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Linking small-scale fisheries to international obligations on marine technology transfer

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A B S T R A C T

This article analyses the interplay between inter-State obligations to increase scientific knowledge, develop research capacity and transfer marine technology in accordance with Sustainable Development Goal (SDG) 14.a, with a view to contributing to enhanced implementation of the international law of the sea (SDG 14.c), and providing access for small-scale artisanal fishers to marine resources (SDG 14.b). It proposes to do so by relying not only on the international law of the sea, but also on international biodiversity law (particularly the Convention on Biological Diversity) and international human rights law (particularly the human right to science). The article seeks to provide a reflection on the opportunities arising from a mutually supportive interpretation of different international law instruments with regard to the means of implementation for SDG 14 in synergy with other SDGs (particularly SDG 17 on 'Partnerships for the Goals' and its targets related to technology transfer, capacity-building and partnerships).

1. Introduction

Scientific knowledge and technology perform several important functions in the fisheries sector, including enhancing the productivity of fishery resources and the effectiveness of fishing activities, informing the regulation of fishing effort, and supporting the elaboration and implementation of strategies for the sustainable management of marine living resources. More specifically, science and technology can improve forecasting of the location of fish stocks based on physical conditions such as current circulation, temperature and salinity [1]. In turn, data on the probable location of fish stocks leads to improved catches and profits. Fisheries science further seeks to develop methods for assessing population size and sustainable rates of fishing. Single-species assessments remain the primary basis for scientific advice geared towards maintaining or restoring commercially valuable fish stocks above levels that can produce maximum sustainable yield (MSY). On the other hand, fisheries science is "gradually becoming more ecological", moving away from its traditional focus on the assessment of MSY for individual species towards multi-species stock analyses and a wider focus on ecosystem-based management at multiple scales [2, p. 380, 3]. Significant in this regard is the contribution of marine science to the identification of biogeographical boundaries and the subsequent delineation of management units; the identification of areas that warrant protection due to their importance for biodiversity and ecosystem services; and the adoption of precautionary reference points for conservation and management purposes [4].

Technology also plays a key role in the implementation of management decisions. One example is the introduction of technical improvements with a view to increasing the selectivity of fishing gears, thus reducing discards and minimizing the impact of fishing activities on marine biodiversity and ecosystems [5]. Moreover, technological advances such as satellite tracking systems are crucial for the purposes of monitoring and enforcement against illegal, unreported and unregulated (IUU) fishing, which is integral to the promotion of an ocean-based bioeconomy [6]. The implementation of international obligations on cooperation in marine scientific research and marine technology transfer, however, continues to lag behind, particularly towards developing States, where small-scale fisheries feature very prominently.[1]

This article analyses the interplay between inter-State obligations to increase scientific knowledge, develop research capacity and transfer marine technology in accordance with Sustainable Development Goal (SDG) 14.a, with a view to contributing to enhanced implementation of the international law of the sea (SDG 14.c), and providing access for small-scale artisanal fishers to marine resources (SDG 14.b). It proposes

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[1] The plurality of terms used to describe small-scale fisheries, including artisanal, inshore, traditional, municipal and subsistence, is a testament to the lack of consensus on how to talk about different categories of fishing. Some of these terms feature more prominently in specific geographical contexts. At the global level, it is perhaps more useful to refer to a list of the main dimensions that often characterise small-scale fisheries: D.S. Johnson [7], p. 749.

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to do so by relying not only on the international law of the sea, but also on international biodiversity law (particularly the Convention on Biological Diversity)[2] and international human rights law (particularly the human right to science).[3] The article seeks to provide a reflection on the opportunities arising from a mutually supportive interpretation of different international law instruments with regard to the means of implementation for SDG 14 in synergy with other SDGs (particularly SDG 17 on 'Partnerships for the Goals' and its targets related to technology transfer, capacity-building and partnerships). The reflection starts from observing an increasing linkage in international policy-making between marine technology transfer and small-scale fisheries, as well as the challenges and risks of this approach. The central part of the article explores the inter-State obligations related to technology transfer, focusing on the duty to cooperate and to share information with a view to fleshing out the concept of partnerships for sustainable development.[4] The article concludes by suggesting how the international law of the sea can be better implemented to enhance international cooperation on marine technology transfer to the benefit of small-scale fisheries, on the basis of the normative standards of the human right to science and the lessons learnt in international biodiversity law, with a view to contributing to the synergetic implementation of the SDGs through genuine partnerships.

It should be noted from the outset that the article acknowledges, but does not focus on, the crucial role played by intellectual property rights (IPRs) in the implementation of the provisions of the international law of the sea and international biodiversity law regarding scientific and technical cooperation[5] – an issue that has also received considerable attention in the policy[6] and academic discourse on the human right to science [11,13,14]. This article rather endeavours to complement the well-documented debate, with a view to shining a light on other critical legal questions relating to innovative forms of international cooperation geared towards strengthening the capacity of States and the actors involved in the small-scale fisheries sector to meet the SDGs.

2. SDG linkages related to marine technological transfer and small-scale fisheries

In the 2030 Sustainable Development Agenda (Agenda 2030) [15], technology is enshrined in SDG 17 as a key means of implementation, while 14 targets explicitly refer to "technology" and 34 relate to issues that tend to be discussed in technology terms [16]. Interestingly for present purposes, technology features in the SDG 14 targets explicitly as well as implicitly: on the one hand, the rationale of developing a global effective innovation system for sustainable development informs a target that expressly seeks to increase scientific knowledge, develop research capacity and catalyse the transfer of marine technology, with a view to improving ocean health and enhancing the contribution of marine biodiversity to the development of developing States (MoI 14.a) [16]. In addition, even though technology is not mentioned in the issue-specific, qualitative targets elaborated under SDG 14 in connection to marine pollution (SDG 14.1) and ocean acidification (SDG 14.3), the improvement of overall technology performance arguably forms part and parcel of these targets' underlying rationale [16].

As the UN Global Sustainable Development Report 2016 notes, technology is crucial "for achieving the SDGs and reaping the benefits of synergies among them, as well as for minimizing trade-offs among goals" [16, p. xiv]. On the other hand, the Report acknowledges technology not only as a tool for achieving a higher degree of social inclusion and cooperation, but also as a potential source of conflict [16]. Ultimately, the effectiveness of technology policies will depend on the extent to which they are grounded in scientific knowledge and take into account the complexities of technology change, transfer and diffusion, and the unique circumstances of the country in question (including technical, economic, institutional, legal and behavioural barriers vis-à-vis IPRs, private sector capacity, mismatched needs, trade tariffs and limited access to trusted information, knowledge and capital) [16]. The Report calls for comprehensive, non-discriminatory and transparent cooperation among developing and developed States as well as for inclusive innovation policies that systematically take into account the interests of "underserved populations" and prevent impoverished and future populations from being forced to accept technologies that are ill-suited to their needs and chosen by others [16, p. 49].

Linkages between inter-State obligations related to marine technology transfer and the choice of small-scale fishing communities have been addressed by Gupta and Vegelin, who have called for accounting at the global level for the needs of least developed and developing States, encouraging meaningful participation in UN processes, adopting equity principles, as well as context-sensitive capacity-building, technology transfer and financial support, with a view to focusing on sectors of high vulnerability, such as small-scale fisheries, in order to enhance human well-being in its many manifestations [17]. This inclusive development approach also draws on the concept of relational inclusiveness, which "recognizes that poverty and ecological degradation are often the result of actions taken by others because of increasing inequality in society and the substance and process of politics" [17, p. 439]. SDGs 10 ("reduced inequalities"), 16 ("Peace, justice and strong institutions") and 17 are thought to explicitly embody relational inclusiveness, putting pressure on developed States "to take their responsibilities seriously and to work through multilateral institutions" [17, p. 444]. However, Gupta and Vegelin note that the relevant SDGs "do not collectively represent a powerful enough relational text that challenges *status quo* politics and existing power relations to create more conducive conditions for enhancing inclusive development" [17, p. 444].

These considerations should be related to the role of information and communication technologies (ICTs) in the fisheries sector. ICTs refer to technologies that facilitate communication and the processing of information by electronic means and include everything from radio and television to telephones (fixed and mobile), computers and the Internet. ICTs are increasingly being used across the fisheries sector, from resource assessment, capture or culture to processing and commercialization. Some of these technologies are specific to fisheries (e.g., sonar for locating fish), while others are general purpose applications (e.g., Global Positioning Systems (GPS) used for navigation and location finding, mobile phones for trading, information exchange and emergencies, radio programming with fishing communities, Web-based information and networking resources) [4, 18]. The Declaration of Principles of the World Summit on the Information Society (WSIS) highlighted the potential contribution of ICTs in building "a people-centred, inclusive and development-oriented Information Society, where everyone can create, access, utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life" [19, para 1, 20, 21]. The Declaration further underlined that the sharing and strengthening of global knowledge for development "can be enhanced by removing barriers to equitable access to information for economic, social, political, health,

[2] 1992 Convention on Biological Diversity (CBD), 1760 U.N.T.S. 79. For a detailed account of the technology transfer regime put in place by the CBD, see M. Ntona [8]. It is worth noting that the provisions of the CBD on scientific cooperation and technology transfer have been further elaborated upon in a number of thematic decisions adopted by the CBD Conference of the Parties (COP) with regard to marine and coastal biodiversity. See, for instance, CBD Decision VII/5 (2004) Annex I, Operational Objectives 1.3(d), 3.4(c) and 3.5, and Part IV paras (b), (e)-(h) and (j); CBD Decision VIII/21 (2006) para 9; CBD Decision VIII/22 (2006) para 4(f); CBD Decision IX/20 (2008) para 25; CBD Decision X/29 (2010) paras 20 and 34; CBD Decision XI/17 (2012) paras 19–23; CBD Decision XII/23 (2014) para 3(c); CBD Decision XII/23 (2014) para 3(k) and Annex, para 11.1.

[3] Universal Declaration of Human Rights (1948) UN Doc A/810 at 71, Article 27.

[4] Which is the key theme of the 2017 UN Oceans Conference: UNGA [9], para 4.

[5] See infra, n. 19 and 20.

[6] UNGA [10]. Note also that the first general discussion in the Committee on Economic, Social and Cultural Rights (ECOSOC) on the right to science focused on intellectual property rights (IPRs), at its 24th Session (13 November – 1 December 2000).

cultural, educational and scientific activities" [19, para 25]. The ongoing work of the WSIS on the role of ICTs in the implementation of Agenda 2030 has further underscored that, in connection to SDG 14.a, empowering communities in the use of such technologies and promoting the production of "useful and socially meaningful content is a capacity-building intervention that can increase scientific knowledge and promote innovation and research" [22, p. 28]. Moreover, ICTs can enhance the efficiency of fishing activities by, inter alia, making information on weather available to fishers and fishing communities in real time, thus boosting economic growth in coastal regions [22]. As for SDG 17, ICTs are instrumental for knowledge-sharing among stakeholders from different regions (SDG 17.6) and for building partnerships between governments, the private sector and civil society at the national, regional, international and global levels (SDG 17.7) [22]. In addition, ICTs can serve as a catalyst for coordinated action and partnerships towards the eradication of poverty, hunger and malnutrition in parallel to the sustainable use and management of natural resources [4,22,23].

The linkages between inter-State technological cooperation and small-scale fishing communities have become evident also in the work of the UN General Assembly (UNGA). The latest UNGA Resolution on Sustainable Fisheries drew attention to the circumstances affecting fisheries in many developing States – especially coastal African States and Small Island Developing States (SIDS) – and highlighted the urgent need for capacity-building, including through the transfer of marine technology and in particular fisheries-related technology [24, Preamble]. In addition, UNGA requested distant-water fishing nations to negotiate access agreements with developing coastal States on "an equitable and sustainable basis" and to take into account "the legitimate expectation" of these States [24, para 214], by inviting to transfer technology and provide assistance for monitoring, control and surveillance, and compliance and enforcement.[7] The extent to which recent access agreements support small-scale fisheries in developing States remains, however, a matter of contention [25]. Moreover, international financial institutions and relevant intergovernmental organizations were invited to increase their efforts towards capacity-building and the provision of technical assistance to developing States, particularly in the small-scale fisheries sector, consistent with environmental sustainability, "in recognition of the fact that food security and livelihoods may depend on fisheries" [24, para 209].

The outcome of the 2017 UN Ocean Conference also refers to the need to strengthen technical assistance to small-scale fishers – especially in SIDS and Least Developed Countries (LDCs) – in the implementation of policies that promote business activity without increasing pressure on fisheries, and provide access to fisheries and partnerships [26, Annex, para 13(o)] although it does not refer to technology transfer as such.

3. Tensions between international technological cooperation and small-scale fisheries

While there may be growing political awareness of the benefits that could arise from marine technology transfer to small-scale fishing communities, unequal attention has been paid to actual and potential risks, particularly with regard to technologies that seek to enhance the effectiveness of fishing activities. Johnson notes that small-scale fisheries have a particularly "iconic" role within the debates on international development and fisheries, insofar as "they stand for counter-narratives of social justice and ecological sustainability" [7, p. 751]. Small-scale fisheries are seen to rely on local technologies that have developed organically through time to meet local needs for food [7,27]. Moreover, local technologies are sensitive to the location in which they are applied, the relative abundance of fishing resources, and the complex, traditional resource use rights that "promote indigenous forms of resource management predicated on sustainability of harvests over time rather than on short term economic gain" [28, p. 1271]. The technologies promoted by international donors, on the other hand, may embody "a host of values and assumptions regarding preferred social organization, wealth distribution, and the division of labour" [28, p. 1271, 29]. The transfer of fishing technologies having their origins in the developed world – which is characterized by greater urbanisation, centralisation, and capital intensity – has often led to the emergence of a dualistic structure of developing States' fisheries sectors, whereby large numbers of small-scale producers using simple technologies are in direct competition with a newly-established large-scale sector [27,28,30,31]. By virtue of its sheer efficiency, the latter has access to a disproportionate share of the total catch. In addition to these structural changes, technology transfer has brought about a shift in values, as it has often led traditional technologies and institutions to be regarded as "primitive and inefficient" and, by extension, as irrelevant for the purposes of participating in the rapidly expanding global markets for certain varieties of fish [27, p. 3]. Furthermore, conservationist resource-use principles and community property rights over fishery resources tend to be seen as incompatible with the "individualistic, entrepreneurial ethic needed to maximise economic growth and raise the throughput from the coastal marine ecosystem" [27, p. 3].

Cycon provides several examples of the disruptive impacts that imported technologies can have in the recipient country's small-scale fisheries sector: for instance, the introduction of nylon nets in Brazil without consideration of local socioeconomic conditions interfered with the well-developed system of traditional property rights and community regulation [32]. Local fishermen were unable to afford the new gear, which led to urban businessmen purchasing the nets and hiring fishermen on a salaried basis. Due to their limited income, fishermen could not save towards purchasing their own equipment, which ultimately resulted in the loss of control over traditional fishing grounds. In addition, the example of southern Sri Lanka's peasant fisheries is illustrative of how the introduction of new gear can upset the catch and conservation balance that has evolved over time within a community. Sri Lanka's sector operated on the basis of a strong community ethic vis-à-vis catch division, which was ignored by fisheries planners in favour of mechanisation. The newly-motorised fleet displaced traditional technologies that had developed over time to cater to different ecological niches, while contributing to unemployment and increased inequality in the distribution of wealth. Such examples emphasise the need to evaluate technological appropriateness in accordance with the goals of the basic needs approach to development, which focuses not only on volumes of output and income, but also the way that those are distributed among the population [33,34].

In the face of the intensification of fishing activities bringing about severe ecosystem changes and resource depletion, as well as the economic marginalisation of coastal fishing communities [30], Kurien advocated for the revival of "locale-specific, small-scale technologies, coupled with community-oriented, participatory measures to protect the ecological integrity of the living coastal resources" [27, p. 3]. To this end, the techniques and tools used by small-scale fishers in the past should be re-examined, with a view to understanding their evolution and the rationale behind their operation and, ultimately, to developing technologies that are suitable for transfer to developing States [27]. Traditional fishing gear provides a fitting starting point, having developed in a manner that is specific to the species of fish it can be used to harvest, passive in operation and seasonal in use. These characteristics render fishing gear low in productivity but also more target-oriented, which contributes to the minimisation of discards and waste and the maintenance of marine ecosystem biodiversity [27]. A better understanding of such elements can facilitate "technology blending," which will infuse the positive aspects of modern technologies into indigenous technologies, producing "hybrids" that are energy-efficient as well as economically and ecologically sustainable [27, p. 29]. Ideally,

[7] FAO, Code of Conduct for Responsible Fisheries (1995) FAO Doc 95/20/Rev/1.

technology diffusion should be carried out through tailoring and adaptation rather than wholesale transfer, taking into consideration "socio-economic and ecological interrelations" and the "techno-ecological circumstances of the "recipient" and "donor" communities" to ensure compatibility [27, pp. 29–30][8]. In addition, the transferred technology should be "appropriable by the user" and "not deskill" its operators [27, pp. 29–30]. ICTs are a good example of such technologies, as they can be adapted and introduced in all but the most remote communities and, once appropriated by users, can have positive impacts on their lives [18], particularly by virtue of their contribution to the implementation of an ecosystem-based approach to fisheries management. For instance, smartphone applications can facilitate the collection of catch data, thus promoting the sustainable setting of catch limits [4,23].

4. Obligations under the law of the sea and international biodiversity law

The UN Convention on the Law of the Sea (UNCLOS)[9] contains the framework for international cooperation in the fields of marine science and technology transfer, but it essentially focuses on inter-State obligations. The Convention on Biological Diversity (CBD)[10] could thus provide scope for leveraging synergies between the general obligations on technology transfer enshrined in UNCLOS and a "commitment to principles of equity in use of biodiversity" [36, pp. 498–499]. A teleological and systemic reading of the CBD can in effect help linking marine technology transfer and small-scale fisheries. CBD provisions on scientific research and technology transfer, while taking a similar approach to UNCLOS, can be read in conjunction with obligations related to protecting customary sustainable use,[11] supporting local efforts to restore ecosystems, and respectfully promoting the use of the traditional knowledge of indigenous peoples and local communities,[12] with a view to sharing fairly and equitably benefits arising from these communities' ecosystem stewardship.[13] From a broader perspective, the CBD is more explicit than UNCLOS in linking scientific and technical capacity-building with the identification, conservation, and sustainable use of biodiversity in its decisions, which – although formally non-binding – provide guidance on how to interpret the Convention,[14] as well as generally accepted standards to specify UNCLOS obligations.[15] In addition, the CBD recently underscored the reliance of the fisheries sector on biodiversity and its components, as well as on the ecosystem functions and services that they underpin, the potential loss of which threatens food security and nutrition.[16] The CBD thus provides a more solid legal basis for mainstreaming biodiversity considerations into fisheries management, as well as into programmes relating to scientific cooperation and technology transfer, with a view to ensuring that fishing communities continue to benefit from the essential goods and services provided by associated ecosystems.[17]

The academic and policy discourse on the interplay between UNCLOS and the CBD, however, has thus far focused primarily on marine genetic resources, particularly in the context of the ongoing negotiations towards a new legally binding instrument for the conservation and sustainable use of biodiversity in areas beyond national jurisdiction [40]. More specifically, commentators have concentrated their efforts on untangling the complex interactions between UNCLOS, the CBD and the international regime for protecting IPRs,[18] with a view to illuminating the tensions that exist between the latter's market-oriented underpinnings and international legal obligations relating to scientific cooperation, technology transfer and the sharing of benefits arising out of the utilization of marine genetic resources.[19] This trend serves as a reminder that, for all the ink that has been spilt over the implications of IPRs for the implementation of key provisions of UNCLOS and the CBD related to international cooperation and capacity-building, this remains as controversial an issue as when these instruments were being negotiated.[20]

Conversely, limited consideration has been given to technological cooperation in relation to the conservation and sustainable use of marine biodiversity, and on sustainable and small-scale fisheries in particular. The following sections will explore international obligations on technology transfer under UNCLOS and international biodiversity law, as well as the guidance provided by the Intergovernmental Oceanographic Commission's Criteria and Guidelines on the Transfer of Marine Technology (the IOC Criteria and Guidelines)[21] and the Guidelines on Small-Scale Fisheries of the Food and Agriculture Organization of the UN (FAO), with a view to better understanding the reasons for the widely acknowledged lack of implementation of international technology transfer obligations [52, paras 57–58, 53, p. 653]. They will also show how developments related to fair and equitable benefit-sharing from the use of genetic resources provide practical insights into how to implement technology transfer obligations on the basis of partnerships [54], which may be of more general relevance, including in the context of ongoing negotiations of a new international legally binding instrument on marine biodiversity in areas beyond national jurisdiction.

4.1. The duty to cooperate

Efforts made prior to the adoption of UNCLOS with regard to marine technology transfer – especially in applied fields such as fisheries – did

[8] Refrigeration equipment is an early example of a technology that had to be tailored to the specific circumstances of recipient States. Ice was difficult to obtain or very expensive in tropical areas, while preventing it from melting during the voyage to the fishing grounds was a major challenge. Liston and Smith identified this as a problem for tropical and subtropical small-scale fisheries, noting the real need for the development of a cheap technique for short-term preservation of fresh fish under high temperature conditions without the use of ice or refrigeration: J. Liston, L. Smith [35].

[9] United Nations Convention on the Law of the Sea (UNCLOS), 21 ILM 1261 (1982).

[10] According to CBD Articles 4(b) and 22(2), the Convention applies to processes and activities in marine areas beyond national jurisdiction, as these activities are carried out under the jurisdiction or control of CBD Parties, consistently with the rights and obligations of States under the law of the sea.

[11] CBD, Article 10(c).

[12] CBD, Article 8(j).

[13] On a broader notion of fair and equitable benefit-sharing in the context of the ecosystem approach under the CBD, see: E. Morgera [37].

[14] Vienna Convention on the Law of Treaties (VCLT), 8 ILM 679 (1969), Article 31(3)(a-b).

[15] UNCLOS Art. 271 (note in this connection that all UNCLOS parties are party to the CBD). The dividing line between legally binding and non-legally binding instruments in international law thus becomes quite blurry once non-legally binding instruments are used to interpret legally binding ones: see generally A. Boyle, C. Chinkin [38], pp. 210 et seq.; D. Shelton [39].

[16] CBD Decision XIII/3 (2016) preamble.

[17] See also 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA), 34 ILM 1542 (1995), Article 5; FAO Code of Conduct for Responsible Fisheries; FAO, Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (2014) FAO Doc COFI/2014/Inf.10, Appendix E, para 5.5.1 (hereinafter, the SSF Guidelines); and, more indirectly, UNCLOS, Articles 192 and 194(5).

[18] Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement), 33 ILM 1197 (1994).

[19] See indicatively: C.B. Thompson [41]; C. Lawson, S. Downing [42]; C. Salpin, V. Germani [43]; A. Bonfanti, S. Trevisanut [44]; A. Broggiato [45]; A. Broggiato, S. Arnaud-Haond, C. Chiarolla, T. Greiber [46].

[20] In the case of UNCLOS, this conflict is particularly palpable in the negotiating history and subsequent amendment of Part XI on the Area. In this connection, see indicatively: M. Herdegen [47], pp. 71–72; S.N. Nandan, M.W. Lodge, S. Rosenne [48], pp. 2–3. More recently, the issue of IPRs arose in the context of the negotiations towards new energy efficiency regulations for international shipping under the auspices of the International Maritime Organization (IMO). In this connection, see J. Harrison [49], pp. 373–375. With regard to the CBD, see: M. Chandler [50]; UNCTAD [51].

[21] Intergovernmental Oceanographic Commission (IOC), Criteria and Guidelines on the Transfer of Marine Technology, adopted at the XXII Session of the General Assembly of the IOC, 2003 (hereinafter, the IOC Criteria and Guidelines).

not bear the desired fruit due to insufficient funding, poorly designed assistance programmes, and inadequate national commitments on the part of receiving States [55]. UNCLOS attempted to rectify this situation by establishing a technology transfer regime based on the diffusion of scientific and technological expertise and the creation of a policy environment to facilitate the transfer of useful marine technologies at the regional level. In that context, marine technology is understood broadly to encompass the "instruments, equipment, vessels, processes and methodologies required to produce and use knowledge to improve the study and understanding of the nature and resources of the ocean and coastal areas."[22] Marine technology thus includes information and data on marine sciences and related marine operations and services in a user-friendly format; manuals, guidelines, criteria, standards and reference materials; sampling and methodology equipment; observation facilities and equipment; equipment for in situ and laboratory observations, analysis and experimentation; computer and computer software, including models and modelling techniques[23]; and expertise, knowledge, skills, technical/scientific/legal know-how and analytical methods related to marine scientific research and observation.[24]

At the heart of the pertinent UNCLOS provisions lies the obligation of States to cooperate,[25] either directly or through competent international organizations, with a view to promoting the development and transfer of marine science and technology on fair and reasonable terms and conditions.[26] These provisions appear to introduce a "framework" commitment based on a recognised duty of cooperation, which requires the conclusion of several implementing arrangements to be effective [57, p. 265]. This has prompted some commentators to argue that the provisions of UNCLOS on technology transfer "are not formulated in terms of strict legal obligations" [58, p. 47]. The reference to the duty to cooperate is accordingly regarded as a "policy-declaring [statement] in the nature of *pacta de contrahendo,*" [56, p. 668, 59, pp. 95–96, 60] which is arguably "too general to allow one to determine how it can be enforced against those who do not comply with it" [61, p. 129]. An additional criticism relates to the fact that UNCLOS fails to address one of the major pitfalls of technology transfer at the international level, namely, that of the lack of a cohesive administrative system that will facilitate implementation [62]. By "[referring] material solutions and decision-making away from both the Convention and the realm of law itself," UNCLOS leaves Parties with "no apparatus for effective technology transfer" [62, p. 69].

By contrast, other commentators held that cooperation "is action" and that interpreting the relevant provisions of UNCLOS in good faith in light of their object and purpose[27] "could hardly lead to the conclusion that action was not intended" [63, p. 145]. Parties are rather required to enter into negotiations "with a view to transforming a provision worded in general terms into specific units of obligation for the purpose of implementation susceptible of being monitored and, where necessary, subjected to dispute settlement procedures" [63, p. 145]. Ultimately, Payoyo argues, the ideal that underpins these provisions is that of equality of capacity for rights and obligations between technologically advanced States and developing States, in accordance with the principle of cooperation in international law as enshrined in the UN Charter [59]. He therefore suggests that UNCLOS *pacta de contrahendo* provisions be implemented in light of the supplementary modalities enshrined in Chapter 17 of Agenda 21, which provides for the transfer of environmentally sound technologies to develop fisheries in developing States and underscores the importance of mechanisms for transferring resource information and improved fishing technologies to fishing communities at the local level, calling for the study, scientific assessment and use of appropriate traditional management systems.[28] As will be further discussed below, the CBD and the interpretative guidance provided by the decisions adopted under it, as well as the IOC Criteria and Guidelines, provide further supplementary modalities that serve to detail UNCLOS obligations[29]. CBD decisions, in particular, do so by way of interpretation in terms that have been negotiated and agreed upon by consensus[30] by all UNCLOS Parties in their capacity as CBD Parties.

Interestingly, the provisions of UNCLOS on the protection and preservation of the marine environment reiterate the obligation to provide scientific and technical assistance to developing States, including in the form of supplying them with the necessary equipment and enhancing their endogenous capacity to manufacture it.[31] These obligations have been interpreted as requiring developed States to "either directly transfer publicly held environmentally sound technologies or finance the licensing of privately held technologies" [60, pp. 58–60][32]. States must thus endeavour to foster favourable economic and legal conditions for the transfer of marine technology for the benefit of all parties concerned on an equitable basis,[33] and to promote the development of the marine scientific and technological capacity of States which may need and request technical assistance.[34] At the very least, States should remove legal barriers in this connection.

In addition, States must promote the acquisition, evaluation and dissemination of marine technological knowledge; facilitate access to relevant information and data; promote the development of appropriate marine technology and of the infrastructure necessary to facilitate its transfer; encourage the development of human resources through training and education of nationals of developing States; and promote international cooperation at all levels, particularly at the regional, subregional and bilateral levels.[35] The latter two objectives may be pursued through, inter alia, the establishment of programmes of technical cooperation, particularly with developing States; the exchange of scientists and of technological and other experts; and the promotion of joint ventures and other forms of bilateral and multilateral cooperation.[36] Furthermore, States are required to promote the establishment of new or the strengthening of existing national marine scientific and technological research centres, particularly in developing coastal States, with a view to providing advanced training facilities and

[22] IOC Criteria and Guidelines, para A(2).

[23] Examples include food web and multi-species distribution models as well as habitat suitability models, which can be used to determine suitable catch levels as well as to identify areas that are important for biodiversity and/or ecosystem services, in line with an ecosystem-based approach to fisheries management. See also A.J. Kenny, N. Campbell, M. Koen-Alonso, P. Pepin, D. Diz [4].

[24] IOC Criteria and Guidelines, para A(2).

[25] UNCLOS, Articles 270 and 278. See also UNFSA, Article 25(2).

[26] UNCLOS, Article 266(1). See also UNFSA, Article 25. The emphasis on international cooperation is further reinforced by the wording of the majority of the provisions of UNCLOS Part XIV, which tends to de-emphasize the element of obligation. Commentators have noted that there is a clear tendency for the UN General Assembly and other bodies dealing with the problem of technology transfer to developing countries to place the emphasis more on international cooperation than on formal obligation: M.H. Nordquist, S.N. Nandan, University of Virginia, Center for Oceans Law and Policy [56], p. 694.

[27] VCLT, Article 31(1).

[28] Agenda 21: Programme of Action for Sustainable Development (1992) UN Doc A/Conf.151/26 (hereinafter, Agenda 21), para 17.92. See also FAO Code of Conduct for Responsible Fisheries, para 12.12.

[29] VCLT, Article 31(3)(c). On the CBD as a source of relevant and applicable rules of international law for the purposes of interpreting other treaties, see: E. Morgera [54], pp. 361–362.

[30] On the international law-making effect of consensus, in that "this way of securing widespread support for a legal text per se legitimizes and promotes consistent State practice" see: A. Boyle, C. Chinkin [38], p. 260.

[31] UNCLOS, Article 202(a).

[32] The UN General Assembly has also noted that current debates about technology transfer and the environment within the context of the World Trade Organization (WTO) raise the question of whether this is just another intellectual property and technology transfer debate, or whether environmentally sound technologies present distinctive challenges: UNGA [64], para 44.

[33] UNCLOS, Article 266(3).

[34] UNCLOS, Article 266(2).

[35] UNCLOS, Article 268. See also UNFSA, Article 1.

[36] UNCLOS, Article 269. Joint ventures are further explored in: H.F. Campbell, A.J. Hand [65].

necessary equipment, skills and know-how, as well as technical experts.[37] Moreover, nationals of other States fishing in the Exclusive Economic Zone (EEZ) must comply with the laws and regulations of the coastal State relating to requirements for the training of personnel and the transfer of fisheries technology, including with a view to enhancing the coastal State's capability to undertake fisheries research.[38]

The elaboration of coordinated bilateral, regional or multilateral programmes, either directly by States or through competent international organizations, is crucial for the development of generally accepted guidelines, criteria and standards for technology transfer.[39] The IOC Criteria and Guidelines, albeit non-legally binding, provide such generally accepted guidance that helps detail UNCLOS obligations of international cooperation for technology transfer, by way of interpretation. The IOC Criteria and Guidelines are meant to promote capacity-building in ocean- and coastal-related matters through international cooperation,[40] with a view to enabling all parties to benefit from developments in marine science-related activities, and in particular those activities that aim at stimulating the social and economic contexts in developing States, on an equitable basis.[41] The IOC Criteria and Guidelines focus on the development of special financial and scientific schemes to facilitate marine technology transfer at the national, regional or sub-regional levels; the transfer of marine technology free of charge or at a reduced rate for the benefit of the recipient State; the taking into account of the needs and interests of developing and land-locked States, as well as of other legitimate interests, including the interests of holders, suppliers and recipients of marine technology; and the importance of the transfer of environmentally sound technologies (ESTs). The continuing relevance of this instrument is evidenced by the calls, in 'The Future We Want' and Agenda 2030, for States to take into account the IOC Criteria and Guidelines with a view to, inter alia, enhancing the contribution of marine biodiversity to the development of developing States [66, para 160; SDG 14.a] and in the Call for Action from the UN Ocean Conference [26, Annex, para 12].

These approaches are complementary to the CBD, which also requires Parties to establish and maintain programmes for scientific and technical education and training with respect to the identification, conservation, and sustainable use of biodiversity, taking into account the needs of developing States.[42] States are further expected to promote and encourage research that contributes to these objectives, and to cooperate in the use of relevant scientific advances to develop methods for conserving and sustainably using biological resources.[43] In acknowledgment of the fact that socio-economic development and poverty eradication are the priorities of developing States,[44] the CBD calls upon Parties to take full account of the specific needs and special situation of LDCs vis-à-vis technology transfer,[45] with special attention to the development and strengthening of national capabilities by means of human resources development and institution-building.[46] CBD Parties must also promote cooperation in the training of personnel and the exchange of experts for the purposes of developing and using technologies that contribute to the objectives of the Convention, specifically referring also to indigenous and traditional technologies.[47] In addition, the CBD explicitly cautions that technology to be transferred needs to be "relevant to the conservation and sustainable use of biological diversity … and … not cause significant damage to the environment."[48]

While the IOC Criteria and Guidelines and the CBD do not make specific reference to small-scale fisheries, the FAO Guidelines on Small-Scale Fisheries arguably consolidate a mutually supportive interpretation of UNCLOS and the CBD on this point. They call upon States to build on existing traditional and local cost-efficient technologies, local innovations and culturally appropriate technology transfers, with a view to contributing to environmentally sustainable practices within an ecosystem approach.[49] In addition, the FAO Guidelines point to the interface between inter-State obligations on marine technology transfer and small-scale fisheries: States are expected to promote enhanced international, regional and subregional cooperation in securing sustainable small-scale fisheries, by supporting capacity development to enhance the understanding of small-scale fisheries and assist the subsector in matters that require subregional, regional or international collaboration, including appropriate and mutually agreed technology transfer,[50] as well as to provide financial assistance, institutional capacity development, knowledge-sharing and exchange of experiences, and assistance in developing national small-scale fisheries policies.[51]

4.2. Multilateral information-sharing

Notwithstanding the complementarity of the multiple international legal instruments of relevance, the lack of coordination between researching States, research institutions, private partners and regional organizations is largely seen as one of the key challenges facing marine technology transfer,[52] including due to limited access to research results and data [67]. The open-ended nature of relevant international obligations has resulted in an ad hoc approach to implementation that makes it difficult to keep tabs on progress on effectively transferred technology, let alone to ensure that disparate efforts contribute to a coherent, regionally balanced and need-based approach.[53]

One of the areas where a multilateral approach seems to be needed is information-sharing, which is also called for under UNCLOS Part XIII.[54] The CBD provides for the exchange of relevant information from all publicly available sources, including the results of technical, scientific and socio-economic research, as well as information on training and surveying programmes, specialised knowledge, and indigenous and traditional knowledge.[55] The IOC Criteria and Guidelines include the proposed establishment of a clearinghouse mechanism that will provide Member States with direct and rapid access to relevant sources of information and practical expertise in the transfer of marine technology. This mechanism will also seek to facilitate effective scientific, technical and financial cooperation; the inclusion in national strategic plans of specific components of marine technology transfer; and the establishment of (sub-)regional focal points for the transfer of marine technology.[56] Meanwhile, the IOC fosters cooperation through programmes such as the Biology and Ecosystems Panel of the Global Ocean Observing System [69], and facilitates knowledge exchange and sharing of data and information through such platforms as the International Oceanographic Data and Information Exchange and the Ocean

[37] UNCLOS, Article 275.
[38] UNCLOS, Article 62(4)(j).
[39] UNCLOS, Articles 271-2.
[40] IOC Criteria and Guidelines, para A(1).
[41] IOC Criteria and Guidelines, para B.
[42] CBD, Article 12(1).
[43] CBD, Article 12(2) and (3).
[44] CBD, preambular para 19.
[45] CBD, Article 20(5).
[46] CBD, Article 18(2).
[47] CBD, Article 18(4).
[48] CBD, Article 16(1).
[49] SSF Guidelines, Appendix E, para 7.5.
[50] SSF Guidelines, para 10.8.
[51] SSF Guidelines, para 13.2. Interesting in this regard is the EAF – Nansen project "Strengthening the Knowledge Base for and Implementing an Ecosystem Approach to Marine Fisheries in Developing Countries," which was initiated by the FAO to support the implementation of the ecosystem approach in the management of marine fisheries. More information on the project can be found at http://www.fao.org/in-action/eaf-nansen/en. (Accessed 17 July 2017).
[52] On the increasing fragmentation of the international system of capacity-building mechanisms for technology and sustainable development, including within the UN system, see UNGA [64], paras 27, 55 et seq.
[53] See discussions on these points in the BBNJ PrepCom: e.g., ENB [68], pp. 9–10.
[54] UNCLOS, Articles 242(2), 244, 248–249, and 252(2) and (4).
[55] CBD, Article 17(1) and (2).
[56] IOC Criteria and Guidelines, para C(1)(a). This was specifically discussed at the BBNJ PrepCom. See: ENB [68], pp. 4 and 10.

Biogeographic Information System (OBIS).[57] The latter is a large, open-access, global data system of the diversity, distribution and abundance of marine species, which sets common standards and guidelines and provides training and capacity development programmes in best-practice methods for biodiversity data collection, management and publication. Harden-Davies suggests that OBIS can enable benefit-sharing and technology transfer through open-access data and information [69, p. 263].

A more institutionalized multilateral approach has in effect emerged as a necessary precondition for information-sharing not only to ensure responsiveness to needs and more equitable distribution across different regions, but also contribute to a more systematic encouragement of virtuous circles among capacity-building, scientific cooperation, and technology transfer [70,71]. Under the International Seabed Authority (ISA), for instance, a series of approaches have been put in place to move towards a need-based approach.[58] The ISA has adopted regulations for prospecting and exploration of seabed mineral resources,[59] whereby contractors are expected to provide training and capacity-building activities to assist developing States who wish to participate in activities in the Area by drawing up "practical programmes for the training of personnel of the Authority and developing States."[60] The ISA Secretariat assists in matching suitable candidates to training opportunities in consultation with contractors. The ISA Legal and Technical Commission then agrees on a list of pre-approved candidates from the roster on the basis of transparent criteria and conducts regular reviews to ensure that the goal of equitable and geographic sharing of opportunities is followed. Under the recommendations adopted by the ISA Legal and Technical Commission for the guidance of contractors and sponsoring States,[61] training programmes are meant to be designed and carried out for the benefit of the trainee, the nominating State and ISA members, especially those among them that are developing States.[62] The planning and formulation of training programmes must be conducted in good faith and best practice must be followed at all times, with a view to ensuring that the training and capacity development needs of the participants' country of origin are addressed.[63] The recommendations further call upon parties – particularly the ISA and developing States - to encourage the use of the training received for the benefit of the trainee and the respective country's involvement in activities related to the Area.[64] However, stakeholders have pointed out that the total number of training opportunities provided by contractors remains low, and that some regions have yet to reap the benefits of the pertinent initiatives [74]. In addition, a range of different factors – including the obligations foreseen by UNCLOS in connection to technology transfer – have led commercial firms to focus their prospecting efforts within national EEZs, "where access regimes are relatively clearer and the legal risks smaller" [75, p. 731]. The recent review of the ISA performance, however, has underscored that "no significant work has been carried out by the Authority to effectively monitor the development of marine technology relevant to activities in the Area, except for the monitoring of technology as described in the annual reports of contractors. The review therefore included a recommendation whereby, although the primary responsibility for developing relevant marine technology should rest with the contractors, the ISA should place emphasis on the specification of the agreed performance standards in the context of the work on the exploitation regulations under the mining code" [74, para 17 and Recommendation 8].

Another example can be found in the context of the IMO energy efficiency regulations, where an Expert Group has been mandated to identify the technology needs of developing States; develop an inventory of energy efficient technologies; and draft a model agreement that expressly refers to the protection of IPRs.[65]

Leaving aside the marine realm, an interesting example, albeit under development, can also be found under the International Treaty on Plant Genetic Resources for Food and Agriculture[66] in connection with fair and equitable sharing of benefits from genetic resources in the form of information-sharing [76]. The example is particularly interesting because it shows how a more institutionalized multilateral approach can serve to advance integrated implementation of information-sharing, capacity-building and technology transfer obligations. A Global Information System is being launched as a web-based entry point to information and knowledge that is specifically geared towards strengthening the capacity for the conservation, management and utilization plant genetic resources for food and agriculture.[67] For present purposes, it is worth highlighting that what is envisaged is a combination of elements to actively pursue not only the sharing of scientific information (by promoting and facilitating interoperability among existing systems, and creating a mechanism to assess progress and monitor effectiveness), but also opportunities for all to contribute to scientific research (by enhancing opportunities for collaboration, and providing capacity development and technology transfer).[68]

4.3. Partnerships

An important challenge for the full implementation of technology transfer obligations stems from the fact that those obliged to transfer marine technology are technologically advanced States. However, research in, and development of, ocean technology, including in connection to fisheries, has been almost exclusively undertaken by private corporations, particularly transnational corporations using their own resources [77]. With no direct access to the actual technologies concerned, technologically advanced States declare themselves unable under a free-enterprise system to compel action by autonomous commercial entities, and assume a passive role during negotiations for the drafting of implementing agreements or codes of conduct.

The corporations that hold proprietary rights over marine technologies, on the other hand, are content to remain outside negotiations they believe can have little impact on their activities, given that their technologies are readily available for purchase or protected from unauthorised use either by law or the maintenance of strict secrecy [57]. Commentators have thus highlighted the importance of the direct involvement of corporations at the multilateral level, which may provide "the most productive context for the development of sound legal provisions for the transfer of technology, since it would offer the best guarantee of binding force: a true balance of obligation assuring mutual benefit" [57, p. 270]. The level of protection assigned to the interests of marine technology holders under UNCLOS is that of States' "due regard" for the rights and duties of holders, suppliers and recipients of

[57] The webpage of the Ocean Biogeographic Information System (OBIS) can be accessed at: http://www.iobis.org/. (Accessed 17 July 2017) This was specifically discussed at the BBNJ PrepCom: ENB [68], p. 4.

[58] UNCLOS, Articles 143 and 144; E. Morgera [70], p. xx. For a broader discussion, see: J. Harrison [72]; J. Harrison [73].

[59] Regulation 27 of the Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area and Regulation 29 of the Regulations on Prospecting and Exploration for Sulphides and Crusts; and Annex 4 of these Regulations. Available online at: https://www.isa.org.jm/files/documents/EN/Pubs/LOS/pdf/277957247.pdf. (Accessed 17 July 2017).

[60] UNCLOS, Annex III, article 15.

[61] Recommendations for the Guidance of Contractors and Sponsoring States Relating to Training Programmes Under Plans of Work for Exploration, ISA Doc ISBA/19/LTC/14 (hereinafter, the ISA Legal and Technical Commission Guidelines).

[62] ISA Legal and Technical Commission Guidelines, para 6.

[63] ISA Legal and Technical Commission Guidelines, para 7.

[64] ISA Legal and Technical Commission Guidelines, para 10.

[65] International Maritime Organization (IMO) - Marine Environmental Protection Committee (MEPC), Resolution MEPC.229(65); IMO – MEPC Doc MEPC.1/Circ.861; IMO – MEPC Doc MEPC 70/5/8. We are grateful to Dr James Harrison, University of Edinburgh, for drawing our attention to this development.

[66] International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGR), 2400 U.N.T.S. 303.

[67] ITPGR, Articles 13(2)(a) and 17.

[68] ITPGR Resolution 3/2015 (IT/GB-6/15/Res 3).

marine technology,[69] which has been criticised for its weak formulation.[70]

One way to navigate around the tensions between technology transfer obligations and the international protection of intellectual property is through multi-stakeholder partnerships, as highlighted in the IOC Criteria and Guidelines.[71] UNGA has also called for the adoption of "innovative voluntary approaches" that "pragmatically address intellectual property constraints for technology transfer," [64, para 46(j)] including public-private partnerships on collaborative intellectual property systems and licensing (e.g., open source and general public licenses) [64, para 51(e)]. Partnerships are favoured in the literature for providing, "in the face of resource constraints, a means of pooling resources together to attain common goals" [67]. Similarly, the CBD calls upon Parties to promote the establishment of joint ventures and research programmes,[72] and to promote cooperation in the training of personnel and the exchange of experts for the purposes of developing and using technologies that contribute to the objectives of the Convention, including indigenous and traditional technologies.[73]

Multi-stakeholder and public-private partnerships have taken center stage in international policy discussions on the implementation of Agenda 2030 [79], particularly SDG 14 [26, para 13(c)]. Partnerships constitute a key component of the Technology Facilitation Mechanism (TFM), which was launched under the Addis Ababa Action Agenda [80, para 123; SDG 17(6)] and has emerged as one the first major UN initiatives to support the realization of the SDGs [81]. The Mechanism is based on a multi-stakeholder collaboration between States, civil society, the private sector, the scientific community, UN entities and other stakeholders, and is composed of a UN inter-agency task team on science, technology and innovation for the SDGs; an online platform which serves as a gateway for information on existing initiatives, mechanisms and programmes; and a collaborative multi-stakeholder forum, which provides a venue for facilitating interaction, matchmaking and the establishment of networks in order to identify and examine technology needs and gaps and to facilitate development, transfer and dissemination of relevant technologies.

It remains to be understood, however, whether these partnerships are merely a mode of governance that is expected to loosely complement government efforts to implement relevant international obligations and commitments, as arisen at the 2002 World Summit on Sustainable Development [82]. Or do partnerships encapsulate a more ambitious idea of a global partnership, as enshrined in the 1992 Rio Declaration on Environment and Development,[74] both in terms of a 'new level of cooperation' between developed and developing States [83, pp. 69 and 71, 84], and a form of cosmopolitan cooperation [83, p. 72, 85, p. 89] that is inspired by a vision of public trusteeship?[75]

It is against this background that the notion of fair and equitable benefit-sharing, as developed under international biodiversity law in relation to the ecosystem approach, provides a useful normative basis beyond questions related to access to genetic resources [54, 87]. Under the CBD, the ecosystem approach calls for incentivizing the good management practices of indigenous peoples and local communities that are responsible for the production and sustainable management of ecosystem functions.[76] Benefit-sharing in this context combines an equity concern for those that devote their efforts to, and bear the risks of, the conservation and sustainable use of biodiversity, and for the larger community (including the international community, when global benefits arise from community practices) that benefits from conservation and sustainable use but does not pay the costs associated with them. In addition, it points to practical concerns about counterbalancing short-term gains that would derive from ecosystem degradation by creating a stake in conservation for those that more closely interact with nature, thereby aiming at ensuring compliance with environmental protection law.[77] This conceptualization of the ecosystem approach has inspired CBD guidance on intra-State benefit-sharing in the context of biodiversity-based tourism,[78] the creation and management of protected areas,[79] and the conduct of environmental and sociocultural impact assessments regarding natural resources traditionally owned or used by indigenous peoples and local communities.[80] Based on a combined reading of interpretative materials, "sharing" principally conveys the idea of agency, as opposed to the passive enjoyment of benefits [88], and therefore a shift away from unidirectional (likely, top-down) or one-off flows of benefits. This is to be realized through a concerted, iterative dialogue aimed at finding common understanding in identifying and apportioning benefits to lay the foundation for a partnership among different actors in the context of power asymmetries.[81] Such a dialogue can be arguably facilitated by the more proactive and institutionalized multilateral approaches to technology transfer discussed above. Benefit-sharing usually relies on a menu of benefits, the nature of which can be economic and non-economic [54]. This arguably allows taking into account, through the concerted, dialogic process of sharing, the beneficiaries' needs, values, and priorities through a contextual selection of the combination of benefits that may best serve to lay the foundation for partnership [54]. And benefit-sharing is accompanied by the expressions "fair and equitable," which is generally left to subsequent negotiations. The reference, however, can be interpreted to signal its rationale of balancing competing rights and interests [92, pp. 197–198 and 250–251] with a view to integrating both procedural and substantive dimensions of justice[82] into a relationship regulated by international law that is characterized by power imbalances [93]. Once again, an interesting example from outside the marine context can be found under the International Treaty on Plant Genetic Resources for Food and Agriculture, which may provide a useful approach to linking inter-State obligations on technology transfers to responsiveness to the needs of small-scale fisheries, while enhancing integrated implementation of capacity-building and information-sharing in a proactive manner. A platform for the co-development and transfer of technologies is a bottom-up, pragmatic, voluntary partnership that was initiated by governments and stakeholders and has gradually been integrated into the multilateral architecture of the Treaty.[83] The platform has brought together a network of public and private institutions that collaborate in delivering a combination of information-sharing, capacity-building and technology co-development and transfer with facilitated access to genetic material. The initiative is meant to identify real needs of targeted beneficiaries (small-scale farmers and their communities), assembling technology packets that

[69] UNCLOS, Article 267.

[70] J.M. Van Dyke, D.L. Teichmann [78], p. 434. However, Nordquist et al. note that, unlike most of the provisions of Part XIV, Article 267 is cast in the language of obligation, albeit flexible: M.H. Nordquist, S.N. Nandan, University of Virginia, Center for Oceans Law and Policy [56], p. 682.

[71] IOC Criteria and Guidelines, para B(d).

[72] CBD, Article 18(5).

[73] CBD, Article 18(4).

[74] Rio Declaration on Environment and Development (1992) UN Doc A/CNF.151/26, Preamble, and Principles 7 and 27.

[75] P.H. Sand [86], p. 617. Sand refers to the ITPGR as a concrete example.

[76] CBD Decision V/6 (2000) Annex, Operational Guidance 2, para 9; CBD Decision VII/11 (2004) Annex, para 12.5.

[77] CBD Decision V/6 (2000) Annex, Principle 8; CBD Decision VII/11 (2004) Annex I, Rationale to Principle 4.

[78] CBD Decision VII/27 (2004) Annex, para 1(3)(7); CBD Decision V/25 (2000) paras 4(b) and (d).

[79] CBD Decision VII/27 (2004) Annex, paras 2(1) and 2(1)(4) (while the latter refers to both benefit- and cost-sharing, the focus on benefit-sharing is clarified in CBD Decision IX/18 (2008), Preable, para 5).

[80] CBD Decision VII/16 (2004) para 40.

[81] On the intra-State dimension of benefit-sharing, see, e.g., UNGA [89], paras 75–77 and 92; ECOSOC [90], para 19. On the inter-State dimension, see, e.g., ECOSOC [91], para 82.

[82] By analogy with the standard of fair and equitable treatment in international investment law: R. Kläger [93], p. 130.

[83] ITPGR Resolution 4/2015 (2015) FAO Doc IT/GB-6/15/Res 4.

could include training and other activities instrumental to fostering technology absorption capacity, as well as developing standardized conditions (such as humanitarian clauses) [94].

The need for concerted and well-resourced multilateral approaches to ensure need-based and integrated implementation of capacity-building and technological support obligations [95,96] has been increasingly underlined in the ongoing negotiations of a new legally binding instrument on marine biodiversity of areas beyond national jurisdiction. Multilateralism can thus be considered as a precondition for realizing the guiding principle of UNCLOS and the IOC Criteria and Guidelines that the transfer of marine technology must always be conducted on "fair and reasonable terms and conditions"[84] and "should enable all parties concerned to benefit on an equitable basis from developments in marine science-related activities, particularly those aiming at stimulating the social and economic contexts in developing countries."[85] Significantly, it can also be a means to give voice and cater specifically for the needs of small-scale fisheries communities.

5. Insights from international human rights law

The references to fairness and equity objectives, as well as to benefits, in the IOC Criteria and Guidelines resonate with a relatively unknown but highly relevant international human right – the human right to science. The human right to science is not a new right [76,88]: it was proclaimed in the Universal Declaration of Human Rights[86] and has been enshrined in several treaties, including the International Covenant on Economic, Social and Cultural Rights,[87] so its legally binding force is not under discussion [88]. It is seen as an autonomous right that is worthy of protection for its contribution to the continuous raising of the material and spiritual standards of living of all members of society, both for individual emancipation and collective economic and social progress [12]. As such, it may contribute to the enjoyment of other human rights such as the rights to food and health [11,88,97], and is therefore significant for the realization of SDGs 2 (hunger) and 3 (health and well-being). In addition, the right to science contributes to "[protecting] and [enabling] each person to develop his or her capacities for education and learning, to form enduring relationships with others, to take equal part in political, social and cultural life and to work without fear of discrimination," [12] therefore playing a part in the implementation of SDGs 4 (education), 8 (decent work) and 10 (inequality).

Admittedly, however, the scope, normative content and obligations of States with regard to the human right to science remain underdeveloped and for this very reason there have been virtually no efforts to implement the obligations to promote, protect and fulfil this right. Nonetheless, current efforts to clarify the content of the right to science provide useful insights for present purposes. A human rights lens may provide a powerful analytic tool for deepening the understanding of the content of, and consequences of non-compliance with, international provisions on technology transfer vis-à-vis small-scale fishing communities.

In 2011, the UN Special Rapporteur in the field of cultural rights Farida Shaheed suggested that the right to science encompasses four distinct elements: the right to access the benefits of science by everyone without discrimination; the opportunity for all to contribute to scientific research; the obligation to protect all persons against negative consequences of scientific research or its applications on their food, health, security and environment; and the obligation to ensure that priorities for scientific research focus on key issues for the most vulnerable [98, paras 1, 25 and 30–43].

Shaheed pointed to an "implied obligation for developing countries [to prioritize] the development, import and dissemination of simple and inexpensive technologies that can improve the life of marginalized populations rather than innovations that disproportionately favour educated and economically affluent individuals and regions." She then pointed to a "corresponding obligation for industrialized countries to comply with their international legal obligations through provisions of direct aid, as well as development of international collaborative models of research and development for the benefit of developing countries and their populations" [98, para 68]. These recommendations, however, do not refer to the need to take into account the preferences of intended beneficiaries and local contextual elements in assessing which technologies may be usefully and equitably shared, as was cautioned by former Special Rapporteur on the Right to Food De Schutter [99, p. 348]. In addition, reference could have been made to the need, at the time of the decision to transfer technology, to convey relevant information specifically to those that are going to manage its risks and/or be exposed to them (workers, civil society, and communities) [100].

Rapporteur Shaheed underscored specifically the need to further clarify the modalities and role of benefit-sharing vis-à-vis technology transfer [98, paras 66–69]. This is particularly interesting for present purposes as it shows the potential of relying on conceptual clarifications and practical approaches adopted under international biodiversity law to implement the law of the sea in line with the human right to science.

The legal scholarship on the right to science has put forward arguments that "sharing" benefits is a key conceptual element to be clarified in this context. Mancisidor emphasized that the concept of "sharing" benefits indicates agency [88]. The *travaux preparatoires* of the Universal Declaration suggest that "sharing" was used to point to the universality of the right to science — in other words, to the idea that even if not everyone may play an active part in scientific advancements, all persons should indisputably be able to participate in the benefits derived from it.[88] Accordingly, a combined interpretation of benefit-sharing under international biodiversity law and under the human right to science reinforces the idea of active participation in the identification of benefits, sharing modalities and beneficiaries through a concerted and dialogic process aimed at building a fair and equitable partnership among different actors that may have different worldviews on what science is and what its benefits are [76].

While international biodiversity law may help understand benefit-sharing as one component of the right to science, the other dimensions of the right, as spelt out by Rapporteur Shaheed, serve to address power dynamics that are affected or engendered by science and technology and are not explicitly addressed under international biodiversity law or the law of the sea. Specific consideration needs to be given to the fact that the benefit-sharing process needs to serve to critically assess whether information-sharing and marine technology transfer lead to non-discriminatory results, prioritize the needs of the vulnerable, and factor in the need to protect against negative consequences of scientific research. A mutually supportive interpretation of the right to science and of technology transfer obligations under international biodiversity law and the law of the sea would need to integrate a consideration of all four dimensions of the right to science into a concerted and dialogic

[84] UNCLOS, Article 266(1); IOC Criteria and Guidelines, para B(b).

[85] IOC Criteria and Guidelines, para B.

[86] On the broad consensus regarding the inclusion of the human right to science in the Universal Declaration of Human Rights, see: W.A. Schabas [11].

[87] International Covenant on Economic, Social and Cultural Rights, 6 ILM 360 (1967), Article 15. See also: Charter of the Organization of American States (1948) 119 U.N.T.S. 3, Article 38; American Declaration on the Rights and Duties of Man (1948) O.A.S. Res. XXX, Article XIII; Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural Rights, 28 ILM 156 (1989), Article 14; and Arab Charter on Human Rights (2004), reprinted in *International Human Rights Reports* 893 (2005), Article 42.

[88] A.R. Chapman [97], pp. 5–6. Note that not all versions of the right to science in different international human rights materials refer to benefit-sharing. For instance, whereas the Universal Declaration of Human Rights makes reference to sharing in the benefits of scientific advancement, the International Covenant on Economic, Social and Cultural Rights refers to the "right to enjoy benefits". However, Mancisidor has argued that the understanding of the wording used in the Declaration should colour the interpretation of the different wording in the Covenant in full: M. Mancisidor [88].

process for identifying the technology to be transferred, transfer modalities and beneficiaries. This can then aim to critically assess how to prevent dependency on external, ready-made solutions that may not fit particular circumstances, or may allow for the exertion of undue influence by donor countries [101, pp. 313 and 331]. The human right to science, therefore, emphasizes key substantive considerations that should inform relevant processes, including more institutionalized, multilateral approaches and partnerships for the enhanced and integrated implementation of technology transfer obligations to the benefit of small-scale fishing communities.

6. Conclusions

The article explores ways to move away from the current ad hoc and insufficient approach to implementing the general obligations on technology transfer enshrined in UNCLOS towards a more concerted, partnership-based and integrated approach that is connected with capacity-building and information-sharing, based on an ecosystem-based approach to fisheries management. To this end, the article illustrates the potential of, and the opportunities arising from, a proactive, institutionalized multilateral approach to lay the basis for concerted, dialogic and iterative processes for identifying and allocating benefits among States and non-State actors, where the recipients of marine technology transfer have agency. Such an approach can (and should, for States that are parties to all relevant treaties) be built upon a mutually supportive interpretation of the law of the sea, international biodiversity law and the international human right to science, including a broad notion of fair and equitable benefit-sharing. The proposed interpretation benefits from existing complementarities across different international treaties and on the consensus-based interpretative guidance that has already been elaborated under them. This interpretation has the potential to inspire multilateral facilitative and brokering arrangements to operationalize relevant duties of cooperation with a view to responding to needs identified in a participatory manner and ensuring more equitable distribution across different regions. It may also facilitate interoperability among and accessibility of existing information systems, and monitoring of effectiveness. The need for such an approach has already been demonstrated in other international processes, such as the International Seabed Authority, the International Maritime Organization and the International Treaty for Plant Genetic Resources for Food and Agriculture.[89]

The article has also illuminated how the various dimensions of the human right to science, such as the avoidance of discriminatory results, the prioritization of the needs of the vulnerable, and the protection against negative consequences of technology transfer, appear particularly useful to consider the role of small-scale fishing communities and their needs to conduct ecosystem-services assessments, as highlighted in the World Ocean Assessment [102], and have a voice in marine spatial planning [103], science-based fisheries management [4], and the development of area-based management tools [23,104]. This would provide recognition, adequate reward and support for small-scale communities' custodial attitude towards marine living resources and the integrity of marine ecosystems on the basis of the "integral reciprocal relationship between the living resources, technology institutions, and people" [27, pp. 8 and 15].

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[89] Note that this Treaty has been considered a relevant source of inspiration in the BBNJ PrepCom: ENB [68].

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