geostrategically significant locations in the Bab el-Mandeb Strait. Briefly occupied by the United Kingdom in 1799 and subsequently incorporated into the British Protectorate of Aden, it has regained considerable strategic importance in the context of the Yemeni conflict and the growing competition for control over the maritime routes of the Red Sea and the Gulf of Aden. The Emirati presence established on the island during the war in Yemen, and maintained until early 2026, has generally been interpreted as part of Abu Dhabi's broader strategy of maritime power projection aimed at expanding its influence along the principal sea lanes connecting the Indian Ocean, the Gulf of Aden, and the Red Sea<sup>3</sup>. Its strategic position makes the island a key observation point for monitoring and potentially controlling maritime traffic.

Operating from Yemen's shores and strategically embedded within the complex web of West Asian crises, the Houthi movement, which controls the northwestern part of the country, has significantly disrupted maritime traffic through the Red Sea since late 2023,

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<sup>2</sup> A. LOTT, *Maritime Security Threats and the Passage Regime in the Bab el-Mandeb*, Norwegian Centre for the Law of the Sea (NCLOS), Tromsø, 2021, available *online*.

<sup>3</sup> P. SALISBURY, *Yemen: National Chaos, Local Order*, Chatham House (Royal Institute of International Affairs), London, 2017, available *online*.

following the outbreak of the Israel– Hamas war, by repeatedly threatening or carrying out attacks against commercial vessels in transit. These actions prompted many shipping companies to avoid the Red Sea route and instead circumnavigate Africa in order to maintain trade flows between the Indian and Atlantic Oceans. Although the situation has relatively stabilized owing to the suspension of Houthi attacks and the effective surveillance and protection activities conducted under EU Operation ASPIDES<sup>4</sup> and U.S.-led Operation Prosperity Guardian (OPG)<sup>5</sup>, the threat to shipping through the Bab el-Mandeb Strait, and, more broadly, to navigation in the Red Sea, continues to represent a critical element of the regional geopolitical landscape, both as a persistent potential risk and because of its capacity to disrupt global maritime routes<sup>6</sup>.

The fragility of the Red Sea is also directly linked to the extraordinary strategic role it has played throughout human history, dating back to antiquity. For centuries, it has served as a corridor for trade and maritime exchange, a bridge connecting distant peoples, and a space of coexistence among the region’s native communities, often marked by conflict and rivalry. This enduring historical function helps explain why, in Chapter 2, the Red Sea has been classified as a *regional sea* – a semi-enclosed maritime area characterized by intensive interactions among coastal states – whose primary functional role is that of a *connector*, linking different maritime basins and regional systems while concentrating major trade, energy, and strategic flows. Its strategic significance derives not only from its geographical configuration but also from its long-standing capacity to facilitate the movement of people, goods, ideas, and political influence across regions.

The Red Sea’s strategic importance and its inherent vulnerability were further amplified by the opening of the Suez Canal. Its inauguration in 1869 marked one of the most significant turning points in the economic and geopolitical history of the past two centuries. Constructed in Egypt under the direction of the French diplomat and entrepreneur Ferdinand de Lesseps, the canal established

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<sup>4</sup> Council Decision (CFSP) 2024/583, of 8 February 2024 on a European Union Maritime Security Operation to Safeguard Freedom of Navigation in Relation to the Red Sea Crisis (EUNAVFOR ASPIDES).

<sup>5</sup> U.S. DEPARTMENT OF DEFENSE, *Operation Prosperity Guardian*, Statement from Secretary of Defense Lloyd J. Austin III on Ensuring Freedom of Navigation in the Red Sea, Washington, D.C., 18 December 2023, available *online*.

<sup>6</sup> R. R. CHURCHILL, V. LOWE, A. SANDER, *The Law of the Sea*, ed. V, Oxford, 2022.

a direct maritime link between the Mediterranean and the Red Sea, enabling ships to travel between Europe and Asia without circumnavigating Africa<sup>7</sup>. The resulting reduction in travel time and transport costs profoundly reshaped global trade and restored the Mediterranean’s strategic and commercial centrality, which had gradually declined following European overseas expansion in the fifteenth and sixteenth centuries. This renewed centrality inevitably enhanced the strategic importance of the Red Sea, whereas prior to the opening of the Suez Canal international trade routes had been largely oriented toward the Atlantic Ocean.

Today, the Suez Canal remains one of the world’s most critical maritime chokepoints. Under normal operating conditions, between 12 and 15 percent of global trade passes through this corridor<sup>8</sup>, together with between 20 and 30 percent of worldwide container traffic<sup>9</sup>, making it particularly significant for commercial exchanges between Asia and Europe.

The route also plays a vital role in international energy security. Approximately 10-12 percent of the world’s seaborne crude oil trade, around 10 percent of refined petroleum products, and roughly 8 percent of global liquefied natural gas (LNG) trade transit through the Red Sea-Suez corridor<sup>10</sup>. Some studies further estimate that approximately 14-15 percent of global trade in cereals and fertilizers passes through this route, underscoring its critical importance for global food security<sup>11</sup>. These figures explain why the SFF assigns the maximum normalized exposure score (5/5) to the risk area *Maritime Routes and International Trade*. Unlike many regional seas, the Red Sea functions as a systemic connector linking Europe, Asia and the Indo-Pacific through one of the world’s most heavily used maritime corridors. Consequently, even localized disruptions may generate

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<sup>7</sup> M. E. FLETCHER, *The Suez Canal and World Shipping, 1869-1914*, in *The Journal of Economic History*, 4, Cambridge, 1958, 556 ff., available online.

<sup>8</sup> P. KAMALI, R. KOEPKE, A. SOZZI, J. VERSCHUUR, *Red Sea Attacks Disrupt Global Trade*, in *International Monetary Fund Blog (IMF Blog)*, 2024, available online.

<sup>9</sup> *Report of the United Nations Conference on Trade and Development (UNCTAD) on Navigating Troubled Waters: Impact to Global Trade Disruption of Shipping Routes in the Red Sea, Black Sea and Panama Canal*, UNCTAD/OSG/INF/2024/2 of 22 February 2024, available online.

<sup>10</sup> J. BARDEN, C. DUNN, P. MEROLLI, *Fewer Tankers Transit the Red Sea*, in *U.S. Energy Information Administration (EIA)*, 2024, available online.

<sup>11</sup> STUDI E RICERCHE PER IL MEZZOGIORNO (SRM), *Italian Maritime Economy. Le nuove sfide dei porti dell’area euro-mediterranea. La crisi nel Mar Rosso e le trasformazioni imposte dai modelli green*, Gruppo Intesa Sanpaolo, Napoli, 2024.

cascading effects across global supply chains, international shipping, food security and energy markets.

For Italy, the Red Sea represents a strategic maritime corridor of primary importance for trade. According to estimates produced by maritime institutions and industry stakeholders, nearly 40% of Italy's seaborne imports and exports transit through this route, accounting for a total value exceeding €150 billion annually<sup>12</sup>. These figures confirm that the stability of the Red Sea is not merely a regional concern but a determining factor for the functioning of global value chains, energy markets, and international economic security. The corridor therefore constitutes not only one of the world's most important maritime trade routes but also a fundamental component of the broader concept of the Wider Mediterranean. Any closure or significant disruption of this route would force vessels to circumnavigate Africa, leading to substantial increases in transport costs, placing considerable pressure on the global economy, and risking the partial marginalization of the Mediterranean basin within global shipping networks. Any paralysis of the Suez Canal therefore produces immediate repercussions for the world economy, not only as a consequence of disruptions in the Bab el-Mandeb Strait but also when the Canal itself is affected by accidents, such as the 2021 grounding of the *Ever Given*, which temporarily brought maritime traffic to a standstill.

The *Ever Given*, a container ship with a capacity exceeding 20,000 TEU and measuring approximately 400 metres in length, ran aground in the southern section of the Suez Canal owing to a combination of strong winds, a sandstorm, and navigational difficulties<sup>13</sup>. The incident is now widely regarded as one of the most emblematic examples of the vulnerability of critical infrastructures underpinning global trade. During the six-day blockage, from 23 to 29 March 2021, more than 400 vessels accumulated at both entrances to the Canal while transits were temporarily suspended. The disruption caused significant delays to global supply chains and economic losses amounting to billions of dollars, highlighting the systemic vulnerability of one of the world's principal maritime choke points<sup>14</sup>.

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<sup>12</sup> *Rapporto annuale sul cluster marittimo italiano della Confederazione Italiana Armatori (CONFITARMA)* del 25 marzo 2025 (Annual report on the Italian maritime cluster by the Italian Shipowners' Confederation (CONFITARMA), dated 25 March 2025).

<sup>13</sup> UNCTAD, *Review of Maritime Transport 2021*, United Nations Publications, New York, 2021.

<sup>14</sup> SUEZ CANAL AUTHORITY, *Successful Refloating of EVER GIVEN*, 2021, available online; SUEZ CANAL AUTHORITY, *The Canal Follows the Highest Safety and Security*

Further disruptions to maritime traffic could result from military operations, acts of sabotage, or deliberate attacks against critical maritime infrastructure<sup>15</sup>. Although the Suez Canal is less directly affected by the armed conflicts taking place across the region, its centrality to global commerce makes it an additional source of vulnerability within the broader Red Sea maritime system.

Within the contemporary geopolitical landscape, the Red Sea has therefore emerged as one of the world’s most strategically important maritime spaces while simultaneously becoming one of the areas most exposed to multiple sources of instability affecting the international system. In recent years, the region has undergone a progressive militarization and an intensification of strategic tensions driven not only by the factors discussed above but also by competition over the basin’s energy and mineral resources, climate change, the proliferation of non-state armed actors, migration crises, piracy, terrorism, and the vulnerability of submarine digital infrastructures<sup>16</sup>. Collectively, these interconnected dynamics demonstrate that the fragility of the Red Sea cannot be explained by any single factor but rather arises from the interaction of geographical, geopolitical, economic, environmental, technological, legal, and social dimensions, reflecting the multidimensional analytical framework adopted in this study.

In particular, the conflict in Yemen, instability in the Horn of Africa, and the growing rivalry among Saudi Arabia, Iran, the United Arab Emirates (UAE), Türkiye, China, and the United States have transformed the Red Sea into a major arena of geopolitical competition, characterized by hybrid forms of conflict and fragmented governance. These dynamics are reflected in the Military Security dimension of the SFF, under the Exposure indicator, where Military Conflicts (3/5) and Terrorism (5/5) identify the basin as a sensitive maritime security environment. Within this context, economic, environmental, political, military, social, legal, and technological factors reinforce one another, generating multiple and mutually reinforcing sources of vulnerability, highlighting the need of a

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*Standards... Special Thanks to the Armed Forces and the Police Forces for Their Continuous Efforts*, 2021, available online.

<sup>15</sup> E. L. MURPHY, T. BRYJA, *The Strategic Future of Subsea Cables: Egypt Case Study*, in *Center for Strategic and International Studies (CSIS)*, 2025, available online; INTERNATIONAL TELECOMMUNICATION UNION (ITU), *Submarine Cable Resilience*, Geneva, 2026.

<sup>16</sup> AFRICA CENTER FOR STRATEGIC STUDIES, *Mapping Gulf State Actors’ Expanding Engagements in East Africa*, 2025, available online.

multidimensional analysis capable of capturing the interactions among the basin's interdependent drivers of fragility.

Among the various dimensions of Red Sea fragility, energy security, logistics, and strategic infrastructure provide one of the clearest examples of the interaction between regional instability and global interdependence. The prolonged weakening of Yemen's state institutions offers a particularly significant example of how local political instability can generate far-reaching consequences for maritime security, freedom of navigation, and international trade.

As previously noted, substantial volumes of oil and natural gas originating in the Persian Gulf transit through the Red Sea *en route* to Europe and North America. The presence of strategic infrastructure along its coasts, including the Yanbu oil terminal in Saudi Arabia, further enhances the region's geopolitical significance. The energy corridors crossing this maritime space have assumed even greater importance following the war in Ukraine and the subsequent reconfiguration of European energy supply strategies.

The strategic relevance of the Red Sea, however, extends well beyond its maritime dimension. Saudi Arabia and Egypt have invested considerable resources in the development of regional energy infrastructure. For Riyadh in particular, the Yanbu terminal enables crude oil exports to Western markets via the Red Sea, thereby reducing dependence on routes passing through the Persian Gulf and the Strait of Hormuz, where Iran retains significant strategic leverage. At the same time, Saudi Arabia has increasingly expanded its renewable energy programmes through the construction of large-scale solar and wind power facilities along the Red Sea coast.

The concentration of strategic infrastructure, commercial shipping routes, and long-term investments has further increased the interest of both regional and global powers in this maritime space. Alongside the United States, China and Russia, the European Union, Türkiye, Qatar and the UAE increasingly regard the basin as a critical area for safeguarding their economic, energy, and geopolitical interests.

Within the SFF, energy represents one of the structural drivers of potential basin exposure and vulnerability. Although the normalized exposure score for the Energy risk area is relatively moderate (1/5) compared with maritime trade (5/5), the concentration of oil terminals, export infrastructure and maritime energy corridors substantially

amplifies the geopolitical consequences of regional instability, particularly in periods where international shocks or crises occur.

Beyond hydrocarbons, increasing attention has also focused on the basin's mineral resources lying beneath the seabed, adding a further economic and geopolitical dimension to regional competition. In recent years, the Red Sea has increasingly become the focus of disputes over submarine mineral resources. Its seabed hosts significant polymetallic deposits, first identified during the 1970s, particularly within the Atlantis II Deep<sup>17</sup>, one of the world's best-known hydrothermal sedimentary basins, characterized by exceptionally high concentrations of zinc, copper, silver, manganese, and other critical minerals.

These deposits have attracted the interest not only of the littoral states but also of major international corporations and the broader scientific community. As highlighted by the International Seabed Authority (ISA), marine metalliferous sediments are increasingly regarded as a potential future source of essential metals for strategic industries, including renewable energy technologies, electronics, and the wider energy transition<sup>18</sup>. Although the current normalized SFF fragility score assigned to the Minerals risk area remains relatively low (1/5) – fundamentally due to a high level of resilience and the absence of High Seas in the basin – considering technological progress and the increasing global demand for critical minerals driven by the energy transition, this dimension may become considerably more fragile in the coming decades.

The convergence of multiple actors pursuing often divergent political, economic, and strategic interests fuels competitive dynamics that may ultimately generate interstate tensions, reinforcing one of the central assumptions of the SFF: the greater the strategic relevance of a maritime space, the greater its exposure to multidimensional sources of fragility.

Deep-sea mineral exploration also raises significant legal and environmental challenges. Several littoral states maintain differing positions regarding sovereign rights over maritime areas, seabed resources, and their strategic control, while deep-sea mining itself has generated increasing environmental concern owing to its potentially

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<sup>17</sup> JAN LEHMKÖSTER, *Marine Resources – Opportunities and Risks*, in *World Ocean Review*, 3, Hamburg, 2014, 74 ff., available *online*.

<sup>18</sup> INTERNATIONAL SEABED AUTHORITY (ISA), *Marine Metalliferous Sediments: A Potential Future Source of Essential Metals?*, 1, Kingston, 2025, available *online*.

irreversible impacts on fragile benthic ecosystems that remain only partially understood. Consequently, competition over submarine mineral resources unfolds within an already complex geopolitical environment shaped by regional rivalries, global strategic interests, and the broader imperative of preserving marine ecosystems and ensuring the sustainable governance of ocean resources. The strategic value of the Red Sea, however, cannot be understood solely in terms of hydrocarbons and critical minerals. Increasingly, the basin is also viewed as a driver of sustainable economic development through the expansion of the blue economy.

Environmental concerns are closely intertwined with the development of the so-called “blue economy”, understood as the broad range of sea-based economic activities pursued in accordance with principles of sustainability<sup>19</sup>. Fisheries, coastal and underwater tourism, marine renewable energy, and port logistics are increasingly important sectors for the economies of the littoral states. The coral reefs of the Red Sea, which have developed in waters characterized by exceptionally high temperatures and salinity levels, rank among the richest and most spectacular marine ecosystems in the world. They constitute a resource of extraordinary ecological and economic value, supporting highly significant tourism and fishing activities and attracting millions of visitors each year, particularly to destinations such as Sharm el-Sheikh and Hurghada.

Against this background, several littoral states have in recent years adopted strategies aimed at promoting the blue economy through investment in port infrastructure, maritime logistics, sustainable tourism, renewable energy, and the protection of coastal ecosystems. Within this broader context, Saudi Arabia provides the most significant example of national economic diversification designed to strengthen the resilience of coastal communities and enhance the value of marine resources within a sustainable-development framework. *Saudi Vision 2030*, the strategic plan launched in 2016 under the leadership of Crown Prince Mohammed bin Salman, assigns the Red Sea a central role in the Kingdom’s economic, technological, and tourism transformation<sup>20</sup>. Some of the

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<sup>19</sup> WORLD BANK GROUP, UN DESA, *The Potential of the Blue Economy: Increasing Long-Term Benefits of the Sustainable Use of Marine Resources for Small Island Developing States and Coastal Least Developed Countries*, United Nations Publication, Washington, D.C., 2017, available online.

<sup>20</sup> KINGDOM OF SAUDI ARABIA, *Saudi Vision 2030*, Riyadh, 2016.

most ambitious development initiatives currently under way at the global level have been launched within this framework. Among the most prominent are the development programme for AIUla, an area of exceptional historical, archaeological, and cultural significance that includes the UNESCO World Heritage Site of Hegra<sup>21</sup>, and NEOM<sup>22</sup>, a vast urban, industrial, and technological development initiative extending along the north-western coast of the Arabian Peninsula overlooking the Red Sea. Its location along the Gulf of Aqaba also reflects the growing strategic importance of the northern Red Sea within emerging trade, logistics and digital connectivity corridors. Rather than representing isolated development initiatives, these projects illustrate Saudi Arabia’s broader strategy of transforming the Red Sea into an integrated space where economic diversification, technological innovation, environmental sustainability, and geopolitical influence mutually reinforce one another.

At the same time, *Red Sea Global* and the AMAALA project seek to promote a model of tourism described by the Saudi authorities as “regenerative”, based on coral-reef conservation, the protection of marine biodiversity, and the environmental sustainability of tourism infrastructure<sup>23</sup>. According to the objectives set out by the Saudi authorities, these initiatives are expected to generate new employment opportunities, increase international tourist flows, and transform the Red Sea coast into one of the world’s leading hubs of the blue economy.

Taken together, these programmes demonstrate that the Red Sea now lies at the centre not only of traditional geopolitical and commercial dynamics, but also of regional strategies of sustainable development, technological innovation, and economic diversification. They therefore confirm the growing interdependence between maritime security, environmental protection, and economic growth: ongoing investments in tourism, renewable energy, fisheries and maritime infrastructure suggest that the economic relevance of this dimension is likely to increase over time. Consequently, this fragility dimension should be closely monitored in future assessments, as exposure levels may increase, should current trends continue.

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<sup>21</sup> ROYAL COMMISSION FOR ALULA, *Journey Through Time Masterplan*, AIUla, 2021.

<sup>22</sup> *Annual Report 2023 of Neom on Social Responsibility*, of 6<sup>th</sup> August 2024, available online.

<sup>23</sup> *Report of Red Sea Global on Unlocking Innovation for Regenerative Tourism*, of 25<sup>th</sup> June 2025, available online.

However, the development opportunities associated with the blue economy and large-scale economic transformation projects increasingly depend on the capacity to preserve the Red Sea's marine and coastal ecosystems. The long-term sustainability of these strategies is intrinsically linked to the conservation of natural resources, upon which essential economic sectors such as fisheries, tourism, maritime transport, and the resilience of coastal communities ultimately depend<sup>24</sup>.

Today, the Red Sea's exceptional natural and cultural heritage is increasingly threatened by pollution, climate change, and the risk of environmental accidents capable of undermining ecosystem integrity and biological productivity, thereby jeopardizing the livelihoods of millions of people living along its coasts. Fisheries constitute a vital economic resource for several littoral states, including Egypt, Sudan, Saudi Arabia, and Eritrea. Marine living resources contribute not only to food security but also to employment, export revenues, and the socioeconomic resilience of coastal communities, albeit basin-specific figures on economic exposure to dependence on maritime activities and product-concentration economic indicators are not available to date in the public domain.

This strong dependence on maritime activities makes many coastal communities particularly vulnerable to economic, political, and environmental shocks. Any disruption affecting international trade, tourism, or fisheries may therefore have immediate consequences for local livelihoods and socioeconomic stability. At the same time, the region's growing economic integration has generated uneven patterns of development, contributing to the modernization of major port cities while leaving other coastal areas comparatively marginalized. Such asymmetries further reinforce the multidimensional nature of maritime fragility by increasing social and economic disparities within the basin.

The Red Sea also possesses considerable strategic importance as a source of water security. In one of the world's most water-scarce regions, the widespread deployment of desalination plants has transformed seawater into an essential source of freshwater for domestic, industrial, and agricultural consumption. Desalination now constitutes a fundamental pillar of water security in countries such as Saudi Arabia and Jordan, where natural freshwater resources are

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<sup>24</sup> K. HAGGAR, *Balancing Conservation and Growth: A Framework for Protecting Red Sea Biodiversity*, in Roland Berger, Munich, 2024, available online.

extremely limited. This dependence, however, creates new strategic vulnerabilities by exposing national water-supply systems to operational disruptions, cyber threats, and potential attacks against critical infrastructure. Recent regional crises have demonstrated that the security of desalination facilities has become an integral component of the national security of several Red Sea littoral states.

The rapid expansion of desalination also poses significant environmental challenges. Together with overexploitation of fish stocks, pollution, and the broader impacts of climate change, desalination may contribute to declining biological productivity, the degradation of coastal ecosystems, and increased ecological stress resulting from the discharge of highly saline brine into marine environments. These pressures risk generating additional economic and social tensions for communities whose livelihoods depend directly on the sustainable use of marine resources, further illustrating the close interdependence between environmental sustainability, human security, and regional stability.

In recent years, several Red Sea littoral states have progressively expanded their networks of Marine Protected Areas (MPAs), recognizing the strategic value of the region’s coral reefs, mangrove forests, and seabed ecosystems not only from an ecological perspective but also as fundamental components of environmental, economic, and climate security<sup>25</sup>. Scientific research has shown that many coral reef ecosystems in the Red Sea, particularly those located in its northern sector and in the Gulf of Aqaba, display a significantly higher tolerance to elevated sea temperatures than coral reefs in many other tropical regions. These corals appear to possess an unusually high thermal threshold, leading some scholars to identify the northern Red Sea as a potential *climate refuge* for the long-term conservation of coral reef ecosystems worldwide<sup>26</sup>.

Against this background, the establishment and expansion of MPAs perform functions that extend beyond the conservation of biodiversity alone. They represent important instruments of climate-change adaptation by reducing local anthropogenic pressures – including overfishing, coastal urbanization, marine pollution, and unsustainable tourism – thereby enhancing the resilience of marine ecosystems to the impacts of global warming. Consequently, marine conservation has become an increasingly important component of

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<sup>25</sup> KINGDOM OF SAUDI ARABIA, *Saudi Vision 2030*, cit.

<sup>26</sup> M. L. BERUMEN ET AL., *Coral Reefs of the Red Sea*, XI, Thuwal, 2019.

broader strategies aimed at strengthening the long-term resilience and sustainability of the Red Sea.

Therefore, the conservation policies adopted by Egypt, Saudi Arabia, and Jordan form part of a broader strategy aimed at safeguarding a natural heritage of growing scientific, economic, and geopolitical significance. In particular, the protection of the Red Sea's coral reefs is now regarded as essential not only for preserving marine biodiversity but also for ensuring the food security of coastal communities, supporting the development of the blue economy, and strengthening the environmental resilience of the region as a whole.

Marine Protected Areas (MPAs) play a fundamental role in conserving biodiversity and maintaining ocean productivity. By restricting harmful activities such as overfishing, uncontrolled coastal development, and marine pollution, they contribute to preserving the ecological balance of the marine environment and enhancing the resilience of coastal ecosystems. In Egypt, for example, Ras Mohammed National Park represents one of the most renowned and ecologically significant MPAs in the Red Sea. Home to an exceptional diversity of coral reefs, fish, and other marine species, it also serves as an important centre for scientific research and sustainable tourism.

In parallel, national and regional programmes for scientific research, environmental monitoring, and ecosystem restoration have been launched by institutions such as the General Organization for the Conservation of Coral Reefs and Turtles in the Red Sea (SHAMS)<sup>27</sup> and Saudi Arabia's National Center for Wildlife<sup>28</sup>. At the international level, these initiatives form part of a broader network of scientific and environmental cooperation involving UNESCO<sup>29</sup>, the International Coral Reef Initiative (ICRI)<sup>30</sup>, United Nations agencies, and numerous research institutions dedicated to the conservation and sustainable management of coral reef ecosystems.

The protection of marine ecosystems is not merely an environmental priority; it is also an essential component of regional economic security, as it is directly linked to the sustainability of fisheries, tourism, and other activities associated with the blue

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<sup>27</sup> GENERAL ORGANIZATION FOR THE CONSERVATION OF CORAL REEFS AND TURTLES IN THE RED SEA (SHAMS), *What Is SHAMS Doing?*, Riyadh, 2024, available online.

<sup>28</sup> NATIONAL CENTER FOR WILDLIFE, *The Wildlife Research Program: A Study and Evaluation of Coral Reefs in the Red Sea*, Riyadh, 2023, available online.

<sup>29</sup> UNESCO, *World Heritage Marine Programme*, Paris, 2005.

<sup>30</sup> INTERNATIONAL CORAL REEF INITIATIVE (ICRI), *Member Activities and Coral Reef Conservation Programmes*, 2024.

economy. Effective management of these areas requires sustained investment, international cooperation, and robust monitoring and enforcement mechanisms capable of addressing illegal fishing and marine pollution. Despite the conservation measures adopted in recent years, however, the Red Sea remains exposed to a wide range of environmental risks.

One of the region’s principal environmental challenges arises from accidents associated with maritime traffic. Thousands of vessels cross the Red Sea every year carrying oil, gas, and industrial goods. This intense level of activity increases the risk of collisions, fuel leaks, and the release of hazardous substances. Oil spills pose a particularly serious threat to marine ecosystems. Coral reefs and fish stocks are especially vulnerable to pollution, which can cause long-lasting damage both to the environment and to local economies dependent on fisheries and tourism.

Climate change represents a further and increasingly serious danger. Rising sea temperatures and ocean acidification are placing growing pressure on the coral reefs of the Red Sea<sup>31</sup>. Although these corals are generally considered more resilient than those found in many other tropical ecosystems, global warming may nevertheless compromise their long-term survival. A further source of concern is pollution generated by urban and industrial activities. Untreated wastewater, plastics, and chemical substances frequently enter the marine environment, damaging marine flora and fauna. In addition, the rapid expansion of tourism in several coastal destinations has increased both the consumption of natural resources and the volume of waste generated.

Among the principal security challenges affecting the Red Sea is maritime piracy, particularly in the Gulf of Aden. Since the early 2000s, armed groups operating primarily from Somalia have repeatedly attacked merchant vessels and oil tankers, hijacking ships, taking crews hostage, and demanding multimillion-dollar ransoms. Between 2008 and 2012, Somali piracy reached such unprecedented levels that it became one of the most serious threats to the security of international commercial shipping. The phenomenon was fuelled by the collapse of the Somali state, the absence of effective control over territorial waters, and the prospect of obtaining substantial ransom payments. According to data from the International Maritime Bureau

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<sup>31</sup> C. R. VOOLSTRA ET AL., *Coral reefs of the Red Sea — Challenges and potential solutions*, in *Regional Studies in Marine Science*, 25, 2019, available online.

(IMB)<sup>32</sup>, attacks attributed to Somali pirate groups increased from 111 in 2008 to 217 in 2009, accounting for approximately half of all reported piracy incidents worldwide. Piracy reached its peak in 2011, when more than 200 attacks were recorded, numerous merchant vessels and oil tankers were hijacked, and hundreds of seafarers were held hostage.

The strategic importance of the Gulf of Aden and the maritime routes linking the Red Sea with the Indian Ocean prompted an unprecedented international response. In 2008, the European Union launched Operation Atalanta (EUNAVFOR Somalia)<sup>33</sup>, the first naval mission conducted under the framework of the Common Security and Defence Policy (CSDP). NATO subsequently initiated Operation Ocean Shield<sup>34</sup>, while several states – including the United States, China, India, Japan, and Russia – deployed naval forces to the region in order to protect commercial shipping and safeguard freedom of navigation.

The combined efforts of these international naval missions, together with the widespread adoption of the Best Management Practices (BMP)<sup>35</sup> by the shipping industry and the increasing use of privately contracted armed security personnel on board merchant vessels, contributed to a dramatic decline in pirate attacks. From 2012 onwards, the number of successful hijackings fell rapidly, and piracy gradually became an episodic rather than a systemic threat. Although Somali piracy has been significantly reduced compared with the peak levels recorded between 2008 and 2012, ensuring the security of commercial shipping lanes continues to justify a substantial international naval presence in the Gulf of Aden and the wider Red Sea region.

Although the number of successful attacks has declined dramatically since 2012, allowing the basin to receive a medium exposure score (2/5) for piracy in the SFF, structural vulnerabilities associated with one of the world's busiest maritime trade corridors persist, suggesting that continued investment in resilience is

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<sup>32</sup> *Annual Reports of International Maritime Bureau (IMB) on Piracy and Armed Robbery Against Ships, 2008*, available online; *Annual Reports of International Maritime Bureau (IMB) on Piracy and Armed Robbery Against Ships, 2011*, available online.

<sup>33</sup> Council Joint Action 2008/851/CFSP of 10 November 2008 on a European Union Military Operation to Contribute to the Deterrence, Prevention and Repression of Acts of Piracy and Armed Robbery off the Somali Coast.

<sup>34</sup> NORTH ATLANTIC TREATY ORGANIZATION (NATO), *Operation Ocean Shield*, Sandy Lane, 2016, available online.

<sup>35</sup> INTERNATIONAL CHAMBER OF SHIPPING, *Maritime Industry Associations launch consolidated BMP Maritime Security publication*, London, 2025, available online.

necessary. Furthermore, the Framework assigns a medium level of exposure (3/5) to the conflict events targeting ports and energy infrastructure, highlighting the extent to which the security of the basin continues to depend on sustained international maritime operations and external military engagement.

This international naval presence must be understood within the broader context of the progressive militarization of the Red Sea, driven not only by the need to combat piracy but also by the strategic competition among regional and extra-regional powers. The Red Sea is, in fact, one of the regions with the highest concentration of foreign military bases in the world. Numerous states have established military facilities along its shores in order to safeguard maritime trade routes, project military power, and consolidate their geopolitical influence.

Djibouti occupies a particularly prominent position in this context. Located near the Bab el-Mandeb Strait, it has emerged as one of the world's most important strategic military hubs. The country hosts military bases operated by the United States, France, China, Japan, and Italy, reflecting the exceptional strategic importance attached to the control of the Red Sea and one of the world's principal maritime chokepoints.

Regional rivalries have further accelerated the militarization of the basin. As discussed above, the conflict in Yemen, which began in 2015, has had direct repercussions for the security of the Red Sea. The Houthi movement, supported by Iran while simultaneously pursuing its own autonomous political agenda, has repeatedly targeted merchant vessels and energy infrastructure, contributing to heightened regional tensions and threatening freedom of navigation. In response, Saudi Arabia and the UAE have strengthened their military presence along the Red Sea in order to protect commercial shipping and counter the security threats arising from the Yemeni conflict. Iran, for its part, has likewise sought to expand its regional influence, further intensifying the geopolitical rivalry among the principal powers of West Asia. More broadly, the deterioration of the regional security environment has led to an increasing concentration of naval forces, with the Red Sea currently hosting the simultaneous presence of numerous navies whose strategic interests frequently diverge.

The Red Sea is also affected by a wide range of transnational security threats, including terrorism, arms trafficking, drug trafficking, human trafficking, and smuggling. Its geographical position at the crossroads of Africa, West Asia, and Asia makes it one of the

principal maritime corridors linking regions characterized by high levels of political instability with major commercial and migratory flows. From a security perspective, particular attention must be devoted to the activities of extremist organizations operating in both the Horn of Africa and the Arabian Peninsula. Groups such as Al-Shabaab in Somalia and Al-Qaeda in the Arabian Peninsula (AQAP) have, at various stages, exploited weak state institutions and the limited capacity of governments to control both territory and maritime spaces, using regional routes to facilitate the movement of fighters, weapons, and financial resources.

In particular, the SFF highlights terrorism – as defined by the United Nations<sup>36</sup> – as a core risk area in terms of exposure in the Red Sea. Indeed, within the domain of Military Security, terrorism presents the highest fragility score. Alongside the threat of terrorism, the Red Sea constitutes one of the world's principal transit corridors for a wide range of illicit trafficking activities. Criminal networks exploit the complexity of maritime routes and the limited capacity to monitor vast maritime spaces in order to transport narcotics, weapons, and contraband goods. Particularly significant is the trafficking of human beings, which primarily affects migrants originating from the Horn of Africa, many of whom are exposed to violence, exploitation, and serious violations of their fundamental rights along migration routes. These activities not only threaten maritime security but also fuel illicit economies, political instability, and armed conflict by providing financial resources to criminal networks and extremist organizations. Countering these challenges therefore requires a high degree of international cooperation, combining naval operations, intelligence sharing, customs controls, technological monitoring of maritime routes, and judicial cooperation among the states concerned.

Beyond posing a direct threat to maritime security, these illicit activities contribute to political instability, the expansion of informal and criminal economies, and the financing of armed groups operating throughout the region. The Red Sea is not only a strategically important maritime space from economic and geopolitical perspectives but also a region whose stability is closely intertwined with the everyday lives of millions of people. Maritime activities shape employment, economic development, migration patterns, and social stability across the littoral states. At the same time, the basin is

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<sup>36</sup> United Nations General Assembly, *International Convention for the Suppression of the Financing of Terrorism*, Resolution 54/109 of 9 December 1999.

affected by a range of human and social challenges, including labour exploitation, the economic dependence of coastal communities on maritime industries, the consequences of systemic shocks, and migration flows driven by armed conflict, environmental degradation, and poverty, all of which have the potential to generate significant social tensions.

Maritime trade and port activities in the Red Sea depend upon the labour of thousands of workers employed in shipping, transport, fisheries, logistics, port infrastructure, and related services. Nevertheless, many of these workers continue to face difficult working conditions and various forms of economic and social exploitation. Seafarers and dockworkers frequently endure prolonged periods under demanding conditions, often characterized by low wages, limited labour protection, and inadequate occupational safeguards. In several littoral states, particularly those marked by greater economic and institutional fragility, maritime employment remains affected by precarious working conditions, limited social protection, and insufficient occupational safety standards.

Intensive industrial fishing has further reduced the availability of marine resources for local communities, exacerbating existing socio-economic inequalities. At the same time, the Red Sea’s maritime routes are increasingly associated with human trafficking and contemporary forms of labour exploitation, particularly affecting migrants and other vulnerable workers, who may become victims of abuse either during their journeys or within the port, logistics, and maritime transport sectors. From the perspective of the SFF, these dynamics are reflected in several interrelated indicators, both in the Social / Institutional domain and in the Legal one. Rather than constituting isolated challenges, the indicators of the above-mentioned domains reinforce one another, confirming how maritime fragility extends well beyond traditional security concerns to encompass human and social dimensions, as discussed in Chapter 1.

International organizations and national governments have sought to improve these conditions through the adoption of maritime labour regulations and enhanced oversight of employment practices. Nevertheless, the region’s persistent economic and political challenges continue to hinder the effective protection of human rights. The rights and working conditions of seafarers are governed primarily by the International Labour Organization’s (ILO) *Maritime Labour Conven-*

tion (MLC, 2006)<sup>37</sup>, which entered into force in 2013 and is now widely regarded as the principal international legal framework governing maritime labour. The Convention consolidated and modernized dozens of earlier ILO instruments by establishing minimum standards concerning conditions of employment, hours of work and rest, medical care, social security, accommodation on board, food and catering, as well as the overall welfare of seafarers. Owing to its comprehensive scope and its certification and inspection system applicable both to flag states and port states, the MLC is widely recognized as the “fourth pillar” of international maritime law, alongside the *International Convention for the Safety of Life at Sea* (SOLAS)<sup>38</sup>, which governs the safety of ships and persons on board; the *International Convention for the Prevention of Pollution from Ships* (MARPOL)<sup>39</sup>, which establishes the principal international framework for preventing ship-source marine pollution; and the *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers* (STCW)<sup>40</sup>, which regulates the professional training, certification, and competencies of seafarers.

Today, the MLC constitutes the principal international legal instrument for ensuring decent working and living conditions for more than one million seafarers employed in global maritime trade. In recent years, however, the Red Sea has been affected by a succession of systemic shocks with significant economic and social consequences. Armed conflicts, energy crises, pandemics, and escalating geopolitical tensions have highlighted the high degree of vulnerability of coastal communities to disruptions affecting global maritime trade and regional stability. Among the systemic shocks that have affected the Red Sea in recent years, the COVID-19 pandemic, the 2021 blockage of the Suez Canal, and a series of regional conflicts have clearly demonstrated the vulnerability of this strategically important maritime basin. The pandemic had severe repercussions for both tourism and maritime trade, resulting in the loss of thousands of jobs, particularly in coastal cities whose economies depend heavily on

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<sup>37</sup> International Labour Organization (ILO), *Maritime Labour Convention*, adopted by the 94th (Maritime) Session of the International Labour Conference (ILC) on 23 February 2006.

<sup>38</sup> International Maritime Organization (IMO), *International Convention for the Safety of Life at Sea (SOLAS)*, of 1 November 1974.

<sup>39</sup> International Maritime Organization (IMO), *International Convention for the Prevention of Pollution from Ships (MARPOL)*, of 2 November 1973.

<sup>40</sup> International Maritime Organization (IMO), *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW)*, of 7 July 1978.

tourism and port-related activities. Regional conflicts, most notably the war in Yemen, have likewise generated profound humanitarian and socioeconomic consequences. Political instability and armed violence have undermined the security of maritime routes, exacerbated the living conditions of civilian populations, and contributed to rising poverty, unemployment, and social tensions. Consequently, the stability of the Red Sea is not merely a matter of international geopolitical and economic interest, but also a prerequisite for the well-being of local communities and the social cohesion of the region as a whole. Migration flows form an integral part of this broader picture, as they are closely linked to the economic, political, and social conditions prevailing throughout the Red Sea region.

For decades, the Red Sea has constituted one of the principal migration corridors linking Africa and West Asia. Every year, thousands of people cross the region in search of safety, employment, and improved living conditions. Many migrants originating from the Horn of Africa – particularly Eritrea, Ethiopia, and Somalia – attempt to reach the Arabian Peninsula by crossing the Red Sea. These migratory movements are driven by a combination of armed conflict, political persecution, poverty, climate change, and limited economic opportunities. These maritime crossings are frequently undertaken under extremely hazardous conditions. Migrants often travel aboard overcrowded and unseaworthy vessels, exposing themselves to the risks of shipwreck, violence, and exploitation by human trafficking networks. Humanitarian crises further aggravate these dangers. The conflict in Yemen, for example, has transformed one of the principal destinations for migrants into an active conflict zone, substantially increasing the risks faced by civilians, refugees, and asylum seekers.

The migratory dynamics and humanitarian crises affecting the Red Sea generate not only profound human and social consequences but also significant legal and governance challenges for the international maritime order. From the perspective of the factors discussed throughout this chapter, the Red Sea is one of the world's most strategically important maritime regions, not only in geopolitical and economic terms but also from a legal perspective. Crossed annually by thousands of merchant vessels and oil tankers, it constitutes a maritime space where issues of public international law, the law of the sea, international commercial law, human rights, maritime security, and the suppression of illicit activities converge.

The presence of regional conflicts, transnational criminal networks, and so-called “shadow fleets” further complicates both the implementation of international legal norms and the effective enforcement of the rule of law at sea. Governing a maritime space traversed by some of the world’s busiest shipping routes therefore requires a comprehensive international legal framework capable of regulating navigation, maritime security, the exploitation of marine resources, and the protection of the legitimate interests of littoral states.

The legal governance of the Red Sea is founded primarily upon the *United Nations Convention on the Law of the Sea* (UNCLOS)<sup>41</sup>, adopted at Montego Bay (Jamaica) on 10 December 1982 and entering into force on 16 November 1994. Commonly described as the “Constitution of the Oceans”, UNCLOS constitutes the principal international legal framework governing maritime spaces. It establishes the rights and obligations of states with respect to the territorial sea, the contiguous zone, the Exclusive Economic Zone (EEZ), the continental shelf, the high seas, the exploitation of marine resources, the protection of the marine environment, marine scientific research, and the peaceful settlement of disputes. Within the context of the Red Sea, the Convention assumes particular significance because of the strategic nature of the basin, where numerous coastal states pursue economic, energy, and security interests that frequently diverge. Of particular importance are the provisions contained in Part III of UNCLOS concerning straits used for international navigation, which establish the regime of *transit passage* and guarantee the uninterrupted movement of vessels through maritime chokepoints that are essential to global trade, including the Bab el-Mandeb Strait.

Alongside the legal regime established by UNCLOS for straits used for international navigation, the regional maritime transport system also includes the Suez Canal, which is governed by a distinct legal framework derived from the *Convention of Constantinople* of 1888. Although subject to its own legal regime, the Canal forms an integral component of the broader maritime system connecting the Mediterranean Sea with the Indian Ocean, thereby reinforcing the Red Sea’s role as one of the principal arteries of contemporary globalization. The effective implementation of international legal norms in the region nevertheless faces numerous challenges.

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<sup>41</sup> United Nations, *Resolution 3067 (XXVIII)*. *United Nations Convention on the Law of the Sea* (UNCLOS), of 10 December 1982.

Persistent geopolitical tensions, armed conflicts, the institutional fragility of several littoral states, and competition over the control of marine resources and strategic infrastructure often hinder meaningful regional cooperation. Disputes concerning the delimitation of maritime boundaries, the management of Exclusive Economic Zones (EEZs), and the exploitation of marine resources are further intertwined with security challenges relating to piracy, terrorism, illicit trafficking, and the protection of critical maritime infrastructure. In this context, the Red Sea represents a paradigmatic example of the tension between the principle of freedom of navigation – one of the cornerstones of the international law of the sea – and the national and collective security interests pursued by states and other international actors operating in the region. The long-term stability of the Red Sea therefore depends not only on the effective implementation of the rules of the international law of the sea, but also on the political willingness of the actors concerned to cooperate in the governance of one of the world's most strategic and fragile maritime spaces.

Among the challenges that have emerged in recent years, the growing phenomenon of so-called *shadow fleets* has attracted increasing international attention. These fleets consist of vessels operating through opaque ownership structures, frequent changes of registration, the extensive use of flags of convenience, and the deliberate deactivation of Automatic Identification System (AIS) transponders in order to evade international monitoring and sanctions regimes. Shadow fleets are primarily employed to transport crude oil and other commodities subject to international restrictions. The phenomenon poses a significant challenge to international maritime law, as competent authorities often encounter considerable difficulties in identifying the beneficial owners of vessels and verifying compliance with applicable legal standards. Moreover, many of these vessels are ageing and subject to limited safety oversight, thereby increasing the risk of maritime accidents and environmental pollution.

The proliferation of shadow fleets illustrates how the Red Sea has become a maritime space in which economic interests, geopolitical competition, and practices aimed at circumventing international legal and regulatory frameworks increasingly converge, placing the effectiveness of contemporary international maritime governance under growing strain.

Beyond its economic and geopolitical centrality, the Red Sea has in recent years acquired growing strategic significance in the fields of

digital infrastructure and telecommunications, emerging as one of the world's most critical nodes of global connectivity. The Mediterranean-Suez-Red Sea digital corridor constitutes one of the principal routes through which data flows between Europe, Asia, and Africa. The submarine fibre-optic cables crossing Egypt and the Red Sea form one of the most important digital chokepoints within the international system<sup>42</sup>.

According to the most widely accepted estimates, more than 90% of data transmission capacity between Europe and Asia passes through cable systems crossing the Red Sea, while numerous strategic connections linking Europe, Asia, and Africa converge along the Suez–Red Sea corridor. The strategic importance of this infrastructure lies in the fact that submarine cables carry the overwhelming majority of global data traffic, including financial communications, cloud services, commercial transactions, digital platforms, and the information systems underpinning international supply chains. The uninterrupted functioning of these networks has therefore become an essential prerequisite for the stability of the global economy<sup>43</sup>. Submarine cables, however, are inherently vulnerable to both accidental damage and deliberate attacks. In the Red Sea, this vulnerability is further amplified by intense maritime traffic, persistent geopolitical tensions, and ongoing regional conflicts. Alongside the risks posed by ship anchors, fishing activities, and geological events, increasing attention has been devoted to the possibility of intentional sabotage, reflecting the growing recognition of digital infrastructure as a strategic target in contemporary geopolitical competition<sup>44</sup>.

According to the SFF, submarine digital infrastructure represents one of the Red Sea's highest sources of vulnerability and fragility. The basin receives the maximum exposure score (5/5) for submarine cables, reflecting the exceptional concentration of global data flows passing through the Mediterranean-Suez-Red Sea corridor. Any disruption to this infrastructure – whether accidental or deliberate – would have consequences extending far beyond the region, affecting global communications, financial markets, digital services, and international supply chains. Any disruption to these networks could produce significant consequences not only for international

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<sup>42</sup> A. MAULDIN, *The Red Sea: A Key Subsea Cable Crossroads Under Siege*, in *Telegeography*, 2024, available online.

<sup>43</sup> E. L. MURPHY, T. BRYJA, *The Strategic Future of Subsea Cables: Egypt Case Study*, cit.

<sup>44</sup> INTERNATIONAL TELECOMMUNICATION UNION (ITU), *Submarine Cable Resilience*, cit.

communications but also for financial services, digital platforms, and global supply chains. To safeguard the Red Sea's digital infrastructure, numerous states and international organizations have strengthened both maritime and cyber security measures. Naval surveillance activities in the region increasingly include the monitoring of areas traversed by submarine cable systems, while telecommunications companies continue to invest in protection, surveillance, and rapid repair capabilities in order to minimize the risk of service disruption. In some cases, alternative cable routes have also been developed to ensure the continuity of communications in the event of damage to the principal infrastructure.

The protection of submarine digital infrastructure has therefore become essential not only for the security of the Red Sea itself but also for the resilience of the global digital economy and the functioning of the communication networks upon which an ever-growing share of contemporary economic activity depends. Precisely because global telecommunications are inherently interconnected and interdependent, international cooperation plays a fundamental role in the protection and governance of these strategic infrastructures. Cybersecurity has consequently emerged as an additional security priority, since telecommunications networks are vulnerable not only to physical damage but also to cyberattacks capable of disrupting data transmission and communication systems.

In light of the geographical, economic, social, legal, and security dimensions examined thus far, it becomes evident that the Red Sea also constitutes one of the most politically complex and strategically significant maritime regions within the contemporary international system. The basin is characterized by fragmented governance, competition among regional and extra-regional powers, the growing influence of non-state actors, and persistent political instability. Within this context, one of the principal challenges lies in the development of a stable, inclusive, and effective regional governance framework. The Red Sea littoral states display markedly different political systems, economic interests, and strategic priorities. Countries such as Egypt, Saudi Arabia, Sudan, Eritrea, Djibouti, Yemen, and Jordan differ considerably in terms of economic development and political stability. While some are affected by internal or regional conflicts, others seek to strengthen their geopolitical influence through economic investment and an expanded military presence.

The absence of a strong and cohesive regional organization makes it difficult to address common challenges such as maritime security, the management of marine resources, illicit trafficking, and environmental protection. Although several initiatives have sought to promote regional cooperation among the Red Sea littoral states, national interests have frequently prevailed over the development of a shared strategic vision. Political fragmentation is further exacerbated by the involvement of external actors, whose interventions continue to shape the regional balance of power. Both global and regional powers regularly engage in the basin to protect their economic, energy, and strategic interests, thereby intensifying geopolitical competition. An important institutional response to the growing geopolitical competition in the Red Sea was the establishment, in January 2020, of the *Council of Arab and African States Bordering the Red Sea and Gulf of Aden* (commonly referred to as the *Red Sea Council*)<sup>45</sup>. Promoted by Saudi Arabia and headquartered in Riyadh, the organization brings together the eight Arab and African littoral states bordering the Red Sea and the Gulf of Aden – Saudi Arabia, Egypt, Jordan, Sudan, Yemen, Eritrea, Djibouti, and Somalia – with the objective of enhancing political coordination, economic cooperation, maritime security, and the protection of commercial shipping routes along one of the world's most strategically important maritime chokepoints.

From the Saudi perspective, the Council was intended to serve as a regional governance platform capable of addressing, through multilateral cooperation, challenges such as piracy, illicit trafficking, terrorism, and political and military instability, while simultaneously promoting economic development, foreign investment, and the sustainable management of marine resources. Despite these ambitions, however, the organization has thus far achieved only limited results and has failed to establish itself as an effective mechanism for collective security, primarily because of strategic divergences among its member states and the intensifying competition among regional and extra-regional powers operating in the basin. Among the regional actors, Saudi Arabia and Egypt are generally regarded as the principal powers shaping the geopolitics of the Red Sea, with both seeking to expand their political, economic, and military influence throughout

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<sup>45</sup> SAUDI PRESS AGENCY, *Foreign Minister: The Council of Arab and African Coastal States of the Red Sea and the Gulf of Aden is a Joint Action System for Coordination and Cooperation*, Riyadh, 6 January 2020, available online.

the region. Egypt exercises control over the Suez Canal, one of the world's most strategic maritime chokepoints. This position provides Cairo with a pivotal role in the management of international shipping routes and the security of the Red Sea, making regional stability a fundamental national priority. Saudi Arabia, for its part, seeks to transform the Red Sea into a key pillar of its economic and geopolitical strategy. Through major investments in infrastructure, logistics, tourism, and maritime development, Riyadh aims to strengthen its regional influence while diversifying its economy beyond the hydrocarbon sector, with the broader objective of consolidating its position as one of the principal economic and logistical hubs connecting Europe, Asia, and Africa.

Despite growing recognition of shared maritime challenges, the absence of an effective and inclusive institutional framework in the Red Sea continues to constrain collective responses to security threats, environmental degradation, critical infrastructure protection, and the sustainable management of maritime resources. The persistence of competing national interests and external geopolitical rivalries therefore reinforces the multidimensional potential source of fragility of the Red Sea, demonstrating that governance constitutes a cross-cutting factor capable of amplifying vulnerabilities across all other dimensions of the framework. The UAE and Iran also play significant roles in the regional geopolitical competition. Over the past fifteen years, the UAE has developed an extensive network of port, logistics, and infrastructure investments across the Horn of Africa, relying primarily on state-owned or state-backed operators, most notably DP World. This strategy has focused in particular on the ports of Berbera (Somaliland) and Bosaso (Puntland), as well as on the use of the Assab military base in Eritrea, thereby establishing a far-reaching geo-economic and maritime projection along the Persian Gulf-Bab el-Mandeb-Red Sea axis<sup>46</sup>.

Through long-term concession agreements and investments in port infrastructure, hinterland logistics, and land transport corridors connecting ports with the African interior, Abu Dhabi has sought to enhance the security of its maritime trade routes, reduce the vulnerability of its supply chains, and expand its strategic influence over one of the world's most important maritime chokepoints. The Port of Berbera represents the clearest example of this strategy.

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<sup>46</sup> A. KOCAK, *Dubai Ports World as the UAE Foreign Policy Tool*, in Clingendael Institute, Wassenaar, 2020, available *online*.

Operated by DP World under a long-term concession, it has gradually been transformed into an integrated logistics hub designed to serve not only Somaliland but also Ethiopia and, more broadly, the commercial flows of the Horn of Africa<sup>47</sup>. The economic dimension of these investments is therefore inseparable from their geopolitical significance. Control over port infrastructure and associated logistics networks enables the UAE to exercise considerable strategic influence along the principal maritime corridors linking the Indian Ocean, the Gulf of Aden, the Red Sea, and the Mediterranean. At the same time, Iran continues to pursue a strategy of regional power projection based on political, military, and ideological alliances, one of whose principal manifestations is its involvement in the Yemeni conflict.

The United States, China, Russia, and the European states likewise regard the Red Sea as a region of fundamental importance for global security and international trade. The United States maintains a substantial military presence to safeguard freedom of navigation and protect strategic energy routes, while simultaneously facing increasingly complex challenges arising from regional instability and intensifying geopolitical competition. China has significantly expanded its presence through infrastructure investments associated with the Belt and Road Initiative (BRI) and by establishing its first overseas military base in Djibouti. Russia has sought to strengthen its diplomatic and military presence throughout the region, while the European Union continues to contribute to maritime security through naval operations aimed at combating piracy and illicit trafficking. The simultaneous presence of numerous global and regional powers has transformed the Red Sea into one of the principal theatres of contemporary geopolitical competition. While each actor seeks to protect its own strategic, economic, and security interests, their growing involvement has also contributed to the progressive militarization of the region, further reinforcing the multidimensional fragility of one of the world's most strategic maritime spaces.

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<sup>47</sup> AFRICA CENTER FOR STRATEGIC STUDIES, *Mapping Gulf State Actors' Expanding Engagements in East Africa*, cit.

## SFF Fragility score for the Red Sea

SFF score: 9.6 – “Medium-High”

| Domain                 | Score |
|------------------------|-------|
| Economic               | 0.64  |
| Environmental          | 1.44  |
| Political              | 1.38  |
| Military security      | 0.65  |
| Social / Institutional | 1.55  |
| Legal (enforcement)    | 1.48  |
| Technological          | 2.50  |

3.2. In light of the analysis presented throughout this chapter, it can reasonably be concluded that the fragility level of the Red Sea cannot be attributed to a single cause or even to a limited set of independent factors. Rather, it emerges from the interaction of multiple geographical, geopolitical, economic, environmental, legal, technological, and social dimensions that mutually reinforce one another. The application of the SFF demonstrates that the Red Sea exhibits high levels of exposure across a broad range of indicators, confirming the multidimensional nature of maritime fragility. From a geographical perspective, the Red Sea’s semi-enclosed configuration and its dependence on two narrow maritime chokepoints – the Bab el-Mandeb Strait and the Suez Canal – create an intrinsic structural vulnerability. This geographical condition is amplified by the basin’s exceptional strategic importance. The Red Sea constitutes one of the world’s principal corridors for maritime trade, energy transportation, global logistics, submarine digital communications, and international connectivity. Consequently, any disruption occurring within this maritime space rapidly generates consequences that extend far beyond the regional level, affecting global supply chains, financial markets, energy security, and digital communications.

The application of the SFF further reveals that the highest levels of fragility are associated with those dimensions where strategic relevance and structural vulnerability most closely overlap. In particular, environmental issues, the protection of submarine cable infrastructure, the security of international maritime routes, and the legal governance of navigation under the framework of the *United Nations Convention on the Law of the Sea* (UNCLOS) emerge as the most critical components of the basin. These are complemented by high levels of exposure related to regional armed conflicts, geopolitical competition, foreign military presence, terrorism, piracy, illicit trafficking, migration flows, environmental degradation, critical infrastructure, and fragmented regional governance. Rather than constituting separate sources of risk, these factors interact continuously, generating cascading effects capable of amplifying the overall fragility of the maritime system. Unlike an open sea, where many of these pressures would be geographically dispersed, the Red Sea concentrates an exceptional density of strategic infrastructures, commercial routes, military deployments, and political rivalries within a relatively confined maritime space. Likewise, were the basin not one of the world's principal economic, logistical, energy, and digital corridors, it would attract considerably less geopolitical competition, military projection, and illicit activity.

The political context further reinforces these structural vulnerabilities. Many of the Red Sea littoral states have experienced revolutions, *coups d'état*, civil wars, institutional crises, or prolonged political instability over recent decades. Weak governance, uneven economic development, and persistent regional rivalries have complicated the construction of stable and cooperative regional institutions capable of addressing common maritime challenges. At the same time, the increasingly competitive relationships among global powers have further reduced opportunities for effective multilateral governance, making long-term regional strategies more difficult to achieve and increasing the likelihood of security crises, humanitarian emergencies, and economic disruption. Overall, the Red Sea exhibits a level of structural fragility consistent with the "Medium-High" Fragility category, reflecting the presence of multiple interacting vulnerabilities that significantly constrain the resilience of the MRS while leaving important adaptive capacities in place. Its resilience continues to depend upon the uninterrupted functioning of

maritime trade, international legal regimes, regional cooperation, and external security arrangements.

More than simply a maritime space, the Red Sea has become a systemic node of contemporary globalization, where energy security, international trade, digital connectivity, maritime governance, environmental sustainability, human security, migration, and geopolitical competition converge. It is precisely this exceptional concentration of strategic functions that transforms the basin into one of the world's most fragile and geopolitically significant maritime regions. The Red Sea therefore constitutes not merely a regional sea but a global maritime connector whose stability increasingly conditions the resilience of the wider international order.

### Sea Fragility Framework: Red Sea

BASIN NAME: Red Sea | TYPE: Regional Sea | FUNCTIONAL ROLE: Connector | SFF SCORE: 9,67/35,00 | COMPLETENESS SCORE: 98,28%

| Domain                       | Risk Area (R)                                                 | Risk value (basin) | Exposure indicator                                                                                       | Exposure score | Resilience indicator                                                                                   | Resilience score |
|------------------------------|---------------------------------------------------------------|--------------------|----------------------------------------------------------------------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------|------------------|
| <b>I. Economic</b>           | <b>Domain Score</b>                                           | <b>0.65</b>        |                                                                                                          |                |                                                                                                        |                  |
| I. Economic                  | Maritime routes & international trade                         | 1.67               | Share of vessel traffic via chokepoints compared to systemic basin ports                                 | 5              | # of trading ports with high connectivity (75th percentile) / global number of high connectivity ports | 3                |
| I. Economic                  | Minerals                                                      | 0.25               | Count of ISA contested seabed/mineral claims intersecting the basin                                      | 1              | Share of littoral states party to UNCLOS (& ISA membership) – %                                        | 4                |
| I. Economic                  | Energy                                                        | 0.33               | Oil & gas rents as % of GDP (basin mean of littoral states)                                              | 1              | Trade-Concentration-Weighted Energy Exposure                                                           | 5                |
| I. Economic                  | Blue economy                                                  | 0.33               | Shipping, ports, fisheries, inland waterways as % of employment                                          | 1              | IUU Fishing Risk Index – "response" score                                                              | 3                |
| <b>II. Environmental</b>     | <b>Domain Score</b>                                           | <b>1.44</b>        |                                                                                                          |                |                                                                                                        |                  |
| II. Environmental            | Geographic position of the basin (ecosystem health)           | 0.33               | Basin-mean chlorophyll-a / nutrient concentration (eutrophication proxy)                                 | 1              | Ocean Health Index – "Clean Waters" goal score                                                         | 3                |
| II. Environmental            | Ocean productivity                                            | 1.00               | Marine-heatwave days per year over the basin                                                             | 3              | % of assessed fish stocks within biologically sustainable levels (mean)                                | 3                |
| II. Environmental            | Climate change                                                | 1.00               | Projected relative sea-level rise (cm by 2050) or % coastal population in the Low-Elevation Coastal Zone | 2              | ND-GAIN readiness score (0–1)                                                                          | 2                |
| II. Environmental            | Reduction of water resources for coastal states               | 1.33               | Baseline water-stress score (0–5)                                                                        | 4              | INFORM Lack-of-Coping-Capacity (inverted)                                                              | 3                |
| II. Environmental            | Marine protected areas (MPAs)                                 | 2.00               | MPA coverage gap = 30 – actual % of basin EEZ protected (distance to 30x30 target)                       | 2              | % of MPAs actively/effectively managed                                                                 | 1                |
| II. Environmental            | Intensity of polluting industrial activities / risk of spills | 3.00               | Oil spills per year (count + volume) in the basin as share of global spill                               | 3              | Spill-response readiness = OPRC-1990 ratification share + operational regional response centre (0–1)   | 1                |
| <b>III. Political</b>        | <b>Domain Score</b>                                           | <b>1.39</b>        |                                                                                                          |                |                                                                                                        |                  |
| III. Political               | Projection of coastal states as security guarantors           | 1.50               | Fragile States Index score (0–120; basin mean)                                                           | 3              | WGI Political-Stability score                                                                          | 2                |
| III. Political               | Weak maritime governance / low political ownership            | 0.67               | Inverse of Stable Seas "Rule of Law" sub-score                                                           | 2              | Stable Seas "Maritime Enforcement" sub-score                                                           | 3                |
| III. Political               | Power shifts                                                  | 2.00               | State-authority gap = FSI "State Legitimacy" + "Security Apparatus" sub-scores (basin mean)              | 4              | WGI Government-Effectiveness score                                                                     | 2                |
| <b>IV. Military security</b> | <b>Domain Score</b>                                           | <b>0.66</b>        |                                                                                                          |                |                                                                                                        |                  |
| IV. Military security        | Maritime domain awareness                                     | 0.33               | "Dark-vessel" activity = count of AIS-disabling (AIS-gap) events per unit sea area per year              | 1              | MDA-centre coverage + VMS mandate (binary/scaled)                                                      | 3                |
| IV. Military security        | Piracy                                                        | 0.50               | Share of piracy incidents in basin vs globally per year                                                  | 2              | Presence & operational level of a regional counter-piracy mechanism (0–3)                              | 4                |
| IV. Military security        | Terrorism (UN definition, 1999)                               | 1.25               | Terrorist incidents per year, compared to regional population as share of global population              | 5              | Global Terrorism Index score (inverted)                                                                | 4                |
| IV. Military security        | Military bases & infrastructure                               | 0.50               | Conflict events targeting ports/energy infrastructure per year (or count of foreign naval bases)         | 3              | Count of active bilateral defence / confidence-building agreements among littoral states               | 5                |

### Sea Fragility Framework: Red Sea

BASIN NAME: Red Sea | TYPE: Regional Sea | FUNCTIONAL ROLE: Connector | SFF SCORE: 9,67/35,00 | COMPLETENESS SCORE: 98,28%

|                                  |                                                                   |                     |                                                                                                                                            |   |                                                                                                                      |   |
|----------------------------------|-------------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------|---|----------------------------------------------------------------------------------------------------------------------|---|
| IV. Military security            | Military conflicts                                                | 0.75                | Naval/maritime-linked conflict events (and fatalities) per year                                                                            | 3 | Share of littoral states in regional naval cooperation / arms-control frameworks                                     | 4 |
| IV. Military security            | Counter-narcotics efforts                                         | 0.50                | Global Organized Crime Index “drug-trafficking markets” score (1–10) or annual maritime seizures (t)                                       | 2 | Membership in a regional maritime-interdiction mechanism (MAOC-N type) – binary/scaled                               | 4 |
| <b>V. Social / institutional</b> |                                                                   | <b>Domain Score</b> | <b>1.17</b>                                                                                                                                |   |                                                                                                                      |   |
| V. Social / institutional        | Labour exploitation in maritime industries                        | 1.00                | Modern-slavery / forced-labour prevalence (per 1,000 population)                                                                           | 1 | ILO C188 (Work in Fishing) ratification share                                                                        | 1 |
| V. Social / institutional        | Dependence on maritime activities / single-state ocean governance | 0.00                | Maritime-export concentration = HHI of export commodities/ports                                                                            |   | Export diversification = UNCTAD product-diversification index                                                        | 3 |
| V. Social / institutional        | Systemic shocks & resilience                                      | 1.67                | Mean share of Total Industry Output at-risk from major port disruption over 90-day period                                                  | 3 | INFORM Lack-of-Coping-Capacity (inverted)                                                                            | 3 |
| V. Social / institutional        | Migration: push & pull factors                                    | 2.00                | Asylum applications in littoral states per year as share of global total                                                                   | 2 | Migration-governance capacity or presence of temporary-protection frameworks                                         | 1 |
| <b>VI. Legal (enforcement)</b>   |                                                                   | <b>Domain Score</b> | <b>1.48</b>                                                                                                                                |   |                                                                                                                      |   |
| VI. Legal (enforcement)          | Human rights                                                      | 2.00                | Human-rights performance = 1 – V-Dem Liberal Democracy Index (basin mean)                                                                  | 4 | V-Dem judicial constraints on executive index                                                                        | 2 |
| VI. Legal (enforcement)          | Applicability of UNCLOS                                           | 3.00                | Count of contested EEZ segments per pending or decided cases involving the basin                                                           | 3 | Share of littoral states party to UNCLOS accepting compulsory dispute settlement under article 287 (%)               | 1 |
| VI. Legal (enforcement)          | Vessels under false flags                                         | 0.25                | Share of littoral states flagged as Flag of Convenience providers                                                                          | 1 | Flag-state whitelist status                                                                                          | 4 |
| VI. Legal (enforcement)          | Smuggling                                                         | 1.50                | Global Organized Crime Index “criminal-markets” score (1–10, basin mean)                                                                   | 3 | Global Organized Crime Index “resilience” score (1–10)                                                               | 2 |
| VI. Legal (enforcement)          | Trafficking in persons or goods                                   | 0.67                | Detected trafficking victims per 100,000 population (or Walk Free prevalence)                                                              | 2 | US TIP tier (inverted) + Palermo-Protocol ratification                                                               | 3 |
| <b>VII. Technological</b>        |                                                                   | <b>Domain Score</b> | <b>2.50</b>                                                                                                                                |   |                                                                                                                      |   |
| VII. Technological               | Submarine cable infrastructure                                    | 7.50                | Count of in-service submarine cables + landing points crossing the basin (concentration at chokepoints) as share of total submarine cables | 5 | Route-redundancy index = number of independent cable paths serving the littoral states as percentage of total cables | 2 |

## CONCLUSIONS

### POLICY IMPLICATIONS AND STRATEGIC TAKEAWAYS

GIACOMO DI CAPUA, ALDO PIGOLI, CARMINE SOPRANO

SUMMARY: 4.1 Strategic takeaways from the SFF. – 4.2 From assessment to strategic action. – 4.3 Looking ahead: the future of maritime fragility.

4.1 The comparative assessment of MRS undertaken in this study provides several broader strategic insights for Italian foreign and maritime policy. Rather than prescribing specific policy measures, the findings highlight several considerations that may support strategic planning, diplomatic engagement and regional maritime governance in an increasingly interconnected international environment.

*Maritime fragility deserves recognition as a strategic policy variable.* Evaluating the multi-dimensional condition of MRS provides an additional analytical perspective that complements traditional state-centred geopolitical assessments of fragility. Monitoring changes in maritime fragility can contribute to identifying emerging vulnerabilities before they develop into wider regional crises and enable anticipatory action in foreign policy approaches to maritime governance.

*Regional maritime governance is becoming increasingly important.* Many of today's maritime challenges—including freedom of navigation, critical infrastructure protection, environmental degradation, and illicit maritime activities—transcend national jurisdictions. Effective responses therefore increasingly depend upon regional cooperation and multilateral governance mechanisms. Effective regional resilience mechanisms and shared policy frameworks are essential for reducing the fragility of MRS.

*Maritime policies should remain context-specific.* The comparative assessment demonstrates that maritime fragility develops differently across MRS. Consequently, diplomatic initiatives and maritime policies are likely to be more effective when tailored to the structural characteristics, governance arrangements, and strategic functions of each maritime region.

*Maritime resilience requires integrated governance.* The multidimensional nature of maritime fragility reinforces the need for closer coordination among diplomatic, defence, environmental,

transport, energy, and economic institutions, both within Italy and across the European Union.

*Evidence-based analysis strengthens strategic decision-making.* Analytical frameworks such as the SFF are most valuable when used to improve situational awareness, support policy prioritisation, and facilitate informed strategic choices, while recognising that political judgement remains central to foreign policy decision-making.

Overall, the findings suggest that incorporating maritime fragility into foreign policy analysis may enhance Italy's ability to anticipate emerging risks, prioritise diplomatic engagement, and strengthen resilience across the MRS most relevant to its national interests, while also supporting its contribution to the European Union's maritime security and strategic interests. Italy's geographical location, maritime tradition and extensive engagement across the Mediterranean, Red Sea, Gulf region and, progressively, the Arctic provide opportunities to strengthen its role as a facilitator of regional cooperation and maritime stability.

4.2 The comparative assessment conducted in this research demonstrates that maritime fragility is not merely an analytical construct but a policy-relevant dimension of the contemporary international system. As maritime regions become increasingly interconnected through trade, energy flows, critical infrastructure, environmental processes, and geopolitical competition, understanding the structural conditions that influence their stability acquires growing strategic significance. While the SFF is not intended to prescribe policy choices, it provides a structured evidence base that can ground geopolitical analyses of regional stability, support more informed strategic reflection, and contribute to the development of coherent maritime policies.

A first implication concerns the prioritisation of diplomatic attention. Foreign policy resources are necessarily limited, requiring governments to identify those regions where political engagement is likely to produce the greatest strategic value. Traditional assessments often prioritise maritime regions according to their immediate geopolitical relevance or the occurrence of specific crises. The findings of this research suggest that incorporating structural assessments of maritime fragility may provide an additional perspective for identifying regions where emerging vulnerabilities deserve closer political attention before they evolve into more complex regional

challenges. Rather than replacing existing geopolitical analysis, this perspective complements it by focusing on the broader resilience of MRS and the interaction of multiple structural pressures that may influence regional stability over time.

The second implication relates to preventive engagement. Many maritime crises appear sudden, yet they frequently develop through the gradual accumulation of environmental, institutional, economic and security-related vulnerabilities. Although external events may act as immediate triggers, their impact is often amplified by pre-existing structural weaknesses within the maritime system. This suggests that diplomatic engagement, technical cooperation and capacity-building initiatives are likely to achieve greater long-term effectiveness when directed towards strengthening resilience before vulnerabilities become systemic. In this respect, the concept of maritime fragility encourages a shift from reactive crisis management towards a more preventive approach to maritime governance, in which resilience-building becomes an integral component of foreign policy rather than a response to exceptional events.

A third implication concerns institutional coordination. The research confirms that maritime fragility extends well beyond the traditional boundaries of maritime security. The stability of MRS depends simultaneously upon environmental governance, transport networks, energy security, fisheries management, digital infrastructure, scientific cooperation, international law and naval security. Such multidimensionality reinforces the need for a whole-of-government perspective in which ministries and agencies responsible for foreign affairs, defence, transport, environment, energy and economic development operate within a shared strategic framework. At the European level, the same logic underlines the importance of strengthening cooperation among European institutions and specialised agencies whose activities increasingly intersect within the maritime domain. Improved coordination does not simply enhance operational efficiency; it also contributes to a more comprehensive understanding of the complex interactions that shape maritime stability.

Finally, the findings highlight the value of strategic prioritisation. The growing complexity of the international maritime environment requires governments to allocate diplomatic attention, technical assistance and policy resources selectively. Comparative assessments of maritime fragility may contribute to this process by identifying

those MRS where structural vulnerabilities are more likely to affect wider geopolitical stability, economic connectivity, or freedom of navigation. Such assessments should not be interpreted as deterministic rankings or automatic indicators of future crises. Rather, they provide an additional source of evidence capable of informing strategic choices regarding diplomatic initiatives, regional partnerships, capacity-building programmes, and international cooperation. In this sense, the principal value of the framework lies not in determining political priorities but in supporting more transparent and evidence-informed decision-making.

More broadly, the research reinforces the importance of adopting a regional perspective in maritime affairs. Contemporary maritime challenges rarely correspond to national jurisdictions alone. They emerge from interactions among states, international organisations, private operators and transnational infrastructures operating across shared maritime spaces. Consequently, effective maritime policies increasingly depend upon the ability to understand MRS as integrated strategic environments rather than simply as collections of adjacent coastal states. This regional perspective not only reflects the realities of contemporary maritime governance but also offers policymakers a more appropriate analytical scale for anticipating emerging challenges and designing cooperative responses.

Ultimately, the transition from assessment to strategic action does not require replacing existing foreign policy instruments with new analytical models. Rather, it involves enriching strategic analysis with a complementary perspective capable of capturing structural patterns of vulnerability and resilience across interconnected maritime regions.

4.3 The maritime domain is undergoing profound transformation. Geopolitical competition, climate change, technological innovation and global economic interdependence are reshaping the strategic importance of the sea, making maritime regions increasingly complex environments where security, economic prosperity, environmental sustainability and technological development converge.

Several long-term trends suggest that maritime fragility is likely to become an increasingly important dimension of foreign and security policy. Intensifying geopolitical competition is increasing the strategic value of many MRS, while climate change is placing growing pressure on coastal populations, maritime infrastructure and marine ecosystems. Although environmental change alone does not generate

instability, its interaction with institutional weaknesses, economic dependence and geopolitical tensions may significantly affect the resilience of maritime regions.

Technological transformation is also redefining the maritime domain. Digital connectivity, artificial intelligence, autonomous systems and satellite surveillance offer new opportunities for maritime governance but also create new vulnerabilities. At the same time, the growing dependence on submarine cables, offshore energy infrastructure and other critical maritime assets highlights the need to integrate traditional maritime security with cyber resilience and infrastructure protection.

Global supply chains further reinforce the strategic significance of maritime resilience. Recent disruptions have demonstrated how local events within a single maritime region can rapidly generate cascading effects across the international economy, underscoring the importance of identifying structural vulnerabilities before they develop into broader systemic disruptions.

These developments suggest the need for analytical approaches capable of capturing the complex interdependencies that increasingly characterise the maritime domain. Rather than focusing exclusively on individual coastal states, the MRS provides a useful perspective for understanding shared vulnerabilities and collective resilience across interconnected maritime spaces.

The SFF should therefore be regarded as an evolving analytical tool rather than a definitive model. As geopolitical dynamics, environmental pressures and technological developments continue to evolve, the framework should be progressively refined through new indicators, broader geographical applications and future empirical validation.

Ultimately, the principal contribution of this research lies not only in proposing a methodology for assessing maritime fragility, but also in promoting a systemic understanding of the sea as an interconnected strategic environment. Integrating this perspective into foreign policy analysis may support more informed strategic decision-making and stronger international cooperation.

For Italy, whose prosperity, security and international role are deeply linked to the maritime domain, understanding the fragility and resilience of MRS represents an increasingly important component of its engagement within the evolving European and global maritime order.



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