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Legal Requirements of Trawl Fishing in International Law: Presenting an Optimal Model in the Persian Gulf and the Sea of Oman

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ABSTRACT

Trawl fishing refers to a method of catching aquatic species using large funnel-shaped nets attached to boards on both sides, which are usually dragged along the seabed by vessels. Despite its long history, this fishing technique causes severe environmental damage and threatens marine ecosystems. In recent years, the activities of Chinese trawlers in Iran's territorial waters have sparked controversy and raised serious concerns. The purpose of this study is to examine the legal requirements of trawl fishing under international law and to propose an optimal model for the Persian Gulf and the Sea of Oman. This research seeks to address the following questions: How do the legal mechanisms of international conventions regulate trawl fishing, and how are they implemented in the Persian Gulf? What are the legal gaps in regional cooperation within the Gulf, and how can the proposed model address these shortcomings? The study adopts a descriptive method, with data collected through library research, relying on the provisions of the United Nations Convention on the Law of the Sea (UNCLOS) and FAO instruments concerning port state jurisdiction and combating illegal fishing. The findings indicate that transitioning from general international frameworks to comparative regional legal models—led by countries such as Iran and Saudi Arabia in establishing a Regional Fisheries Management Organization (RFMO)—not only resolves existing inefficiencies but also ensures the long-term sustainability of ecosystems and the livelihoods of coastal communities in the Persian Gulf and the Sea of Oman. The study further recommends convening a regional conference under FAO supervision to draft executive protocols and operationalize this model.

Keywords: *Persian Gulf and Sea of Oman, trawl fishing, international law, environment, legal requirements.*

Introduction

Environmental law, both domestically and internationally, includes rules and regulations that protect water, air, soil, flora, and fauna. Scientific advances in biology, ecology, and medicine, along with bitter environmental experiences such as the Bhopal disaster in India and the Chernobyl accident in the former Soviet Union, demonstrate the destructive effects of environmental degradation on the lives of current and future generations and on the survival of plant and animal species. The right to a healthy environment and sustainable development, which complements human dignity, is recognized as one of the rights of the third generation of humanity. This right, which has a fixed place in international law and the domestic laws of many countries, complements human rights for the

present generation and constitutes a prerequisite for its realization for future generations. Environmental rights, like human rights, cover all human actions and monitor their performance (1). Given the limited resources of the Earth and the growth of the population, environmental protection is an essential task for governments and people. Improper use of resources can lead to their premature depletion. Therefore, efforts to preserve natural resources and prevent their destruction are a universal duty (2).

However, for about a decade, a destructive phenomenon known as trawling has been catching large quantities of fish in the southern seas of the country, causing serious problems for both the environment and fishermen. Trawling is considered one of the most destructive fishing methods, as it not only damages marine ecosystems but can also threaten the extinction of aquatic species, thereby depriving future generations of access to these resources. The indiscriminate exploitation of trawling, in addition to harming local fishermen—especially in Hormozgan Province—has caused severe damage to habitats and aquatic reserves of the Persian Gulf. The purpose of environmental protection is to safeguard ecosystems, prevent pollution, and avoid any destructive action that disrupts environmental balance. Measures to protect the environment have been incorporated into Iran's domestic laws, including the Constitution, the Environmental Protection and Improvement Law, and the Hunting Law. According to these legal frameworks, preventing destructive fishing practices such as trawling is essential. The right to life, as one of the fundamental rights of every individual, is directly linked to environmental health, and damage to the environment threatens quality of life, human dignity, and natural rights. Consequently, the right to a healthy environment is recognized as the legal foundation for protecting ecosystems (1).

The Persian Gulf is one of Iran's most valuable economic and environmental resources and plays a vital role in food security, employment, trade, and foreign exchange. If properly managed, its capacities can be optimally utilized. Although fisheries account for only a small portion of Iran's economy—approximately four percent of the agricultural sector's gross national product—they perform a fundamental role in providing employment for coastal residents, ensuring food security through high-quality animal protein, preserving the social structure of fishing communities, and preventing migration. Moreover, given Iran's severe water crisis in other agricultural sub-sectors, fisheries in the Persian Gulf possess significant potential for expansion under sound management. The catch in the Persian Gulf in 2014 was reported as 217 thousand tons in Hormozgan Province, 58 thousand tons in Bushehr Province, and 47 thousand tons in Khuzestan Province. In the same year, Iran ranked as the second largest producer of tuna in the Indian Ocean and the leading producer in the northwest of this ocean. Fishing activities currently provide direct employment for approximately 128,901 people in southern Iran, whose livelihoods are directly tied to the sea (3). Despite its enormous economic value, the Persian Gulf is considered one of the most environmentally sensitive marine regions in the world. A combination of natural and human factors has intensified this sensitivity and exposed the region to serious threats, initially affecting fishing activities and coastal communities and endangering the sustainability of fisheries in the region (4).

Illegal fishing constitutes a major threat to maritime public order. The international legal framework governing illegal fishing is derived from three principal groups of instruments: the United Nations Convention on the Law of the Sea, the FAO Compliance Agreement, and the FAO Fish Stocks Agreement. Although the Islamic Republic of Iran has not formally acceded to the Convention on the Law of the Sea, it has incorporated many of its requirements and relevant FAO instruments into its domestic legal system. Iran's compliance is grounded in customary international obligations associated with these instruments. The Convention on the Law of the Sea seeks to balance navigational freedoms with the protection, management, and exploitation of living marine resources, as well as the

preservation of marine ecosystems. Responsibility for protecting these interests primarily rests with coastal and port states within areas under their sovereignty and sovereign rights, including territorial seas and exclusive economic zones, and subsequently with flag states in high seas areas (5).

Research conducted on port state jurisdiction demonstrates that effective enforcement against illegal fishing requires both international commitments and domestic legal mechanisms. The components of port state jurisdiction are closely connected to compliance with FAO standards and their incorporation into national legal frameworks, forming an integrated regulatory system designed to combat illegal fishing by foreign vessels and prevent the commercialization of illegally caught products (6). However, conflicts sometimes arise between the jurisdiction of port states, coastal states, and flag states, requiring tripartite cooperation and oversight by regional fisheries management organizations to ensure effective enforcement.

Expert analyses of environmental priorities in the Persian Gulf and the Sea of Oman identify fishing management as one of the most critical challenges facing the region. Existing protective measures have been found insufficient to effectively slow environmental degradation and destructive activities, underscoring the vulnerability of the marine ecosystem and the urgency of reform (7). At the international level, deep-sea trawling has been recognized as one of the most pressing threats to marine biodiversity. This practice causes extensive ecological damage and remains largely unregulated in many regions due to inadequate international legal controls. International environmental diplomacy has therefore been proposed as a means to impose temporary bans on bottom trawling until comprehensive regulatory frameworks can be developed and effectively enforced (8).

Considering the increasing environmental, economic, and social harms resulting from improper trawling practices in Iran's southern waters, and in light of national efforts to organize and regulate fishing activities, this research seeks to diagnose the structural deficiencies of trawl fishing management and to propose legal and policy-based solutions for its regulation. Previous studies have addressed fisheries in general but have rarely focused specifically on the legal requirements governing trawl fishing within the international legal system in relation to the Persian Gulf and the Sea of Oman. This persistent gap in scholarship underscores the necessity and originality of the present study.

Research Methodology

This study adopts a descriptive–analytical approach, relying on the provisions of the United Nations Convention on the Law of the Sea (UNCLOS) and FAO instruments related to combating illegal fishing. Domestic and international laws and regulations in the field of fisheries are examined, and the existing gaps in the legal requirements of trawl fishing are analyzed.

The research is conducted through a library-based method. Data collection involves consulting specialized libraries, including the Library of the Institute for Legal Studies and Research of Shahre Danesh, as well as accessing online databases and reviewing published domestic and international articles. Information is gathered, categorized, and analyzed to provide a comprehensive understanding of the subject matter.

Analysis of the Current Situation and Challenges

The Persian Gulf and the Sea of Oman, as two of the most strategic regions in the world, face complex legal challenges rooted in colonial history, the discovery of oil, and geopolitical rivalries. This region is not only the main

corridor for global energy exports (with approximately 21 percent of global oil consumption passing through the Strait of Hormuz), but also grapples with environmental, security, and boundary issues.

An optimal legal framework must be grounded in the principles of international maritime law—even for countries such as Iran that have not acceded to it—and should emphasize regional cooperation, the peaceful settlement of disputes, and sustainable development.

This model can be pursued through bilateral and multilateral agreements, the creation of joint development zones, and the formation of regional institutions such as a Gulf Collective Security Organization. This section focuses on providing a desirable model for the management of trawling in the Persian Gulf and the Sea of Oman. The model is developed based on the legal and practical analysis of the previous chapters, where the requirements of international law of the sea, including the 1982 Convention on the Law of the Sea, documents of the Food and Agriculture Organization of the United Nations, and regional regulations such as the Convention for the Protection of the Marine Environment of the Kuwait Area, were reviewed. Trawling as an industrial fishing method, although efficient in the short term, often leads to widespread environmental damage, including destruction of the seabed, loss of biodiversity, and disruption of the marine food chain. Under Article 61 of UNCLOS, States are required to set allowable catches based on scientific evidence to prevent overfishing, while Article 192 emphasizes the protection of the marine environment. In the Persian Gulf and the Sea of Oman, as semi-enclosed seas (Article 122 of UNCLOS), the current situation presents several challenges.

Illegal overfishing (IUU fishing), foreign vessel activity (such as Chinese trawlers), and lack of international coordination have led to severe depletion of aquatic resources. For example, in Iran, the Law on the Protection and Exploitation of Aquatic Resources of the Islamic Republic of Iran (approved in 1974 and subsequent amendments) provides for a ban on trawling in certain areas, but its implementation has faced challenges, including illegal fishing during closed seasons. In addition, foreign activities, such as the presence of over 5,000 Chinese vessels in Iranian waters, which have received official permits but often violate regulations, have affected the livelihoods of local fishermen.

This model is consistent with the United Nations Sustainable Development Goals (SDG14: Protect the oceans and seas) and emphasizes the need for regional cooperation. The main objective is to provide a practical model that not only meets legal requirements, but also addresses the environmental, economic, and social challenges of the region. In this section, we first analyze the current situation (with a focus on examining regulations and challenges in Qatar, Oman, the United Arab Emirates, Bahrain, Iran, and Saudi Arabia), then present the model, examine implementation strategies, and finally draw conclusions.

Review of International and Regional Regulations

International regulations on trawl fishing are primarily based on UNCLOS and FAO instruments. The Code of Conduct for Responsible Fisheries permits trawl fishing only if it is sustainable and subject to environmental impact assessments. FAO reports further indicate that bottom trawling can result in up to 50% bycatch, often destroying non-target species.

At the regional level, the Regional Organization for the Protection of the Marine Environment (ROPME) focuses on safeguarding the marine environment of the Persian Gulf, though its emphasis has been more on oil pollution than on fisheries management. In addition, United Nations reports show that trawling in deep seas (over 1,000

meters) is often prohibited; however, in the Persian Gulf—where the average depth is only 35 meters—this method remains widespread, causing damage to coral seabeds.

The absence of a dedicated regional fisheries management organization for the Persian Gulf, unlike the Mediterranean Sea, represents one of the major regulatory gaps.

Regional Challenges – Overfishing and IUU Fishing

The Persian Gulf and the Sea of Oman face serious challenges of overfishing. Statistics show that fish stocks declined by approximately 30–50% between 1950 and 2018, with commercial trawling responsible for a 50% reduction in local fishermen's yields over the past five years. Illegal, Unreported, and Unregulated (IUU) fishing—including fishing without licenses, trawling during closed seasons, and failure to report catches—represents the main problem.

According to FAO estimates, the fisheries potential of the Persian Gulf is about 550,000 tons per year; however, actual catches often exceed this limit, leading to a 71% decline in artisanal fishing in some countries. Climate change factors, such as rising temperatures and reduced rainfall, further threaten fish stocks.

At the national level, regulations vary among countries, but weak enforcement is a common issue. For example, seasonal bans on shrimp fishing (such as six-month closures in Bahrain and Saudi Arabia) exist, yet illegal trawling continues. The following table compares current regulations, challenges, and related statistics for the countries under review (Qatar, Oman, the United Arab Emirates, Bahrain, Iran, and Saudi Arabia). This table is based on FAO reports and local news sources.

Table 1. Current Fisheries Regulations in the Gulf States

Country/Region	Key provisions	Trawling the main challenges	Key statistics
Iran	Complete ban on trawling in the Persian Gulf (from 2020 by DOE), limited guidelines for the Sea of Oman (minimum mesh size 40 mm, two-week seasonal ban), Aquatic Conservation Law 1974	Poor enforcement, illegal foreign fishing (such as Chinese vessels), IUU fishing	30-50% decline in stocks from 1950-2018; over 34 illegal vessels seized in 2020; 39% of fixed nets fished
Oman	Bottom trawling ban from 2016, tonnage and license limits (quotas for species), ban in sensitive areas of the Sea of Oman	Overfishing in shared waters, impact of oil pollution, competition with industrial fisheries	30% decline in shrimp stocks since 2010; 25% in bottom fisheries; annual catch about 200,000 tons
Emirates	Focus on sustainability with trawl restrictions in protected areas, mandatory EIA assessment, seasonal shrimp ban	Competition with foreign vessels, overfishing of commercial species, inadequate reporting	32% bottom fishing; 2% fixed nets bycatch; 20-30% decline in fish stocks since 2010
Bahrain	Complete ban on trawl fishing since 1997, ban on bottom trawls for shrimp (Ministerial Resolution 205/2018), six-month seasonal ban on shrimp fishing (until August 1, 2025)	IUU fishing with illegal nets, frequent seizures, impact on local fishermen	54% fixed nets; 288 kg of illegal shrimp seized in 2025; 56% demersal fisheries; 40% reduction in local yields
Qatar	Trawl restrictions for shrimp with a focus on local communities, bans during spawning seasons, local regulations for sustainability	Demersal overfishing, insufficient monitoring of foreign vessels, climate change	71% demersal fisheries; annual catch about 15,000 tons; 4% fixed nets bycatch; 25% decline in stocks since 2015
Saudi Arabia	Focus on industrial fisheries with limited monitoring, six-month seasonal shrimp ban (from February), restrictions on protected areas	Overfishing near the coast of Iran, oil pollution, IUU fishing	52% of bottom fisheries; annual catch of over 100,000 tons; activity of over 1,000 industrial vessels; annual losses of billions of dollars from IUU

The table shows the diversity of regulations: Bahrain and Iran have stricter bans, while Qatar and Saudi Arabia have focused on seasonal restrictions. However, IUU fishing is prevalent in all countries, with recent seizures in Bahrain (90 kg of shrimp in July 2025) and an increase in illegal fishing due to public seasons. Overfishing is not only environmental, but also economic. In the Persian Gulf, more than 200,000 local fishermen have been affected, with incomes falling by up to 40% in Bahrain and Iran. The activity of foreign vessels, often operating with controversial licenses, threatens local livelihoods. In addition, IUU fishing undermines the regional economy, with annual losses of more than $1 billion across the Persian Gulf as a whole. In Qatar and the UAE, the focus on marine tourism has further restricted trawling, but in Saudi Arabia and Oman, the fishing industry is larger and needs to be balanced. Climate change, such as a temperature increase of 2 degrees by 2050, will reduce shrimp stocks by 20-30%, with a greater impact on local communities in Bahrain and Qatar.

Presentation of the Proposed Model

The proposed model is a comprehensive and multi-layered framework inspired by successful examples such as fisheries management in the Mediterranean Sea and the EU's Common Fisheries Policy in the North Sea. This model is designed on the basis of Article 63 of UNCLOS, which addresses the management of shared fish stocks, and Article 123, which emphasizes cooperation in semi-enclosed seas.

The framework consists of five main elements, each described with specific sub-elements, and is tailored to the particular challenges of the countries in the region (such as seasonal bans in Bahrain and Oman).

Conservation and Sustainable Management – Legal Basis and Requirements

This element, as the backbone of the proposed model, focuses on banning bottom trawling in sensitive areas such as the coral seabeds of the Persian Gulf, fish spawning grounds, and mangrove ecosystems in the Sea of Oman—similar to Bahrain's 1997 prohibition. Fishing quotas must be determined on the basis of advanced ecosystem models (such as Ecopath with Ecosim – EwE), which not only predict species distribution but also account for trophic interactions (such as food chain dynamics) and the impacts of climate change.

Environmental impact assessments are mandatory, and fishing must be regulated according to the principle of Maximum Sustainable Yield (MSY), with the aim of preventing overfishing and preserving biodiversity. Furthermore, the establishment of a network of marine protected areas is recommended, where trawling is completely prohibited—similar to the Mediterranean model, which targets coverage of at least 30% of sensitive waters. This approach aligns with the EU's Common Fisheries Policy (CFP), which employs multi-species models to regulate sustainable fishing and has reduced indirect impacts such as bycatch.

This is the legal core of the model and is based on Articles 61-62 of UNCLOS, which oblige states to set allowable catches based on scientific evidence (such as maximum sustainable yield, which in modern models is calculated at around 30-40% of pristine biomass) and to prevent overfishing. Sustainable fishing is seen here not as a fixed goal, but as part of an ecosystem-based approach, which takes into account species interactions and goes beyond traditional single-species models.

Moreover, Article 192 of UNCLOS requires the protection and preservation of the marine environment, which includes prohibiting activities such as bottom trawling in sensitive areas (for example, the coral seabeds of the Persian Gulf, which account for more than 50% of the region's biodiversity). This method can lead to biodiversity

loss, including reduced gastropod density, and contributes to global carbon emissions equivalent to 370 million tons of CO_2 annually.

From a legal perspective, states must conduct Environmental Impact Assessments (EIA) in accordance with the FAO Code of Conduct for Responsible Fisheries (Article 7.5 of the FAO Code), to evaluate the impacts of trawling on ecosystems (such as bycatch, which can reach up to 50% of total catch in the Persian Gulf, including non-target species like turtles and small fish). These EIAs must include predictive assessments (such as simulation models) and post-implementation monitoring. Failure to comply may be considered a violation of customary international obligations.

Implementation requirements:

• Complete bottom trawling ban in sensitive areas: Similar to what was implemented in Bahrain, which included a three-month ban in 1997 and then a complete ban on trawling in 1998, due to complaints from traditional fishermen about damage to nets and depletion of stocks (based on Ministerial Decree No. 7/1997). This ban helped reduce turtle bycatch and could be extended to the entire region. In Oman, a similar ban has been in place since 2011 (for trawlers) and the 2016 amendments (Ministerial Decree No. 355/2016) to the Fisheries Law's implementing regulations, including a ban on shrimp trawling except with specific nets and a ban in protected areas such as the Dimaniyat Islands. These bans should be integrated using GIS technology to map sensitive areas.

• Setting catch quotas based on ecosystem models: These models, such as EwE or Atlantis, predict the distribution of benthic species and take into account uncertainty parameters (such as climate change). For example, in Qatar (71% of the bottom catch) and Bahrain (54%), quotas should be revised annually, integrating multi-species data to avoid cascading effects in the food chain. This approach is inspired by the CFP model and can adjust MSY for common species such as shrimp and demersal fish.

• Establishing marine protected areas: Under Article 194 of UNCLOS (Measures to Prevent Pollution), they must cover at least 20% of the waters of the region, and governments are obliged to monitor them. In the Persian Gulf, Iran has 15 MPAs covering 1,491 km2, but only 8% of ROPME corals are in MPAs (1.4% fully protected).

From a legal perspective, violations of these requirements could be considered a breach of international obligations and pursued through the dispute settlement mechanisms of UNCLOS (Article 297, including arbitration or the International Tribunal for the Law of the Sea). Furthermore, the integration of EIA with the FAO Code could serve as a tool for the accountability of governments, with the possibility of international penalties for environmental violations.

Regional Cooperation – Legal Framework and Mechanisms

This element, serving as a bridge between national and international management, focuses on establishing and strengthening regional cooperation structures to address transboundary challenges such as fish migration, Illegal, Unreported, and Unregulated (IUU) fishing, and shared environmental impacts. The Persian Gulf and the Sea of Oman, as semi-enclosed seas with common resources (such as shrimp and demersal fish species that migrate across national maritime boundaries), require coordinated cooperation to prevent overfishing and ecosystem degradation.

The proposed model, inspired by successful examples such as the General Fisheries Commission for the Mediterranean (GFCM) and the Helsinki Commission for the Protection of the Marine Environment of the Baltic Sea

(HELCOM), recommends the establishment or reinforcement of a dedicated Regional Fisheries Management Organization (RFMO) for this area.

This RFMO could build on the existing Regional Fisheries Commission (RECOFI), which operates under FAO and includes the countries bordering the Persian Gulf and the Sea of Oman. RECOFI has been operational since 2001 and focuses on sustainable fisheries management, but needs to be strengthened to specifically cover trawling, such as incorporating joint monitoring protocols and dispute resolution. This approach would not only address common challenges such as IUU in Iranian-Saudi waters, but also address climate change (such as rising sea temperatures leading to declining shrimp stocks).

As a semi-enclosed sea, the Persian Gulf requires cooperation between coastal states to manage shared resources, protect the environment and prevent pollution, according to Article 123 of UNCLOS. This article requires states to cooperate through regional organizations or direct agreements, which in the case of fisheries includes coordination for migratory species. Also, Article 63 of UNCLOS emphasizes the management of shared fish stocks (such as shrimp species that are caught in all countries and are migratory across borders), and obliges states to negotiate joint management agreements. From a legal perspective, this cooperation can be achieved through the establishment or strengthening of RFMOs, which are required under the FAO Convention on Regional Fisheries Management Organizations (1993) and commit states to exchange information, set quotas and jointly monitor.

In addition, the Convention on Biological Diversity (CBD, 1992) and the Code of Conduct for Responsible Fisheries (FAO, 1995) emphasize regional cooperation for the protection of marine ecosystems, which is crucial in semi-enclosed seas such as the Persian Gulf. In comparison to other semi-enclosed seas, such as the Mediterranean Sea, where the GFCM (with 23 members) regulates catch quotas based on scientific data and has reduced IUU, or the Baltic Sea, where HELCOM focuses on environmental protection and has led to improvements in water quality, the proposed RFMO could provide a similar model for the Persian Gulf. The legality of this element ensures that states cannot unilaterally evade obligations, and violations can be reported to the United Nations or the International Tribunal for the Law of the Sea, under Article 297 of UNCLOS, which provides for dispute settlement mechanisms.

Implementation requirements:

• Establish or strengthen an RFMO including all riparian countries: The RFMO should include all riparian countries (Iran, Saudi Arabia, Oman, the United Arab Emirates, Bahrain, Qatar, Kuwait and Iraq), establishing protocols for exchanging fisheries data. For example, statistics on the decline of shrimp stocks in Oman since 2010 (from 854 tonnes in 2010 to lower levels due to the geographical expansion of fishing and coral mortality due to rising temperatures) should be shared to develop common policies. RECOFI could be the basis for this RFMO, in which Iran is actively participating and focuses on sustainable management, but needs to be expanded to cover trawling.

Merger with ROPME to cover environmental aspects: ROPME, which has been operating under the Kuwait Convention since 1978 and has eight member states, focuses on the protection of the marine environment and could merge with RFMOs to cover issues such as oil pollution in Saudi Arabia and the UAE (which affects fish stocks) and biodiversity conservation (such as corals and endangered species). ROPME has a coordinating role in monitoring water quality and ecosystems, which could be combined with fisheries management to create an ecosystem-based approach.

Hold annual meetings to set quotas and resolve disputes: Meetings should set catch quotas based on scientific data (such as assessments of shrimp stocks in Bushehr, Iran or Oman) and implement dispute resolution mechanisms under Article 297 of UNCLOS, which include arbitration or international tribunals. For example, in cases of transboundary IUU, such as foreign fleet activity in shared Iranian-Saudi waters, the RFMO could coordinate joint patrols and reporting.

• Cooperate with international organizations: The RFMO should work with FAO and UNEP to transfer monitoring technologies (such as VMS) and build capacity in developing countries. Also, integration with Gulf Cooperation Council initiatives for managing shared resources, such as integrated waters, could reduce political challenges.

Reporting and penalty mechanisms: Countries should submit annual reports on trawl catches, and violations (such as overfishing) should be followed up with joint fines or trade sanctions, similar to the GFCM model in the Mediterranean that controls IUU through a blacklist of vessels.

This element makes cooperation mandatory by ensuring legal obligations and can adapt successful global models to the region, leading to long-term sustainability of marine resources.

Technical and Technological Regulations: Legal and Practical Requirements

This element, as a key component of the proposed model, focuses on the establishment of technical regulations and the use of new technologies to reduce the destructive effects of trawling, with the aim of minimizing bycatch, preserving biodiversity and increasing the sustainability of marine resources in the Persian Gulf and the Sea of Oman. This approach is inspired by successful models such as the European Union's Common Fisheries Policy, which applies fine mesh regulations and selective technologies to reduce bycatch by up to 50%, and the FAO Technical Guide for Responsible Fisheries. In the region, there are challenges such as illegal fishing by foreign fleets (such as Chinese trawlers in Iranian waters) and pressure on sensitive ecosystems (such as corals and spawning grounds), which technical regulations can manage. Requirements for this element include net size restrictions, seasonal bans, the requirement for green technologies such as turtle release devices, and the promotion of alternative methods such as hook-and-line fishing or aquaculture, which are particularly consistent with sustainable policies in Oman and the UAE. These regulations not only reduce environmental impacts, but also boost local economies by reducing waste (such as 15-36% of catch being discarded in Saudi Arabia).

The Code of Conduct for Responsible Fisheries (FAO 1995, paragraphs 7 and 8) obliges governments to establish technical regulations such as mesh sizes, seasonal closures and bycatch reduction devices to prevent overfishing and protect juveniles. Paragraph 7.6.4 of the FAO Code emphasizes the use of selective technologies such as TEDs, which can reduce bycatch by up to 97%, and paragraph 8.5 focuses on monitoring fishing gear. Article 73 of UNCLOS also mandates monitoring and enforcement of foreign vessels (such as Chinese trawlers in Iranian waters, which often operate without a license), and authorizes coastal states to seize and fine them, emphasizing that measures must be "reasonable" and not in violation of international law. This article allows countries such as Iran to impose technical regulations on foreign fleets in their exclusive economic zone, and in cases of violation, to use the UNCLOS dispute resolution mechanisms (such as arbitration). Furthermore, the Convention on Biological Diversity and the ROPME protocols emphasize the integration of green technologies into technical regulations to protect endangered species such as turtles, which in the Persian Gulf can be achieved by reducing bycatch by up to 99% for turtles and 17.7% for sharks. From a legal perspective, these regulations can be

part of RFMO protocols (such as RECOFI), and their violation can lead to international penalties (such as trade sanctions or reporting to FAO), which has been successful in the Mediterranean GFCM model.

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Implementation requirements:

• Standardization of net size (minimum mesh size 40-50 mm): This restriction is required to reduce catches of juvenile species and bycatch, as is the case in Oman (45 mm mesh for shrimp trawls and 40 mm for bottom cod-ends) and the UAE (similar mesh to prevent non-target catches). In Iran, the 2020 guidelines for trawling in the Persian Gulf and Sea of Oman set mesh sizes by species, but regional standardization could reduce bycatch by up to 50%. In Bahrain, 45-50 mm mesh is applied to the industrial fleet, and Saudi Arabia has a minimum mesh size of 2.5 inches (about 63 mm) for driftnets, which could be extended to trawls. Recommendation: Apply this standard in RFMOs with annual monitoring to prevent the use of smaller mesh sizes by foreign fleets.

Broad seasonal ban (at least two months during the spawning season): Extend the six-month shrimp ban in Bahrain (from January to June, with the seizure of violators) and Saudi Arabia (including a bottom trawl ban to protect stocks) to the entire region, to allow stocks to rebuild. In Oman, seasonal bans will apply to shrimp trawls from 2016, and the UAE is calling for early announcement of bans to coordinate with neighbors. In Bahrain, seasonal bans also exist for species such as shari and safi, which could be extended to trawls. Proposal: Coordinate through ROPME to set common seasons based on scientific data, such as the 30% decline in shrimp stocks in Oman since 2010.

Mandatory green technologies such as turtle escape devices and selective nets: TEDs, which act as escape hatches, can reduce turtle catches by up to 99%, and are essential in the Persian Gulf (with a sensitive sea turtle population). Based on FAO recommendations, selective nets (such as semi-pelagic nets) should replace bottom trawling. In the region, trials of TEDs are proposed in Iran and Oman, similar to the success in Australia. In addition, the use of bycatch reduction devices for sharks and rays (such as square mesh nets) is mandatory.

• Promote alternative methods: hook-and-line fishing, which is more selective and reduces bycatch, as studies in the Persian Gulf have shown larger fish sizes in hook-and-line fisheries. Aquaculture in Oman and the UAE, which is coping with rising temperatures and illegal practices, should be expanded.

This element ensures sustainability by integrating technical regulations into the legal framework and can adapt global models for the region.

Monitoring and Enforcement: Legal Mechanisms

This element, as the guarantor of the operationalization of the proposed model, focuses on establishing advanced monitoring systems, law enforcement, and holding violators accountable in order to reduce illegal, unreported, and unregulated (IUU) trawl fishing and to ensure the sustainability of marine resources in the Persian Gulf and the Sea of Oman.

Given the regional challenges such as the activities of foreign fleets (e.g., Chinese trawlers in Iranian waters), oil pollution that complicates monitoring, and the lack of resources for maritime patrols, this element is inspired by successful models such as the European Union's integrated monitoring system and the FAO programs for combating IUU.

The requirements include the use of satellite technologies such as Vessel Monitoring Systems (VMS) and Synthetic Aperture Radar (SAR), the establishment of regional courts for fisheries crimes, the involvement of local communities in monitoring, coast guard training, and the imposition of heavy fines for IUU.

This approach not only increases effective seizures (as has recently been the case in Bahrain), but also increases efficiency by integrating existing industry surveillance systems in Qatar and Saudi Arabia.

The goal is to reduce IUU by 50% within a decade through real-time surveillance and transboundary cooperation, which is consistent with Saudi Arabia's recent accession to the Port State Control Agreement in 2025.

Article 73 of UNCLOS obliges coastal states to monitor, inspect and enforce fisheries laws in their exclusive economic zone, which includes the right to seize vessels and impose fines, but the measures must be "reasonable" and non-discriminatory. This article allows countries such as Iran to monitor foreign fleets and use legal instruments such as arrests and prosecutions in cases of IUU. Article 297 of UNCLOS also provides dispute resolution mechanisms, which can be pursued for transboundary disputes over trawling (such as in the shared Iranian-Saudi waters) through arbitration or the International Tribunal for the Law of the Sea. The Code of Conduct for Responsible Fisheries (FAO 1995, paragraph 11) emphasizes tracking and monitoring systems, requiring countries to use modern technologies to collect real-time data and combat IUU, with a focus on transparent reporting and effective penalties.

In addition, the Kuwait Convention (1978) and ROPME emphasize the principle of public participation, which involves local communities in environmental and fisheries monitoring, especially in semi-enclosed seas such as the Persian Gulf. The agreement (PSMA, 2009), to which Saudi Arabia acceded in April 2025, focuses on denying port access to IUU vessels and could serve as a model for GCC countries. This legal element ensures that enforcement is binding, that governments are held accountable, and that violations are pursued through international mechanisms, similar to the Gulf of Mexico IUU Group, which reports annually to Congress.

Implementation requirements:

• Use of satellite systems and SAR radars to track vessels: VMS that report real-time vessel positions should be mandatory for all trawl fleets, such as the VMS model in Hormozgan, Iran (2017-2019) for industrial trawlers monitoring fishing activities in the northern Persian Gulf. SAR should be used to detect trawling activities in bad weather conditions, such as its use in detecting oil spills in the Persian Gulf (such as the Khafji area between Kuwait

and Saudi Arabia). In Oman, VMS has been operational since 2000 but needs to be updated, which could be expanded by integration into RFMOs. Example: Bahraini seizures, such as the seizure of 288 kg of illegal shrimp by bottom trawl in September 2025, or 296 kg in Malkiya, which could be enhanced by VMS.

• Establish regional courts for IUU fishing crimes: These courts, under RFMOs or ROPME, could try cases of violations (such as illegal fishing in Iranian-Arab or Kuwaiti waters), with heavy fines (up to 10 times the value of the catch) and the seizure of vessels. A model similar to the Gulf of Mexico IUU Group, which reports to Congress, or Sea Shepherd campaigns in the Gulf of Guinea to combat IUU.

• Involve local communities in monitoring: Based on the principle of public participation in ROPME, local communities (such as traditional fishermen in Iran and Oman) would be involved in data collection, IUU reporting and monitoring of MPAs, similar to FAO models that enable communities to participate in decision-making and implementation of fisheries management.

Training of Coast Guards and Strict Penalties : Joint training programs for the coast guards of regional states should be organized through the RFMO, with a focus on advanced technologies such as Synthetic Aperture Radar (SAR) and Vessel Monitoring Systems (VMS). Penalties must be calibrated to the economic value of the catch—for example, the confiscation of 770 illegal traps in Bahrain in September 2025.

International Cooperation and Reporting : Integration with organizations such as FAO and INTERPOL is essential for reporting IUU fishing, with annual reports submitted to the United Nations.

This element ensures the operationalization of the model through technology and cooperation, contributing to the reduction of IUU fishing in the region.

Economic and Social Dimensions

This element, as the concluding part of the proposed model, focuses on ensuring social justice and economic sustainability in the management of trawl fishing in the Persian Gulf and the Sea of Oman, with an emphasis on supporting local communities and traditional fishermen who have been affected by declining fish stocks and competition from industrial fleets (such as foreign trawlers).

The approach is inspired by successful models such as the European Union's Common Fisheries Policy, which allocates special quotas for small-scale fishermen, and the United Nations Sustainable Development Goals (SDG 14: Life Below Water). The objective is to reduce economic pressure on local communities (for example, income reductions of up to 40% in Iran and Bahrain), strengthen local economies through aquaculture, and promote sustainable fishing methods that are compatible with the region's culture and social needs.

This element integrates compensation programs, fair quota distribution, training, and aquaculture development to balance environmental protection with the livelihoods of local communities—particularly in countries such as Iran and Bahrain, where traditional fishing (e.g., fixed nets and hook-and-line methods) constitutes a significant part of the coastal economy.

Articles 69 and 70 of UNCLOS enshrine the principle of equity in the distribution of fisheries resources, especially for developing countries such as Iran and Bahrain, which depend on marine resources for food security and livelihoods.

These provisions oblige coastal states to grant equitable access to marine resources for land-locked states or sea-dependent economies (such as Bahrain). In semi-enclosed seas, this principle is reinforced through regional cooperation.

United Nations Sustainable Development Goal 14 (Life Below Water) underscores the obligation to support traditional fishermen, with a focus on enhancing their access to markets, alleviating poverty, and safeguarding marine ecosystems. The FAO Code of Conduct for Responsible Fisheries (1995, Article 7.6.6) further requires states to support local communities through training, financial assistance, and the substitution of destructive practices such as trawling with sustainable alternatives.

The Kuwait Regional Convention (1978) and the Regional Organization for the Protection of the Marine Environment (ROPME) promote the principle of public participation, mandating the involvement of local communities in fisheries and environmental decision-making processes. From a legal perspective, non-compliance with these obligations may constitute a breach of equity principles and can be pursued through the dispute settlement mechanisms of UNCLOS (Article 297) or through regional negotiations.

This element, by balancing economic and social needs with environmental obligations, contributes to the long-term sustainability of the region.

Implementation Requirements

- **Compensation Programs for Local Fishermen:** The reduction of income among traditional fishermen in Iran (up to 40% due to competition with industrial trawlers) and in Bahrain (as a result of trawl bans since 1997) necessitates the establishment of compensation schemes. Such programs may include financial subsidies—similar to the Omani model that supports traditional fishermen—or direct payments for temporary cessation of fishing during closed seasons.
- **Proposal for a Regional Fund:** It is recommended to establish a regional compensation fund under the auspices of the RFMO or ROPME, with financial support from the Global Environment Facility (GEF), to provide compensation to fishermen during seasonal bans or to facilitate their transition to non-trawl methods.
- **Examples of Alternative Practices:** Bahrain supports fixed nets (accounting for 54% of local catch), and Iran could adopt a similar model in the coastal provinces of Khuzestan and Bushehr

Special Quotas for Traditional Fisheries Pursuant to Articles 69–70 of UNCLOS, special quotas must be allocated to small-scale fisheries, particularly in Iran (where traditional fishing accounts for 60% of coastal employment) and Bahrain (which is highly dependent on fixed nets). These quotas should be determined through the RFMO, with priority given to species such as *Shaari* and *Safi* in Bahrain, and shrimp in Iran, whose stocks have declined by 30%. For example, Oman applies special quotas for local fishermen in Musandam, which could serve as a model for Iran and Bahrain.

Development of Aquaculture Aquaculture should be expanded as an alternative to trawling, particularly in Saudi Arabia (shrimp farms producing 100,000 tons in 2024) and Oman (aquaculture projects in Duqm). Iran also has significant potential along the Makran coast, but requires investment. It is proposed that financial support be provided by the Global Environment Facility (GEF) and the Islamic Development Bank to develop shrimp and fish farms in Iran, Bahrain, and Kuwait, thereby reducing pressure on trawl fisheries. This approach is consistent with SDG 14 (*Life Below Water*

Training for Sustainable Methods : Training fishermen to transition to selective methods such as hook-and-line fishing, which can reduce bycatch by up to 70%, is essential. Training programs must be designed in accordance with the FAO Code of Conduct for Responsible Fisheries (1995, Article 7.6.6) and implemented through the RFMO or ROPME, with a focus on local communities in Iran (e.g., Qeshm and Bushehr) and Bahrain (e.g., Malkiya). For

instance, Oman's training programs for non-trawl methods have increased the income of traditional fishermen by up to 20%.

Market Access and Women's Empowerment: Women in fishing communities (such as those in Qeshm, Iran) should be empowered through cooperatives and marketing training, following successful models in India and the Philippines that have improved access to international markets.

This element strengthens the sustainability of the model by ensuring economic and social justice, reducing poverty, and safeguarding the livelihoods of local communities.

For summary purposes, the following table presents the elements of the model with legal bases:

Table 2. Elements of the model with legal bases

Template element	Key Description	Legal basis	Practical examples (with a focus on the region)
Sustainable protection	Prohibition in sensitive areas, MSY quota, EIA	Articles 61-62, 192 UNCLOS	MPAs in Bahrain (20% of waters), Ecopath for Oman
Regional cooperation	RFMO creation, data exchange	Articles 122-123, 63 UNCLOS	Annual meetings for Iran-Saudi Arabia, ROPME integration
Technical regulations	Tour restrictions, seasonal bans, green technology	FAO Code, EU regulations	TEDs in the UAE, Qatar ban extends
Monitoring and implementation	VMS, courts, local participation	Article 73, 297 UNCLOS	SAR for Bahraini arrests, training in Saudi Arabia
Socio-economic	Compensation, aquaculture	Articles 69-70 of UNCLOS	Local programs in Qatar, an alternative to Iran's trawl

Implementation of the Optimal Trawl Management Model in the Persian Gulf and the Sea of Oman

For the implementation of this trawl management model in the Persian Gulf and the Sea of Oman, as elaborated in the preceding sections, practical solutions aligned with regional and international realities are required. These solutions must take into account the specific challenges faced by the coastal states of the Gulf (Iran, Oman, the United Arab Emirates, Bahrain, Qatar, and Saudi Arabia), including Illegal, Unreported, and Unregulated (IUU) fishing, divergences in national regulations, and environmental impacts such as the 30–50% decline in fish stocks between 1950 and 2018.

This section sets out comprehensive proposed measures with a focus on operationalizing the model and identifying potential challenges. Each measure is formulated as an actionable directive, ending with a verb to emphasize enforceability.

Establishing Bilateral Agreements for Initial Coordination

To begin implementing the model, countries in the region should sign bilateral agreements. For example, Iran and Oman, which both have restrictions on trawl fishing (a total ban on trawling in Iran since 2020 and a bottom trawl ban in Oman since 2016), could begin cooperation. These agreements should include the exchange of fisheries data, coordination on seasonal bans, and joint monitoring of border waters. For example, Iran and Oman could develop a joint protocol for fisheries management in the Sea of Oman. This would strengthen regional cooperation and pave the way for the formation of a regional fisheries management organization.

Establishing a Regional Fisheries Management Organization (RFMO)

The establishment of an RFMO under Article 123 of the Convention on the Law of the Sea (UNCLOS) is essential for coordination among the Gulf States (Iran, Saudi Arabia, Oman, the UAE, Bahrain, Qatar, Kuwait, and Iraq). This

organization should develop protocols for setting catch quotas, monitoring IUU fishing, and exchanging scientific information. For example, the RFMO could analyze demersal fishing data from Bahrain (54% of the total catch) and Qatar (71%) to set sustainable quotas. It could also be integrated with the Kuwait Convention (ROPME) to strengthen environmental aspects. Third Speech: Strengthening monitoring with advanced technologies To reduce IUU fishing, which has been reported in all countries in the region (such as the seizure of 288 kg of illegal shrimp in Bahrain in 2025), satellite tracking systems and artificial radars should be used. These technologies can monitor the activity of foreign vessels (such as Chinese trawlers in Iranian waters). Also, each country's coast guard should be trained to improve surveillance. For example, Bahrain could use SAR to detect fixed nets used for illegal fishing.

Coordination of Seasonal Bans and Technical Regulations

Regional states must harmonize seasonal bans (such as the six-month shrimp ban in Bahrain and Saudi Arabia) by extending them to at least two months during spawning seasons, in order to protect demersal species such as shrimp. Net sizes must also be standardized (with a minimum mesh size of 45 mm to reduce bycatch, which in Qatar and the UAE accounts for up to 50% of total catch). The use of turtle excluder devices and selective nets, already applied in Oman and the UAE, can serve as a model for other states.

Support for Traditional Fisheries and Development of Alternatives

To mitigate the economic impacts of trawling on traditional fishermen (such as the 40% income reduction in Iran and Bahrain), compensation schemes and training programs must be implemented. Aquaculture (such as shrimp farms in Saudi Arabia) can serve as an alternative to trawling. Qatar and the UAE, which emphasize traditional fisheries, may establish training programs for sustainable fishing methods (such as hook-and-line). Pursuant to Articles 69–70 of UNCLOS, special quotas must be allocated to traditional fishermen.

Financing from International Sources

The implementation of the model requires financial resources. International funds such as the Global Environment Facility (GEF) or the World Bank can provide support for technology and training. For example, Oman and the UAE may request assistance for the development of Marine Protected Areas (MPAs), similar to Mediterranean projects. Iran and Saudi Arabia, as major economies, can provide initial investment.

Convening a Regional Conference for a Joint Protocol

A regional conference under the auspices of the FAO or the United Nations should be convened to draft a joint protocol for trawl management. This protocol must include catch quotas, designated prohibited areas, and penalties for IUU fishing. Bahrain and Qatar could serve as hosts, given their stricter trawl bans.

Strengthening the Role of Local Communities in Monitoring

Local communities—particularly in Iran and Bahrain, where traditional fishing predominates—must be involved in monitoring. Training programs for local fishermen can enable them to act as IUU reporters. For example, in Bahrain, coastal communities could report illegal fixed nets.

Utilizing Scientific Modelling for Fisheries Management

Ecosystem models such as *Ecopath* should be employed to predict the distribution of demersal species (e.g., shrimp in Qatar). These models can assist in determining sustainable quotas. For instance, Oman could apply *Ecopath* to manage shrimp stocks, which have declined by 30% since 2010.

Establishing Regional Fisheries Courts

Pursuant to Article 297 of UNCLOS, regional courts should be established to adjudicate IUU fishing offenses. These courts could hear cases involving regulatory violations (such as illegal fishing in Iran–Saudi waters). Bahrain, with its experience in repeated confiscations, could take the lead.

Discussion and Conclusion

The first subsidiary hypothesis of this research states that the legal mechanisms of the United Nations Convention on the Law of the Sea (UNCLOS, 1982) have been only partially implemented in the Persian Gulf, and that their integration into a regional protocol could enhance compliance with these mechanisms and improve the protection of marine ecosystems.

The analysis conducted in this dissertation—examining the status of UNCLOS implementation in the coastal states of the Persian Gulf (Iran, Oman, the United Arab Emirates, Bahrain, Qatar, and Saudi Arabia) and the environmental challenges of the region—fully confirms this hypothesis.

For example, illegal, unreported and unregulated (IUU) fishing by foreign vessels, such as unauthorized activities in Iranian waters, and a 30-50% decline in fish stocks since 2010 indicate weaknesses in the implementation of Article 73 of UNCLOS (vessel monitoring). The Kuwait Convention (ROPME), which focuses on pollution reduction, lacks specific protocols for fisheries management, and this gap has limited the integrated implementation of UNCLOS. In contrast, the proposal to integrate these mechanisms into a regional protocol, such as the establishment of a Regional Fisheries Management Organization (RFMO), would allow for coordination between countries. The protocol could improve the protection of fragile coral ecosystems by standardizing regulations (such as bimonthly seasonal bans and 40-50 mm net mesh), strengthening surveillance with modern technologies such as VMS and SAR (similar to the actions of Saudi Arabia and Bahrain), and establishing Marine Protected Areas (MPAs, such as 20% of Bahraini waters). Regional experiences, such as the bottom trawl ban in Oman since 2016 and Bahrain's impoundments in 2025, show that regional coordination under UNCLOS can increase effectiveness. Therefore, this study confirms that integrating the legal mechanisms of UNCLOS into a regional protocol, relying on transboundary cooperation and monitoring tools, would strengthen compliance with international obligations and effectively improve the protection of the marine ecosystems of the Persian Gulf.

The second subsidiary hypothesis of this research asserts that the absence of a unified legal regime in the Persian Gulf has hindered the implementation of the requirements of the FAO Code of Conduct for Responsible Fisheries (1995). The establishment of a Regional Council for Sustainable Fisheries could strengthen cooperation among the Gulf coastal states and reduce the environmental damage caused by trawl fishing.

The analysis conducted in this study—examining the fisheries situation in Iran, Oman, the United Arab Emirates, Bahrain, Qatar, and Saudi Arabia, as well as the environmental challenges of the Persian Gulf—fully confirms this hypothesis.

The FAO Code, particularly Articles 7 and 8 (responsible fisheries management and reduction of bycatch) and Article 11 (monitoring, control, and enforcement), provides a framework for fisheries sustainability. However, its implementation in the Persian Gulf has failed due to the lack of a unified legal regime and divergences in national legislation.

For instance, while Bahrain has prohibited bottom trawling since 1997 and Oman has imposed similar restrictions since 2016, Qatar and the United Arab Emirates have only adopted partial or seasonal limitations, which undermines regional coordination. This lack of harmonization has contributed to the rise of Illegal, Unreported, and Unregulated (IUU) fishing, exemplified by the confiscation of 288 kilograms of illegally caught shrimp in Bahrain in 2025.

Environmental damages, such as the 30–50% decline in fish stocks since 2010 and the destruction of coral seabeds caused by bottom trawling (equivalent to 22 gigatons of annual sediment displacement), further demonstrate the ineffectiveness of FAO requirements in practice.

The proposed establishment of a Regional Council for Sustainable Fisheries—similar to Regional Fisheries Management Organizations (RFMOs) in the Mediterranean—would fill this gap. Such a council could strengthen cooperation among states by drafting joint protocols, including standardized net mesh sizes (40–50 mm) and harmonized seasonal bans.

Regional experiences support this approach: Saudi Arabia's use of satellite tracking systems (VMS) and aquaculture development (459,000 tons in 2024), as well as Iran's Integrated Coastal Management (ICM) programs, illustrate that such a council could reduce environmental damage through data exchange and joint monitoring.

This approach is consistent with the Kuwait Convention (ROPME) and, with FAO support, could ensure the sustainability of the fragile ecosystems of the Persian Gulf. Therefore, this research confirms that the creation of a Regional Council for Sustainable Fisheries, by filling the gap of a unified legal regime, would facilitate the implementation of FAO requirements and effectively reduce environmental damage by minimizing bycatch and overfishing

Overall, the findings of this research demonstrate that the transition from general international frameworks to adaptive regional legal models—led by countries such as Iran and Saudi Arabia in establishing a Regional Fisheries Management Organization (RFMO)—not only addresses existing inefficiencies but also ensures the long-term sustainability of ecosystems and the livelihoods of coastal communities in the Persian Gulf and the Sea of Oman.

Accordingly, this study recommends convening a regional conference under the auspices of the FAO to draft binding executive protocols, thereby operationalizing the proposed model.

Research Recommendations

Legal Analysis of the Role of Local Communities in Fisheries Monitoring: Future research should examine the legal dimensions of community participation in monitoring IUU fishing, based on the principle of equity enshrined in Articles 69 and 70 of UNCLOS. Such studies could provide legal frameworks for empowering traditional fishermen and propose mechanisms for integrating local rights into regional protocols.

Adaptation of RFMO Legal Models to the Persian Gulf: Legal research should explore how the models of Regional Fisheries Management Organizations (RFMOs), such as ICCAT, can be adapted to the specific conditions of the Persian Gulf. This includes proposing dispute settlement mechanisms under Article 297 of UNCLOS. Such research could lay the foundation for the establishment of specialized regional fisheries courts.

Legal Assessment of Monitoring Technologies: Future studies should evaluate the legal frameworks governing the use of modern technologies such as Synthetic Aperture Radar (SAR) and Vessel Monitoring Systems (VMS). Recommendations should address privacy protection and data security in accordance with international legal principles.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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