Abstract: Illegal, unreported and unregulated (IUU) fishing has become a key issue of increasing concern in the world. Led by the United Nations Food and Agriculture Organization (FAO), recent developments focused on the role of port states as the principal actor against IUU fishing. However, the FAO adopted the Voluntary Guidelines for Flag State Performance (the Guidelines) in 2013, implying that the principal role against IUU fishing still corresponds to flag states. As one of the leading distant-water fishing nations, Taiwan has adopted many domestic regulations in accordance with these international instruments voluntarily, regardless of its statehood debate. Although the adoption of the Guidelines is “a real breakthrough” against IUU fishing, the instrument is “soft law” in nature, meaning the implementation of the Guidelines may depend on the political will of states, and the effectiveness and efficiency of the Guidelines are thus highly questionable. Furthermore, the consensus among states to adopt a legally binding agreement on flag state performance in the near future, akin to the development of the Port States Measures Agreement that successfully evolved from a “soft law” to a “hard law” basis, is not yet clear.

Keywords: illegal, unreported and unregulated (IUU) fishing; Voluntary Guidelines; flag state performance; Taiwan; soft laws

1. Introduction

Illegal, unreported and unregulated (IUU) fishing has become a key issue of major concern for the community of international fisheries since the 1990s, particularly for the subject of sustainable utilization of marine fisheries resources [1]. While no exact numbers and figures are revealed, it is globally recognized that IUU fishing has escalated in the past 20+ years, and its magnitude is considerable [2]. To resolve this problem, the international community has adopted several international instruments that included effective management measures against IUU fishing, such as the 2001 FAO International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU) and the 2005 Model Scheme on Port State Measures to Combat Illegal, Unreported and Unregulated Fishing (the Model Scheme). Later, the 2005 Model Scheme resulted in the adoption of the 2009 FAO Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (the PSM Agreement), a legally binding “treaty”.

Furthermore, the Committee on Fisheries (COFI) of the United Nations Food and Agriculture Organization (FAO) endorsed the Voluntary Guidelines for Flag State Performance (the Guidelines) at its 31st session in 2014. The Guidelines, a set of international standards and procedures that aims to...
hold flag states more accountable for fishing vessels under their registrations, set out a range of actions 
that each state can implement to ensure that fishing vessels registered under their flags do not engage 
in IUU fishing [3], the consequences of which are the loss of short-term and long-run social justice, 
economic benefits and opportunities and huge negative impacts on environmental stability and food 
security [4]. Interestingly, the IPOA-IUU and the Model Scheme, along with the Guidelines, are not 
legally binding (also called "soft laws"), as shown in Table 1. Why the international community prefers 
soft laws (without legally binding force) rather than hard laws (with legally binding force) is thus a 
question that is worthy of further analysis.

### Table 1. Summary of the international soft laws against illegal, unreported and unregulated (IUU) 
fishing (summarized by this study).

| Subjects Included to Combat IUU Fishing | FAO IPOA-IUU | FAO Model Scheme | 2014 FAO Guidelines |
|----------------------------------------|--------------|------------------|---------------------|
| Legal Basis                            | Soft Law     | Soft Law         | Soft Law            |
| Year Adopted                           | 2001         | 2005             | 2014                |
| Important Contents                     |              |                  |                     |
| • The first specific international instrument to combat IUU fishing | | | |
| • Provides definitions for IUU fishing and six principles on which it is based | | | |
| • Provides all int’l subjects with comprehensive, effective and transparent measures | | | |
| • Requests states to adopt their NPOA-IUU | | | |
| • Basic framework and implementation details of the port state measures have been established and listed | | | |
| • Provides definitions for the subjects and scope to which the port state measures should be applied | | | |
| • Provides instructions for port states as references when they implement relevant port state measures | | | |
| • Provide criteria (measures and actions) and procedures for implementing performance assessment and cooperation between flag states and coastal states | | | |
| • Limited to fishing and fishing-related activities in areas beyond national jurisdiction | | | |
| • Annexes are Paragraph 47 and 24 of the IPOA-IUU | | | |

In addition, the Sustainable Development Goals (SDGs), part of the 2030 Agenda for Sustainable 
Development, were adopted by the United Nations General Assembly in 2015. The SDGs are designed 
to be a blueprint to achieve a better and sustainable future for all mankind [5]. There are 17 SDGs 
included, among which SDG 14, “Life Below Water”, is mainly for the sustainable development 
of oceans and marine resources. Key issues concerned in SDG 14 include ocean acidification, 
deterioration of coastal waters, marine pollution (plastics), protection of marine biodiversity and 
resource management [6]. Currently, SDG 14 has been incorporated into several international legal 
instruments, such as the Aichi Biodiversity Targets of the Convention on Biological Diversity (CBD) [7]. 
Thus, SDG 14 is now a very important guideline for ocean-related issues, including the sustainable 
development of marine resources.

As one of the distant-water fishing nations (DWFNs), Taiwan has to face relevant regulations 
incorporated in these instruments from other actors, even if these instruments are only soft laws. 
Despite the fact that the Fisheries Agency of Taiwan, the competent authority for fisheries management 
in Taiwan, has tried to enact conservation and management measures (CMMs) mostly according to 
those regulations, challenges such as international sanctions are still faced by Taiwan. The sanction 
from the International Commission for the Conservation of Atlantic Tunas (ICCAT) in 2005, in which 
Taiwan, as a flag state, failed to effectively control fishing vessels registered to it to conduct illegal, 
unregulated and unreported (IUU) fishing and illegal fish laundering [8], and the “yellow card” issued 
in 2015 by the European Union are the best examples [9]. Although the yellow card was lifted in 2019, 
the European Union may again give Taiwan a yellow card or even list Taiwan as a “noncooperating third 
country” (red card) and ban the importation of Taiwanese fish and fish products to the European Union 
if Taiwan’s efforts against IUU fishing are not satisfactory to the European Union in the future [10]. 
The purpose of this article is to understand the development and key elements of these soft laws, 
their influence against IUU fishing and Taiwan’s response to these soft laws for its high-seas
fisheries management. This paper firstly introduces the evolution of the international fisheries legal regime, particularly focusing on the development and contents of these two soft laws. Secondly, this paper analyzes the origin and details of the Guidelines. Thirdly, Taiwan’s recent actions in response to these soft laws against IUU fishing are discussed. Lastly, observations and conclusions based on the analysis of those efforts as policy recommendations for Taiwan are provided.

2. IUU Fishing and International Laws

IUU fishing is in fact not a new issue in marine capture fisheries. Although Erikstein and Swan (2014) stated that the 1982 United Nations Convention on the Law of the Sea (UNCLOS) “provides the overall framework for the international law of the sea, whose provisions subsequent instruments incorporate or elaborate upon as appropriate [11]”, the term “IUU fishing” did not exist in the UNCLOS and its subsequent legal instruments, such as the 1993 FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (the Compliance Agreement) and the 1995 United Nations Fish Stocks Agreement (UNFSA) [12].

The first appearance of the term “IUU fishing” can be traced back to the 16th annual meeting of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), held in Hobart, Tasmania, Australia in 1997 [13]. At the opening of the meeting, the chair mentioned that “[t]he extent of illegal fishing had led to great concern and had visibly undermined the conservation policy of CCAMLR. The stocks . . . were under pressure because of illegal fishing [8].” Furthermore, the chair urged that “the issue of illegal fishing—and measures to contain it—was a serious issue facing the Commission at this meeting, and central to this containment were measures of control and enforcement [14].”

In addition, Agenda 5 of the meeting discussed “Illegal, Unreported and Unregulated Fishing in the Convention Area”. The European Union considered that CCAMLR was facing an unwanted challenge from the illegal fishing activities. The progress achieved by the organization over the last 15 years, however, “is consequently at risk, not only of being undermined, but irreparably damaged by these activities [14].” Finally, most member states of the organization agreed that the evidence of large-scale IUU fishing in the Convention Area “has seriously undermined the work of CCAMLR on achieving of the Convention’s objective”, and the situation “calls for collective efforts within CCAMLR, measures by Flag States and Coastal States and steps vis-à-vis non-Contracting Parties to enhance enforcement and compliance with conservation measures regarding living resources in the Convention Area [14].”

To resolve these issues, the international community proposed all kinds of workable solutions and actions against IUU fishing [15]. The first was the adoption of the FAO IPOA-IUU, the origin of which was relevant to the 1995 FAO Code of Conduct for Responsible Fisheries (CCRF) [16]. Two years after the adoption of the CCRF, in 1997, member states of FAO determined that having some international instruments to address issues concerned for compliance with the CCRF was necessary [17]. Later, the development of a global action plan to address all kinds of IUU fishing through cooperative efforts “among States, regional fisheries management organizations (RFMOs), FAO, and other international organizations” was decided in the FAO Ministerial Meeting on Fisheries, 1999 [18]. To this end, FAO, with the assistance of Australia, convened an expert consultation to discuss this action plan related to IUU fishing in Sydney, Australia in May 2000. To further negotiate details of the action plan, two subsequent FAO technical consultations were convened in Rome, Italy in October 2000 and February 2001, respectively [19]. Finally, the IPOA-IUU was adopted in the COFI of FAO by consensus on 2 March 2001 and urged all members of the FAO to take the necessary actions to implement it [18].

Although a “soft law”, the IPOA-IUU was the first specific international instrument adopted to combat IUU fishing [20]. It contains seven parts, including “Introduction”, “Nature and Scope of IUU Fishing and the International Plan of Action”, “Objective and Principles”, “Implementation of Measures to Prevent, Deter and Eliminate IUU Fishing”, “Special Requirements of Developing Countries”, “Reporting” and “Role of FAO”. Particularly, the section on “Implementation of Measures to Prevent,
Deter and Eliminate IUU Fishing” is the bulk of the IPOA-IUU, in which every subject under international fisheries laws, such as flag states, coastal states, port states, market states and RFMOs, are obligated to assume part of the duties and responsibilities in combating IUU fishing, and therefore, the adoption of the IPOA-IUU is to “provide all States with comprehensive, effective and transparent measures by which to act” [4].

After the adoption of the IPOA-IUU, the Secretary-General of FAO held an expert consultation in 2002 in order to analyze “port State measures” as a means in combating IUU fishing with the International Maritime Organization (IMO), according to paragraph 90 of the IPOA-IUU, to promote the implementation of the IPOA-IUU. A draft paper named “Port State Control of Foreign Fishing Vessels” proposed by FAO was thoroughly discussed “for a harmonized system of port State measures” and “how such a comprehensive and transparent system might be achieved [21].” A comprehensive analysis on “port State measures with respect to fishing vessels” was conducted, along with the identification of issues that can be incorporated in a regional memorandum of understanding (MOU) regarding utilizing port state measures against IUU fishing [21]. Finally, it was recommended to convene a conference discussing principles and guidelines for such a regional MOU [21].

To this end, the Secretary-General of FAO convened a technical consultation meeting in 2004 to deal with practical issues relating to “the role of the port State in combating IUU fishing” and “principles and guidelines for the establishment of regional MOU on port States measures to prevent, deter and eliminate IUU fishing” [22]. Some states stated that they reserved their rights on adopting a regional MOU as a tool to implement the IPOA-IUU because “it would create a further bureaucratic layer and that its establishment would be a lengthy process [22].” However, these states agreed that “there was a need for a suite of model provisions to implement port State measures” and this tool “did not exclude the need to prepare in the future an international instrument on the rights and obligations of port States [23].” Finally, states agreed that the regional MOU should be titled “Model Scheme” as “a framework, a set of minimum requirements which States, RFMOs or others could use and consult when developing port State measures [22],” and it was officially adopted in the 26th COFI of FAO in 2005 [23].

The Model Scheme, similar to the IPOA-IUU, is a “soft law” in nature [24]. In addition to the “Introduction”, it includes five additional sections, namely “General”, “Inspections”, “Actions”, “Information” and “Others,” along with five annexes [23]. Overall, the basic framework and implementation details of the port state measures have been established and listed in the document. The Model Scheme not only clearly provides definitions on the scope and subjects to which port state measures are applicable, such as the ports and fishing vessels, but also gives instructions to port states for their reference when they implement port state measures. Thus, it should be safe to say that port state measures, to a certain degree, have been recognized by many states as a workable measure against IUU fishing.

As mentioned earlier, the adoption of the PSM Agreement resulted from the adoption of the Model Scheme [25]. This is because the implementation of the Model Scheme highly depends upon port states’ political will. Therefore, the possibility of developing a legally binding agreement against IUU fishing based on port state measures remained concerned [26]. This can be evidenced in the 61st UN General Assembly, in which states were encouraged to “initiate a process within FAO to developing, as appropriate, a legally binding instrument on minimum standards for port State measures, building on the Model Scheme and the IPOA-IUU” [27].

The objective of the PSM Agreement is to “prevent, deter and eliminate IUU fishing through the implementation of effective port State measures, and thereby to ensure the long-term conservation and sustainable use of living marine resources and marine ecosystems [28].” It is worth noting that, after analyzing its provisions, most contents and relevant regulations of the PSM Agreement are highly similar to those contents of the IPOA-IUU and the Model Scheme, meaning that it is a legally binding instrument that includes existing regulations in other “soft laws [29]”. It is expected that under
its framework, port state measures will be implemented by contracting port states more effectively because these states will have their compulsory obligations under international law [30].

3. Flag State Performance and the Adoption of the Guidelines

Despite the fact that the international community in this period concentrated their endeavors to shape “port states” as a key actor to combat IUU fishing, lacking effective flag state control is a very important contributory element for IUU fishing. This is because, according to FAO, “some States, after authorizing vessels to fly their flags, fail to meet their obligations under international law with respect to the supervision and control of these vessels” or “do not provide proper authorizations for their vessels to fish once they assume the State’s flag” [31]. Thus, flag states still play a very important role in combating IUU fishing.

3.1. Negotiation and Adoption of the Guidelines

To this end, after the adoption of the PSM Agreement, the Director-General of FAO again convened an expert consultation to discuss flag state performance from 23 to 26 June 2009, which was attended by 13 individual experts in this field. In the consultation, the following areas were considered by attendees: “(1) criteria for assessing the performance of flag States; (2) possible actions against vessels flying the flag of States not meeting the criteria for flag State performance; (3) the role of national governments in implementing criteria and actions for flag States performance; (4) the role of regional fisheries management organizations in implementing criteria and actions for flag State performance; (5) the role of international institutions and instruments in implementing criteria and action for flag State performance; and (6) assistance to developing countries” [32]. Participants also suggested that “international guidelines on criteria for assessing the performance of flag States and possible actions against vessels flying the flags of States not meeting such criteria should be developed.” Finally, participants suggested convening a conference relating to “international guidelines on criteria for assessing the performance of flag States and possible actions against vessels flying the flags of States not meeting such criteria should be developed [32].”

To continue the discussions on this issue, a technical consultation regarding “flag state performance” was convened by FAO at its headquarters in Rome, Italy, on 2–6 May 2011 [33]. The purpose of the consultation was to “draft criteria for flag State performance for submission to FAO COFI [34]”. At the end of the session, the chairperson’s draft text was provided as the conclusion of the session, which would also become the basis for future meetings of the technical consultation [33]. Later, the resumed session of the technical consultation was reconvened on 5–9 March 2012 to continue discussing standards for flag state performance. Based on the mandate given by the FAO COFI and the agenda adopted for the technical consultation, it was agreed in the session that the meeting output should be organized in the following structure, including “(1) statement of purpose and principles; (2) scope of application; (3) performance assessment criteria; (4) procedures for carrying out assessments; (5) measures and incentives to encourage compliance by flag States; and (6) cooperation with, and assistance to, developing countries with a view to capacity development” [34].

The second resumed session of the technical consultation was reconvened on 4–8 February 2013 to finalize the draft criteria for flag state performance. This meeting focused on issues regarding “geographical scope”, “cooperation between flag States and coastal States”, “procedure for carrying out assessments” and “compliance and deterrence of non-compliance by flag States.” The draft text was analyzed and discussed, and all the text was agreed upon by the end of the meeting. In addition, considering that the instrument is voluntary, its title was determined to be “Voluntary Guidelines for Flag State Performance [33]”. Finally, the Guidelines were adopted on 28 February 2013 and were endorsed by the FAO COFI at its 2014 session.
3.2. Content Analysis of the Guidelines

According to the FAO Assistant Director-General for Fisheries and Aquaculture, the Guidelines are “a real breakthrough to prevent, deter and eliminate IUU fishing, and can help to ensure the long-term conservation and sustainable use of precious, living marine resources and ecosystems [2].” The Guidelines are divided into eight sections, along with two annexes. The first section, “Statement of purpose and principles”, states that this document is voluntary. Despite this, however, contents of the Guidelines are mainly based on existing international laws, such as UNCLOS. Through the effective implementation of flag state responsibilities, the Guidelines aim to eliminate IUU fishing and relevant activities supporting it in order to “ensure the long-term conservation and sustainable use of living marine resources and marine ecosystems [35].” In addition, the Guidelines stipulate some requests when flag states effectively exercise their responsibilities, including that they should “act following relevant international laws and regulations”; “respect sovereignty and coastal State rights”; “take effective measures against non-compliance activities taken by vessels flying their flags”; and “recognize special requirements of developing States, particularly the least developed States (LDS) and small island developing States (SIDS)” [35].

The second section, “Scope of Application”, includes two subsections: “geographical” and “vessels”. In the former, the Guidelines “apply to fishing and fishing-related activities in maritime areas beyond national jurisdiction.” They might also “apply to areas under the national jurisdiction of the flag State or of a coastal State” (subject to its sovereign rights under UNCLOS). In the latter, it defines that the Guidelines apply to “any type of vessels used for fishing or fishing-related activities, or used in supporting of fishing (e.g., landing, packaging, processing, transhipping or transporting of fish) that have not been previously landed at a port,” excluding substance or artisanal fisheries. If a coastal state authorizes any fishing vessel chartered by its nationals to fish exclusively within its jurisdictional waters (i.e., territorial sea and exclusive economic zone, EEZ) and under its control, such a fishing vessel should be “subject to measures by the coastal State that are as effective as measures applied in relation to vessels entitled to fly its flag while in waters of the coastal State” [35].

The following section, “Performance Assessment Criteria”, is the bulk of the Guidelines and contains four subsections. The first subsection, “General”, requests that flag states must have “incorporated the flag State principles and rules that are binding on them in accordance with international laws into their domestic laws and regulations.” Furthermore, flag states should ensure that vessels flying their flags “do not engage in any activity that undermines the effectiveness of the international conservation and management measures”, such as those adopted by RFMOs, and should “support cooperation among flag States on managing fishing capacity, catch limits and output control” [35]. In “Fisheries Management”, flag states should “establish an institutional, legal, technical foundation/framework for fisheries management, including governmental agencies for policy-making and enforcement, internal coordinating network, and infrastructure for scientific advice” [35]. Meanwhile, flag states should adopt laws, regulations or other arrangements based on principles and rules of relevant international instruments or applicable RFMO measures and ensure their effective implementation [35].

The second subsection, “Information, Registration, and Records”, states that flag states should follow minimum requirements, such as requirements from FAO and IMO. Information on vessel owners, operators, beneficial owners, prior vessel name and flag and vessel characteristics should be established, provided and accessible easily. Furthermore, flag states must “follow registration procedures; maintain a record of fishing vessels entitled to fly their flag including all information set out in the Compliance Agreement; and avoid registration of vessels with a history of non-compliance”. In “Authorization”, the third subsection, it requests that flag states should have in place “a regime for authorizing fishing activities to ensure no vessel is allowed to fish unless so authorized, and a license will only be issued if all conditions set by flag States are satisfied” [35].

Lastly, the “Monitoring, Control, Surveillance, and enforcement” subsection requests that states should establish a control regime over vessels under their flags, including an inspection regime,
as well as an enforcement regime to detect violations and conduct timely investigations, sanctions and cooperation and mutual legal assistance with RFMOs. In addition, flag states should “undertake effective and comprehensive monitoring, control and surveillance (MCS) measures, including those stipulated in IPOA-IUU” [35].

In the section on “Cooperation between Flag States and Coastal States”, when “a coastal State determines to negotiate a fisheries access agreement with a flag State, both States must agree on how to implement their respective roles and responsibilities under the agreement”. The agreement should be reached only when both sides have determined that “such fishing activities will not undermine the sustainability of the coastal State’s fisheries resources.” In addition, the flag state should impose sanctions on its vessels that have violated regulations and exchange all relevant information with the coastal state [35]. The following section on “Procedure for Carrying out Assessment” encourages all flag states to conduct both self- and external performance assessments periodically. This section also provides recommended procedures to conduct such assessments, including doing so through a transparent process, making the result publicly available, developing a validation process and applying relevant provisions in the Guidelines, the results of RFMOs’ flag state assessment and international law [35].

In addition, the section on “Encouraging Compliance and Deterring non-Compliance by Flag States” contains only one paragraph. It states that “measures taken in light of the results of a resource assessment” may include “corrective actions taken by flag States, other interested States and RFMO” and “those set out in the IPOA-IUU, the CCRF and other international instruments as applicable” [35]. Next, the section on “Cooperation with and Assistance to Developing States with a View to Capacity Development” requests states to provide developing states relevant assistance to “improve their performance as flag States”. In addition, states should “give full recognition to special requirements of developing States” and enhance their abilities to develop, inter alia, “an adequate legal and regulatory framework”, “a strengthened institutional agency”, and “an effective MCS system”. To this end, states may also “cooperate to establish appropriate funding mechanisms to assistant developing States in implementing the Guidelines” [35].

The last section, “Role of FAO”, requests that “States should report to FAO on progress with the implementation of the Guidelines and the result of performance assessments conducted”. In addition, “FAO should consider providing specific in-country technical assistance to States that request assistance” and “collect relevant information on the global implementation of flag State performance assessment criteria and report this information to the FAO COFI” [35]. Lastly, Annex 1, “Conditions of Authorizations”, and Annex 2, “Monitoring, Control and Surveillance”, provide supplemental information for paragraph 29(c)(vi) and paragraph 33 of the Guidelines, respectively. In fact, the wording of these two annexes is actually adopted from paragraphs 47 and 24 of the IPOA-IUU, respectively [35].

3.3. Summary

Based on the analysis above, the Guidelines in fact draw on existing international laws and instruments, including UNCLOS, the CCRF and the IPOA-IUU. The Guidelines contain suggested means to urge and assist flag states to fulfill their international responsibilities regarding registration and controlling fishing vessels under their flag, such as “performance assessment criteria and procedures for carrying out assessments and cooperation between flag States and coastal States” [36]. The Guidelines also provide possible approaches to ensure compliance and prevent noncompliance by flag states. Last but of course not least, the Guidelines provide achievable paths for states to help developing states regarding their capacity building and clearly define the role of FAO in aiding these procedures.

4. Taiwan’s Actions against IUU Fishing

As one of the leading distant-water fishing nations in the world, Taiwan should play an important role against IUU fishing alongside other states. According to the Fisheries Agency of Taiwan, the development of Taiwan’s fisheries commenced significantly from the 1960s. According to the
government, academia and relevant research institutes, the fisheries industry of Taiwan generates a
total production of 1.2 million tons and a value of 95 billion New Taiwan dollars (NT$, or approximately
US $3.2 billion) [37]. As regards the distant-water fisheries, according to the 2018 FAO statistics of the
world’s fisheries production published in 2020, Taiwan was the 22nd fisheries producer in the world,
mainly in the tuna longline fishery, tuna purse-seine fishery, stick-held dipnet saury fishery and squid
jigging fishery. The average annual production in recent years is around 730 thousand tons, with a
value of NT $40.2 billion (or approximately US $1.36 billion). Currently, there are over 1100 Taiwanese
fishing vessels operating in three oceans, including the high seas as well as EEZs of currently 22
coastal states [37]. With such a huge fishing capacity, Taiwan will inevitably attract attention globally,
including from RFMOs, conservation-oriented states (e.g., the United States and the European Union)
and some environmental nongovernmental organizations (NGOs) such as Greenpeace. This can be
evidenced by the “yellow card” issued by the European Union mentioned earlier to request better
management of the Taiwanese fishing fleet and the sanction to Taiwan adopted in Recommendation
05-02 by ICCAT in 2005, in which Taiwan’s quota of bigeye tuna was reduced from 16,500 tons to
3300 tons for IUU fishing and illegal fish laundering of Taiwanese fishing vessels [8].

To comply with CMMs adopted by RFMOs, Taiwan has become more active in participating in the
work of these organizations, which also fulfills the request of paragraph 83 of the IPOA-IUU. Due to
the fact that Taiwan is not recognized by the United Nations and most states as a “state”, it is not able
to participate in these RFMOs and obtain “contracting party” status. To circumvent this difficulty,
Taiwan takes “fishing entity” defined in the 1995 United Nations Fish Stocks Agreement as its capacity
to participate in the work of RFMOs, but organizational status granted to it varies. For example,
Taiwan is granted membership in some RFMOs such as the Western and Central Pacific Fisheries
Commission (WCPFC) and the Inter-American Tropic Tuna Commission (IATTC). In other RFMOs,
Taiwan is only granted cooperating noncontracting party (CNCP) status, such as in the ICCAT. Its
obligation for combating IUU fishing, however, is no different from that of a state, no matter what
organizational status is granted to Taiwan. Particularly, in order to effectively manage its distant-water
fishing vessels operating in the three oceans so that they will not be sanctioned for further violations,
in recent years, Taiwan has incorporated resolutions and decisions adopted by relevant RFMOs into its
domestic legal system, including port state measures, attending regional observer programs (ROPs)
and high-seas boarding and inspection schemes and the compulsory installation of vessel monitoring
system (VMS) equipment on each of its distant fishing vessels, all of which aim to regulate and control
its fishing fleet more effectively [37].

In addition to requirements from RFMOs, Taiwan has endeavored to fulfill other
requirements/requests listed in international legal instruments or from other states. For example,
paragraph 25 of the IPOA-IUU requests that states should develop and implement their national
plans of action (NPOAs) no later than three years after the adoption of the IPOA-IUU. To this end,
Taiwan voluntarily adopted its NPOA against IUU fishing (NPOA-IUU) in 2013, despite the fact that
Taiwan was not even a member state of FAO. Taiwan’s NPOA-IUU was developed mostly in line
with the provisions of the IPOA-IUU. The contents of Taiwan’s NPOA against IUU fishing include
“all States responsibilities”, “flag States responsibilities”, “coastal States measures”, “port States
measures”, “internationally agreed market-related measures”, “research”, “adoption of CMMs within
the framework of regional fisheries management organizations” and “supportive of the special
requirements of developing countries,” most of which are identical with those of the IPOA-IUU.
Through the adoption of this NPOA, it reflects the willingness of Taiwan to implement the IPOA-IUU, a
nonlegally binding instrument, in conserving and managing marine fisheries resources as well as their
sustainable utilization [38]. The implementation of the NPOA also fulfills Taiwan’s responsibilities as a
flag state under the Guidelines and demonstrates Taiwan’s willingness to voluntarily comply with the
Guidelines as well.

Next, in order to remove the yellow card from the European Union, Taiwan has adopted a new
law titled “Act for Distant Water Fisheries” in 2016 to ensure its capability for the conservation of
marine fisheries resources, strengthen management of its distant-water fisheries, curb IUU fishing and improve traceability of catches and fisheries products, all of which is to guarantee the sustainable development of its distant-water fisheries through effectively fulfilling its international obligation as a flag state [39]. Particularly, sanctions and fines for violations have been significantly increased in the act, from originally NT $300,000 (or approximately US $10,000) maximum to at least NT $2 million (or approximately US $65,000) or even up to NT $60 million (or approximately US $2 million) [39]. Meanwhile, the “Fisheries Act” and the “Act to Govern Investment in the Operation of Foreign Flag Fishing Vessels” were amended in accordance with the “Act for Distant Water Fisheries” (the so-called “Three Fisheries Laws”), and 15 bylaws to strengthen the management of its fishing fleet were adopted [40]. Furthermore, in 2016, the Fisheries Agency of Taiwan also adopted the “Strategy Plan for Auditing Industry Related to Distant Water Fisheries” to improve the traceability of fisheries products, audit its distant-water fishing industry on an irregular basis and ensure their catches or fisheries products to be traded legally and not engaging in IUU fishing activities. All of these aim to fulfill the requirements from the European Union, primarily to fulfill Taiwan’s responsibilities as a flag state, in order to remove the yellow card. In addition, Taiwan has conducted bilateral cooperation with the United States, Japan, Pacific island states to which Taiwan has signed bilateral fisheries agreements and port states to which the catch of Taiwanese distant fleets will be landed to further strengthen the effectiveness of its management measures [41].

In addition to IUU fishing, Taiwan also commits itself for the conservation and management of species associated with its distant-water fisheries, particularly sharks. Taiwan has long been putting tremendous efforts in conducting scientific research and adopting a series of CMMs for sharks, such as the 2007 “Regulations on the Prohibition on Catching, Possessing and Selling of Whale Shark”; the 2012 “Regulations on Shark’s Fins Naturally Attached to Bodies”, which aims to eliminate and deter shark finning; the 2013 “Regulations on the Catching of Great White Shark, Basking Shark and Megamouth Shark”; and the 2016 “Regulations on Manta Ray Catch”, which establish a mechanism for “reporting and collecting biological information on rare large shark species.” The Fisheries Agency of Taiwan clearly declared that violations of any kind will be investigated and sanctioned accordingly to demonstrate its determination on shark conservation [42]. The protection of sharks also meets the requests in the International Plan of Action for Conservation and Management of Sharks (IPOA-Sharks), another soft law adopted by FAO.

5. Discussion

IUU fishing was not officially concerned by the international community as a key factor in jeopardizing the sustainable utilization of marine fisheries resources until the end of the last century. In order to combat IUU fishing, several international and voluntary instruments, including both hard and soft laws, have been adopted to this end.

Although the IPOA-IUU includes many subjects under international law to combat IUU fishing, the endeavors of FAO and states primarily focused on the port state measures after its adoption. As Swan stated, “[t]he FAO Model Scheme could be regarded as a stepping-stone; a broader process, involving a full complement of players, could build on, and as appropriate, expand the current standards [43].” The soft law Model Scheme was first adopted by FAO to guide states on how to “voluntarily” implement port state measures, followed by the hard law PSM Agreement. After these achievements, the international community then again turned their attention to the performance of flag states. This is because IUU fishing is primarily caused by flag states who do not effectively regulate and control fishing activities conducted by fishing vessels flying their flags.

Some observations can be drawn from the analysis of the Guidelines. Firstly, the Guidelines are a “soft law” in nature, not yet a “hard law” similar to the PSM Agreement. Hard law provides a powerful cooperation framework to ensure parties fulfill their legal obligations, but it may require longer reaching final agreements among parties. Therefore, hard law is often unsuitable for dealing with urgent issues. On the other hand, soft law offers a more flexible and faster way to address urgent
issues, easier ways to achieve final agreements than hard law and more effective ways to address uncertainty [44]. Thus, a soft law can act as “a first or provisional step to bring all parties together due to the nature of soft law” mentioned above, followed by a legally binding instrument as a subsequent step to ensure parties fulfill their obligations [45]. The best example is the subsequent adoption of the Model Scheme and the PSA Agreement against IUU fishing. Thus, despite the fact that no clear evidence has been observed, it is still reasonable for us to expect that the Guidelines should only be the first step [46], and a legally binding instrument that ensures flag states fulfill their obligations would be likely adopted later in the future [47].

Secondly, the geographical scope of the Guidelines primarily applies to areas beyond national jurisdiction or high seas. Although the Guidelines might also apply to the territorial seas and EEZ of a flag state or a coastal state, it needs the consent of the state if the Guidelines are to be applied in its territorial seas and EEZs. In other words, states remain within their rights to decide what measures and actions are to be applied for flag state performance assessment in their territorial seas and EEZs. This could result in a possibility that criteria for flag state performance could be inconsistent beyond and within national jurisdiction. A possible explanation is that international legal instruments usually do not involve a state’s internal affairs to prevent jeopardizing a state’s sovereignty and sovereignty rights. Furthermore, most states may not be ready to accept the Guidelines to be applied, whether voluntarily or compulsorily, in their territorial seas and EEZs yet [48].

Thirdly, a variety of measures and actions of performance assessment criteria have been provided in the two “Performance Assessment Criteria” sections. These could be simply categorized into several groups: (1) criteria for people related to fisheries, including owners, operators and beneficial owners/operators; (2) criteria for vessels, including vessel data, registration procedures and the record of fishing vessels; (3) actions that states should implement, such as cooperating with other flag states and ensuring “their fishing vessels do not engage in activities that undermine the effectiveness of relevant measures”; and (4) establishment of administrative and legal structures for fisheries management, including government agencies, laws and regulations and a regime for authorizing fishing activities. On the other hand, however, there are only principles rather than detailed steps provided in the sections on “Procedure for Carrying out Assessment” and “Encouraging Compliance and Deterring Non-Compliance by Flag States”. In other words, flag states seem flexible to accept what measures and actions they should implement listed in the Guidelines but are reluctant to list detailed steps on how to implement these measures and actions. A possible explanation is that having performance assessment is the right and internal affairs of a flag state, on which international law usually is reluctant to “cross the boundary”. In addition, doing so could be misinterpreted that flag states have reached consensus on these implementation steps and agreed to be bound by them [49].

Lastly, despite the adoption of the Guidelines, further endeavors against IUU fishing are still likely. In addition to the adoption of a legally binding instrument for flag state performance, measures related to market states and RFMOs, the last two subjects under international law included in the IPOA-IUU, could be the subsequent possible directions for the international community against IUU fishing. As long as the obligations and measures taken for each subject in the IPOA-IUU are well-defined and implemented, it is reasonable to believe that impacts from IUU fishing would be significantly reduced, or eventually eliminated, in the foreseeable future.

As regards Taiwan’s efforts against IUU fishing, it is obvious that Taiwan has adopted many domestic laws, provisions and CMMs to demonstrate its determination and willingness in this regard; all of these are to fulfill Taiwan’s international obligation as a flag state under the regime of international fisheries. In fact, Taiwan’s regulations and CMMs are highly relevant and greatly consistent with those requests in the Guidelines, such as criteria for people, vessels and actions a State should implement, despite the fact that the Guidelines provide only principles rather than details in some issues. However, pressures from RFMOs and many other States still exist for Taiwan, particularly on the implementation of these regulations and sanctions to violators. For example, the European Union strongly expressed its concern regarding Taiwan’s enforcement on its nationals who illegally
invest in foreign fishing vessels, the amendment of Taiwan’s domestic laws and regulations against the importation of IUU fish products and landing inspections in foreign ports [50]. In addition, Greenpeace also accused some Taiwanese flagged vessels of conducting illegal transshipments, having employment contracts that violate the “Regulations on the Authorization and Management of Overseas Employment of Foreign Crew Members” and possibly having forced labor situations onboard [51]. Thus, how these rules are to be implemented effectively and how enforcement and sanctions are to be ensured are still the main challenges that the Fisheries Agency of Taiwan has to face in the near future.

6. Conclusions

IUU fishing, a serious threat not only to ocean fisheries resources but also to the global economy and human society, has been widely recognized by each state. To effectively deal with this threat, many actions have been taken by states and international organizations. The IPOA-IUU was the first endeavor. Despite the fact that it is not a binding instrument in nature, the IPOA-IUU did offer adequate policy guidance for each state and the international organization to prepare appropriate means against IUU fishing, the latest one of which is the flag state performance.

The adoption the Guidelines, as stated by the FAO Assistant Director-General for Fisheries and Aquaculture, can “give countries a new way to work together to meet this challenge [2].” However, the Guidelines are still a “soft law” in nature, meaning that they will likewise encounter the same challenges faced by other soft laws, such as heavily depending on the political will of states. Therefore, the effectiveness of the Guidelines against IUU fishing remains a question to debate. Based on the fact that the development of port state measures successfully evolved from the Model Scheme (a soft law) to the PSM Agreement (a hard law), despite the fact that no clear evidence has been observed, it is still reasonable to anticipate that a legally binding instrument on flag state performance that ensures flag states fulfill their obligations would be likely adopted later in the future. Thus, how the concept of “flag state performance” will evolve to combat IUU fishing in the future and how it will affect the management of Taiwan’s distant-fishing fleet are thus worthy of sustained attention.

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References
1. Erceg, D. Deterring IUU fishing through state control over nationals. *Mar. Policy* 2006, 30, 173–179. [CrossRef]
2. Food and Agriculture Organization of the United Nations. International Guidelines Take Aim at Illegal Fishing (IUU). Available online: http://www.fao.org/news/story/en/item/170570/icode/ (accessed on 20 May 2020).
3. Food and Agriculture Organization of the United Nations. Countries Crack Down on Illegal, Unreported and Unregulated Fishing. Available online: http://www.fao.org/news/story/en/item/233912/icode/ (accessed on 20 May 2020).
4. Food and Agriculture Organization of the United Nations. About IPOA-IUU. Available online: http://www.fao.org/fishery/ipoa-iuu/en (accessed on 20 May 2020).
5. Sustainable Development Goals Knowledge Platform. Sustainable Development Goals. Available online: https://sustainabledevelopment.un.org/?menu=1300 (accessed on 9 July 2020).
6. Sustainable Development Goals Knowledge Platform. Sustainable Development Goal 14. Available online: https://sustainabledevelopment.un.org/sdg14 (accessed on 9 July 2020).
7. Convention on Biological Diversity. Aichi Biodiversity Targets. Available online: https://www.cbd.int/sp/targets/ (accessed on 9 July 2020).
8. International Commission for the Conservation of Atlantic Tunas. Recommendation by ICCAT Regarding Control of Chinese Taipei’s Atlantic Bigeye Tuna Fishery, Rec. 05-02. Available online: https://www.iccat.int/Documents/Recs/compendiopdf-e/2005-02-e.pdf (accessed on 20 May 2020).
9. Shajahan, K.M. The European Union Regulation on IUU Fishing: Impact on Developing Countries. Econ. Political Wkly. 2012, 47, 81–88.
10. European Union. Commission Decision of 1 October 2015 on Notifying a Third Country of the Possibility of Being Identified as a Non-Cooperating Third Country in Fighting Illegal, Unreported and Unregulated Fishing (2015/C 324/10), 17–28. Available online: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C:2015:324:FULL&from=EN (accessed on 20 May 2020).
11. Erikstein, K.; Swan, J. Voluntary Guidelines for Flag State Performance: A New Tool to Conquer IUU Fishing. Int. J. Mar. Coast. Law 2014, 29, 116–147. [CrossRef]
12. Baird, R.J. Aspects of Illegal, Unreported, and Unregulated Fishing in the Southern Ocean; Springer: Berlin, Germany, 2006.
13. Bender, P. A State of Necessity: IUU Fishing in the CCAMLR Zone. Ocean Coast. Law J. 2008, 13, 233–280.
14. Commission for the Conservation of Antarctic Marine Living Resources. Report of the 16th Meeting of the Commission. In Proceedings of the Commission for the Conservation of Antarctic Marine Living Resources, Hobart, Australia, 27 October–7 November 1997.
15. Ainsworth, C.H.; Pitcher, T.J. Estimating Illegal, Unreported and Unregulated Catch in British Columbia’s Marine Fisheries. FISH Fish. Res. 2005, 75, 40–55. [CrossRef]
16. Hosch, G.E.; Ferraro, G.; Failler, P. The 1995 FAO Code of Conduct for Responsible Fisheries: Adopting, Implementing or Scoring Results? Mar. Policy 2011, 35, 189–200. [CrossRef]
17. United Nations. The International Plan of Action to Prevent, Deter, and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU); Food and Agriculture Organization of the United Nations: Rome, Italy, 2001; p. 1.
18. Report of the Second Technical Consultation on Illegal, Unreported and Unregulated Fishing, Rome, 22–23 February 2001; FAO Fisheries Report 646; Food and Agriculture Organization of the United Nations: Rome, Italy, 2001.
19. Edeson, W. The International Plan of Action on Illegal Unreported and Unregulated Fishing: The Legal Context of a Non-Legally Binding Instrument. Mar. Coast. Law J. 2001, 16, 603–623. [CrossRef]
20. Report of the Expert Consultation to Review Port State Measures to Combat Illegal, Unreported and Unregulated Fishing, Rome, 4–6 November 2002; FAO Fisheries Report No. 692; Food and Agriculture Organization of the United Nations: Rome, Italy, 2001.
21. Report of the Technical Consultation to Review Port State Measures to Combat Illegal, Unreported and Unregulated Fishing, Rome, 31 August–2 September 2004; FAO Fisheries Report No. 759; Food and Agriculture Organization of the United Nations: Rome, Italy, 2001.
22. Food and Agriculture Organization of the United Nations. Model Scheme on Port State Measures to Combat Illegal, Unreported and Unregulated Fishing. Available online: http://www.fao.org/3/a0985t/A0985T.pdf (accessed on 21 May 2020).
23. Kao, S.M. International Actions Against IUU Fishing and the Adoption of National Plans of Action. Ocean Dev. Int. Law 2015, 46, 2–16. [CrossRef]
24. Daley, R. Commentary: New Agreement Establishing Global Port State Measures to Combat IUU Fishing. Aus. J. Mar. Ocean Aff. 2010, 2, 28–31.
25. United Nations. General Assembly Resolution A/RES/60/31; United Nations: New York, NY, USA, 2005; p. 10.
26. United Nations. General Assembly Resolution A/RES/61/105; United Nations: New York, NY, USA, 2005; p. 10.
28. Food and Agriculture Organization of the United Nations. Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing. In Proceedings of the 36th Conference of the FAO, Rome, Italy, 18–23 November 2009; p. 5.

29. Molenaar, E.J. Port State Jurisdiction to Combat IUU Fishing: The Port State Measures Agreement. In Recasting Transboundary Fisheries Management Arrangements in Light of Sustainability Principles: Canadian and International Perspectives; Russell, D.A., Van der Zwaag, D.L., Eds.; Brill: Leiden, The Netherlands, 2010.

30. Kueflangan, B.; Press, M. FAO Preventing, Deterring and Eliminating IUU Fishing—Port State Measures. Environ. Policy Law 2010, 40, 262–268.

31. Food and Agriculture Organization of the United Nations. Illegal, Unreported and Unregulated (IUU) Fishing. Available online: http://www.fao.org/3/y1224eY1224E.pdf (accessed on 22 May 2020).

32. Expert Consultation on Flag State Performance, Rome, 23–26 June 2009; FAO Fisheries and Aquaculture Report No. 918; Food and Agriculture Organization of the United Nations: Rome, Italy, 2009.

33. Administrative Report of the Technical Consultation on Flag State Performance; Food and Agriculture Organization of the United Nations: Rome, Italy, 2013; p. 1.

34. Report on the First Session of the Technical Consultation on Flag State Performance, Rome, 2–6 May 2011; Food and Agriculture Organization of the United Nations: Rome, Italy, 2011.

35. Food and Agriculture Organization of the United Nations. Voluntary Guidelines for Flag State Performance; Food and Agriculture Organization of the United Nations: Rome, Italy, 2015.

36. The Pew Charitable Trusts. How to End Illegal Fishing: The Role of the Flag State. 2019. Available online: https://www.pewtrusts.org/-/media/assets/2019/08/theroleoftheflagstate_factsheet_v3.pdf (accessed on 23 May 2020).

37. Fisheries Agency of Taiwan. The Fisheries of the Republic of China (Taiwan); Fisheries Agency of Taiwan: Kaohsiung City, Taiwan, 2015; pp. 4–7.

38. Fisheries Agency, Council of Agriculture, Executive Yuan, (Taiwan, ROC). National Plan of Action to Prevent, Deter and Eliminate IUU Fishing. Available online: http://www.fa.gov.tw/cht/includes/GetFile.ashx?mID=198&id=161&chk=f6a7b1d2-604e-450e-997e-1c1d99e464f2 (accessed on 23 May 2020).

39. Laws & Regulations Database of the Republic of China. Act for Distant Water Fisheries, Article 1. Available online: https://law.moj.gov.tw/ENG/LawClass/LawAll.aspx?PCODE=M0050051 (accessed on 24 May 2020).

40. The China Post. 15 Fishing By-Laws to Come into Force Jan. 20: Fisheries Agency 13 January 2017. Available online: http://www.chinapost.com.tw/taiwan/national/national-news/2017/01/13/489358/15-fishing.htm (accessed on 24 May 2020).

41. Fisheries Agency, Council of Agriculture, Executive Yuan, (Taiwan, ROC). Combating IUU, Strategy Plan for Auditing Industry Related to Distant Water Fisheries. Available online: https://www.fa.gov.tw/en/PolicyIUU/content.aspx?id=6&chk=841549c0-1d55-43c4-891a-fd4cc0b94fe&param=pn%3d1 (accessed on 24 May 2020).

42. Fisheries Agency, Council of Agriculture, Executive Yuan, (Taiwan, ROC). Combating IUU, Mainland Chinese Fishing Vessel Claiming Illegal Catch it Possessed to be from Taiwan’s Fishing Vessel, and such Assertion is not True. Available online: https://www.fa.gov.tw/en/PolicyIUU/content.aspx?id=5&chk=abe2a3ee-ab7c-44fc-bf0b-a0c1a5a84b5c&param=pn%3d1 (accessed on 24 May 2020).

43. Swan, J. Port state measures to combat IUU fishing: International and regional developments. Sustain. Dev. Law Policy 2006, 7, 38–43.

44. Abbott, K.W.; Snidal, D. Hard and Soft Law in International Governance. Int. Org. Leg. World Politics 2000, 54, 421–456. [CrossRef]

45. Guzman, A.T.; Meyer, T.L. International soft law. J. Legal Anal. 2010, 2, 171–225. [CrossRef]

46. Skjærseth, J.B.; Stokke, O.S.; Wettestad, J. Soft Law, Hard Law, and Effective Implementation of International Environmental Norms. Global Environ. Politics 2006, 6, 104–120. [CrossRef]

47. Boyle, A.E. Some reflections on the relationship of treaties and soft law. Int. Comp. Law Q. 1999, 48, 901–903. [CrossRef]

48. Boyle, A.E. Further Development of the Law of the Sea Convention: Mechanisms for Change. Int. Comp. Law Q. 2005, 54, 563–584. [CrossRef]

49. Shelton, D.L. Commitment and Compliance: The Role of Non-Binding Norms in the International Legal System (Introduction). 2000. Available online: https://scholarship.law.gwu.edu/cgi/viewcontent.cgi?article=1228&context=faculty_publications (accessed on 24 May 2020).
50. Fisheries Agency, Council of Agriculture, Executive Yuan, (Taiwan, ROC). Taiwan and the European Union Continue Cooperation against IUU Fishing to Fulfill Regional Fisheries Management Responsibility. Press Release (in Mandarin Chinese). Available online: https://www.fa.gov.tw/cht/NewsPaper/content.aspx?id=2630&chk=37bd7132-6430-456b-9348-e401e4331583&param=pn%3d%26yy%3d2020%26mm%3d (accessed on 24 May 2020).

51. Greenpeace. Choppy Waters—Forced Labor and Illegal Fishing in Taiwan’s Distant Water Fisheries. Available online: https://www.greenpeace.org/usa/research/choppy-waters-forced-labor-illegal-fishing-seafood-taiwans-distant-water-fisheries/ (accessed on 24 May 2020).

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