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Governing in a placeless environment: Sustainability and fish aggregating devices

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ABSTRACT

Sustainability governance views 'place' as either a central concept and phenomenon to counter homogenising globalisation, or as an irrelevant concept for understanding ostensibly 'placeless' global environments such as oceans. Based on a review of global tuna fisheries in placeless oceans, we illustrate the importance of place in governing the sustainable use of fish aggregating devices (FADs); floating objects under which tuna and other fish aggregate, enabling efficient purse seine fishing practices. These FADs are places that connect global tuna flows with national and global capital, information and regulatory networks. We argue that addressing sustainability challenges in purse seine tuna fisheries means governing FADs as places, by recognising and altering the networked relations that structure global flows of capital, information, regulation, and trade. We do this by bringing in 'place' to our analysis, thereby providing a new perspective on the governance of marine sustainability and an alternative to the homogenising regional or global governance regimes. In doing so we also challenge habitually localised, sense-making and sedentarist connotations of place-based sustainability governance, and instead call for greater theorisation of globally networked places in otherwise placeless environments.

1. Introduction

A strange dichotomy appears to have emerged in academic research on sustainability governance. On the one hand, the role of place seems to be largely ignored. Governing sustainability is framed as an abstract and placeless process, where networks of actors develop rules, institutions and regimes that are homogenised across geographical space. Studies on global climate change governance, food sovereignty and food safety governance, and (inter)national air quality governance, for instance, all tend to either ignore or downplay the importance of place (Hulme, 2010; Lövbrand et al., 2009). On the other hand, and partly in reaction to homogenised and placeless sustainability governance conventions, the importance of localised, place-based sustainability governance is also often overemphasised (Lane and Corbett, 2005). Here, sustainability is not only strongly attached to local places with unique, concrete and contextualised notions and definitions of sustainability; it is used to refute the abstracting and homogenising effects of globalisation.

While sustainability governance often remains at an abstract global scale, place remains fundamental because the contribution to and outcome of any governance process can only meaningfully exist when it is specified for particular places. The social relations that constitute governance cannot (and should not) be lifted out of these localised places to be generalised and abstracted across larger time–space configurations. Research on local sustainable food production-cum-consumption systems (Wiskerke, 2009), locally embedded

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sustainable companies (Shrivastava and Kennelly, 2013) and locally specified nature conservation initiatives (Pollock, 2004) all emphasise the importance of local place-based forms of sustainability governance. In doing so, this body of literature often considers non-localised influences as hampering and undermining endogenous or 'bottom up' decision making over sustainability within these localities.

In this paper we start from the idea that it is essential to give place a (more) central position in sustainability governance studies by moving beyond abstract, detached, homogenised and de-contextualised notions of how sustainability governance functions. Abstract and homogenised notions of governance regimes hold different consequences for sustainability in specific places, and hence it is essential to include place as a category when studying and designing sustainability governance. But, by the same token, we are not convinced that place-informed sustainability governance studies are preferably sedentary and/or static; limited to just localised places, where sustainability is primarily or only connected to local identities or experiences of place, and local networks of actors constituting and defining sustainability.

Place for us is instead constituted by networks of finances, capital, information and social relations that can be more or less localised/globalised depending on the kind of place-based system that is being governed (Mol, 2007; Mol and Spaargaren, 2006). The result is that some governance arrangements have to deal with highly localised, sedentary and readily tangible resources or environments (e.g. forest or mineral regimes), while others are focused on highly mobile, abstract and homogenised resources or environments that continually 'flow' across global space (e.g. fishery, carbon emission and genetically modified organism regimes) (Mol and Law, 1994; Urry, 2003). Governing the sustainability of these resources in places therefore means identifying the networks and flows that constitute and configure place-based practices; and in turn analysing how these networks and flows can be employed in the governance of these placed-based practices.

Our goal in this paper is to explore the relevance of place and the need to conceptually detach place from localised, sedentarist space. In operationalising such a perspective and illustrating how places are relevant categories also without being conceptualised as localised, sedentarist and immobile, we will focus on the role of fish aggregating devices (FADs) in governing the sustainability of tuna fisheries. FADs are employed as fixed or floating objects placed in the ocean and they attract mainly pelagic fish species for capture (Dempster and Taquet, 2004). Because of their efficiency in attracting fish the sustainability of using FADs for tuna harvesting purposes has been widely questioned (e.g. Bromhead et al., 2003; Fonteneau et al., 2000b; Gilman, 2011): when a fishing gear or method leads to low biological growth rates or critically low biomass levels, or if non-target species are adversely affected (including vulnerable species such as sharks, billfish and turtles), it may be deemed to be 'unsustainable'. But as variously noted (e.g. Dagorn et al., 2013b; Taquet, 2013), this does not mean that FADs are unsustainable per se; rather it means that information on the location and use of FADs, as well as (political) economic pressures for their widespread use need to be better understood and better governed.

Governing the sustainability of FAD-based tuna fisheries is not a representative case, but rather a specific or 'extreme' case (Yin, 2014) of governing natural resources in (mobile and sedentary) networked places. Not only is the biophysical environment mobile and fluid, the fishers that exploit the resources at these places are also (globally) mobile. Such an 'extreme' case can therefore clarify the position of place as an analytical category for sustainability governance (see for example Eisenhardt and Graebner, 2007; Flyvbjerg, 2006). Based on a review of the literature on FAD fisheries, the following section outlines the sustainability challenges faced by three classifications of FADs – each an ideal type based on a set of social, regulatory, material and environmental place-based 'classifiers'. We then turn to a discussion of what FAD fisheries as an 'extreme' case provides us in terms of generalised insights of place-based sustainability governance.

2. Oceans, tuna fisheries and FADs

2.1. *A placeless environment*

The oceans are the world's most expansive environment, covering 70% of the globe's surface and extending to depths 25% greater than the height of Mount Everest. Marine ecosystems are also highly varied, extending from dynamic and highly biodiverse land–sea interface ecosystems, to different categories of near shore and deep-sea benthic and bentho-pelagic habitats. Marine ecosystems are also classified by depth, ranging from the near surface or 'blue water' photic zone, to the extreme depths of the aphotic abyssal zone (Fig. 1). The classification of these zones and habitats illustrates the heterogeneity of the marine environment, but paradoxically also illustrates the placeless nature of water-bound three dimensional space. The relative inaccessibility of these environments for the vast majority of society, and the abstract and mediated ways in which we experience parts of these environments through remote-sensing technologies, make the classification of marine places even more problematic – and may also make them appear largely irrelevant.

Societal attempts to create territories in the marine environment, to which access is regulated, are also abstract and placeless. The United Nations Convention on the Law of the Sea (UNCLOS), ratified in 1994, has divided benthic and pelagic marine resources into: the sovereign territorial waters (12 nautical miles), an extended or contiguous zone (a further 12 nautical miles), and the Exclusive Economic Zone (EEZ) extending to 200 nautical miles off-shore, beyond which are the 'high seas' or areas beyond national jurisdiction (ABNJ; see Fig. 1). Specific rights of countries over benthic and mineral resources in the first three zones are further specified by national jurisdictions, often referred to as different parts of the continental shelf. The high seas are then subject to broadly defined international treaties on fishing, pollution, transport and mineral extraction. While benthic seascapes are mapped and classified as trenches, reefs, shelves, banks and seamounts, pelagic habitat is defined by coordinates of longitude and latitude, and ranges of depth. The overall effect is a highly stylised, homogenising and placeless geography of the marine

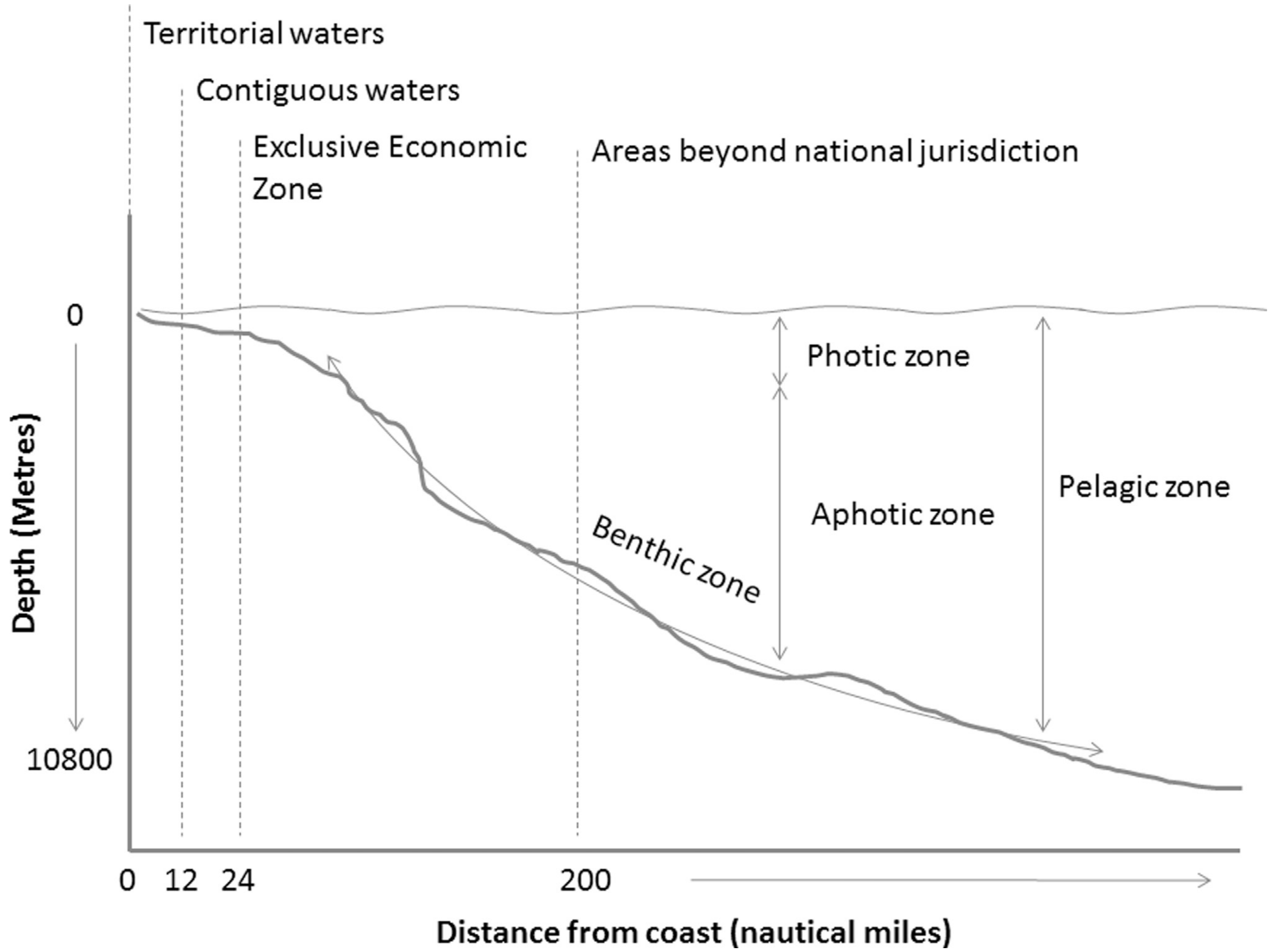

Fig. 1 – Simplified breakdown of 'zone' classifications and jurisdictions in the oceanic environment.

environments; leading directly to homogenising sustainability governance arrangements.

2.2. *Tuna and FADs*

Collectively, the five main oceanic tuna species (yellowfin, bluefin, bigeye, skipjack and albacore) constitute the most valuable commercially exploited fish stocks in the global tropics and sub-tropics (see Fig. 2). Although also often homogenised as 'tuna' the specific ecologies of these species differ considerably. However, common to all is their highly migratory nature, moving in and out of the regulatory territories outlined above throughout their spatial range (Sibert and Hampton, 2003). These species are also delimited by depth; e.g. adult bigeye tuna is confined to specific thermal ranges at greater depths than the other tuna species (Matsumoto et al., 2013). Their management is governed under UNCLOS, which stipulates that tuna caught in sovereign waters fall under national jurisdiction, while tuna caught in areas beyond national jurisdiction fall under the purview of six Regional Fisheries Management Organisations (RFMOs) defined for both specific high sea areas and the spatial extent of highly migratory fish stocks (see for example Ardron et al., 2014). RFMOs regulate tuna fisheries through a combination of conservation and management measures aimed predominantly at limiting fishing effort. Examples include catch allocation for yellowfin and big eye tuna in the Atlantic Ocean and seasonal FAD closures designed to reduce fishing mortality on bigeye tuna in the Western and Central Pacific (see Table 1 for further detail). Such cases illustrate that fishing effort is allocated or restricted across spatially defined jurisdictions, but with no direct reference to specific places.

But does this mean that tuna and tuna fisheries are themselves homogenous and placeless in the three-dimensional pelagic environment? A distinguishing factor of tuna fisheries is the association of tuna around floating objects. Although some form of association with floating objects has been long recognised by artisanal fishermen in various parts of the world (Dempster and Taquet, 2004; Kakuma, 2000; Morales-Nin et al., 2000; Taquet, 2013), fish aggregating devices (FADs) were first used by industrial scale purse seine vessels in the 1950s (Castro et al., 2001; Hall, 1998). As outlined by Dagorn et al. (2013b), the benefit of FADs to fishermen is an improved efficiency of fishing. Not only do FADs increase the probability of locating fish, they are detectable from the surface, thereby providing a reference point and reducing search time and cost,

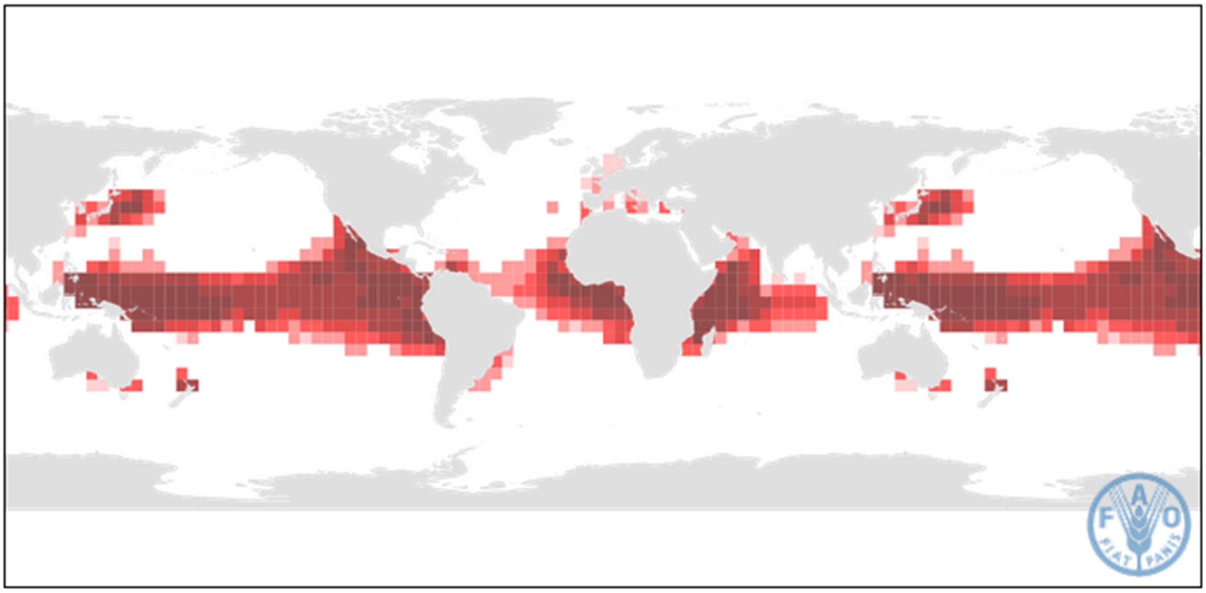

Fig. 2 – Cumulative spatial extent and intensity of purse seine tropical tunas catches from 2000 to 2013 – skipjack, yellowfin, bigeye and albacore. *Note*: High intensity (dark red), lower intensity (light red). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
Generated from FAO (2014).

Table 1 – Comparison of conservation and management measures related to the fish attraction devices implemented by the five tuna regional fisheries management organisations.

RFMO	FAD-related measures	Status	Reference
Western and Central Pacific Tuna Commission (WCPFC)	• Time–area closure to FAD fishing – by 2017 high sea ban on FAD sets. • Limits on numbers of vessel days for fishing the high seas. • Development of fleet level FAD management plans. • Full-retention of tunas caught by purse seiners operating in the sub-tropical zone of the western Pacific. • 100% regional observer coverage for both high seas and areas under national jurisdiction.	• Bigeye tuna – exploitation rates above FMSY • Yellow fin tuna – fishing mortality within sustainable levels • Skipjack tuna – fishing mortality at sustainable level, but risk of catch rates declining	CMM 2009-02, CMM 2012-01, CMM-2013-01
Inter American Tropical Tuna Commission (IATTC)	• Annual fishing closure (of 62 days) for purse seine vessels greater than 182 tonnes carrying capacity to 2016. • One month seasonal closure of the purse seine fishery in specified area west of the Galapagos Islands. • Full retention of purse seine catches of bigeye, skipjack and yellowfin tunas.	• Bigeye tuna – fishing mortality at sustainable level. • Yellow fin tuna – exploitation rates above FMSY • Skipjack tuna – fishing mortality at sustainable level	Resolution C-13-01
The International Commission for the Conservation of Atlantic Tunas	• Total Allowable Catch for bigeye tuna with allocation to member states and penalties. • TAC for yellowfin, with no allocation. • Vessel register (>20 m). • Two-month prohibition of fishing on floating objects in an area off West Africa. • Submission of FAD management plans by countries with purse seine and baitboat (pole and line) fisheries. • Requirement for reporting specific data elements for FAD management for monitoring drifting FAD deployment and utilisation patterns.	Concern remains over bigeye given the total allowable catch specified is exceeded by catch levels due to catch allowance made for Contracting Parties and Cooperating non-Contracting Parties.	Recommendation 11-01
Indian Ocean Tuna Commission (IOTC)	• One-month closure for purse seiners and longliners (in different months) in an area of size $10^\circ \times 20^\circ$. • Ban of discards by purse seine vessels. • Members to report specific data elements for FAD management that will permit adequate monitoring of dFAD and aFAD deployment and utilisation patterns.	None of the three stocks are now experiencing overfishing and/or are considered to be overfished.	Resolution 13/11, Resolution 12/13

Source: adapted from ISSF (2013) and European Parliament (2014).

and increasing the success rate of setting gears (Miyake et al., 2010). Two general types of FADs are today employed – anchored FADs (in coastal and archipelagic waters less than approx. 2–3 km depth) and drifting FADs (in deep high sea areas) (Fig. 3). With advances in technology FADs are also increasingly fitted with geo-referenced echo-sounders which continuously transmit data on fish density, allowing fishers to locate and estimate the biomass of aggregating tuna and further increase their catchability. But low-tech versions are also used by coastal communities, consisting of little more than buoys and palm fronds.

The improvements in efficiency that FADs have afforded to fishers, coupled with relatively weak regulation, has led to a number of impacts on marine sustainability. The first set of issues relates to the heterogenous associations of tuna and other marine species around FADs. Skipjack tuna, which is considered underexploited, is often the target species for high-volume purse seine fisheries. But more vulnerable tuna species, such as bigeye and yellowfin tuna – currently (near to) being overfished – associate with skipjack schools and are also caught in sets around FADs. In regions such as the Western Pacific Ocean juvenile bigeye tuna only makes up an estimated 7% of this catch, but this is generally agreed that this is enough to maintain overfishing (Leroy et al., 2013). Non-endangered and threatened species also associate with FADs and are also affected by increased fishing pressure (e.g. Filmalter et al., 2011); although evidence also shows high release rates (Leroy et al., 2013). The second issue relates to the changing ecology of marine species as a result of FAD association. In some parts of the oceans the concentration of artificial FADs is so high that they create a ''perpetual artificial floating object habitat'' (Davies et al., 2014, p. 44): estimates of mean minimum distance range between 20 and 72.3 km for anchored and drifting FADs respectively (Dagorn et al., 2013a; Leroy et al., 2013). And numbers seem to only be increasing: in the Western and Central Pacific Ocean alone the number of FADs deployed is reported to have increased from 7774 in 2006 to 9813 in 2008 (WCPFC, 2009) (see Fig. 4). The effect of this 'new habitat' remains unclear, but next to more efficient fisheries and higher fishing mortalities there are concerns that the consequences of FADs also relate to wider ecosystem effects as migratory behaviour or predation patterns might be changed, decreasing fitness and increasing their natural mortality – expressed for instance in the so called 'ecological trap' hypothesis (Hallier and Gaertner, 2008).

2.3. *Oceanic places constituted by networks and flows*

FADs have become an important part of the pelagic fishing environment, allowing fishers to maintain a requisite level of

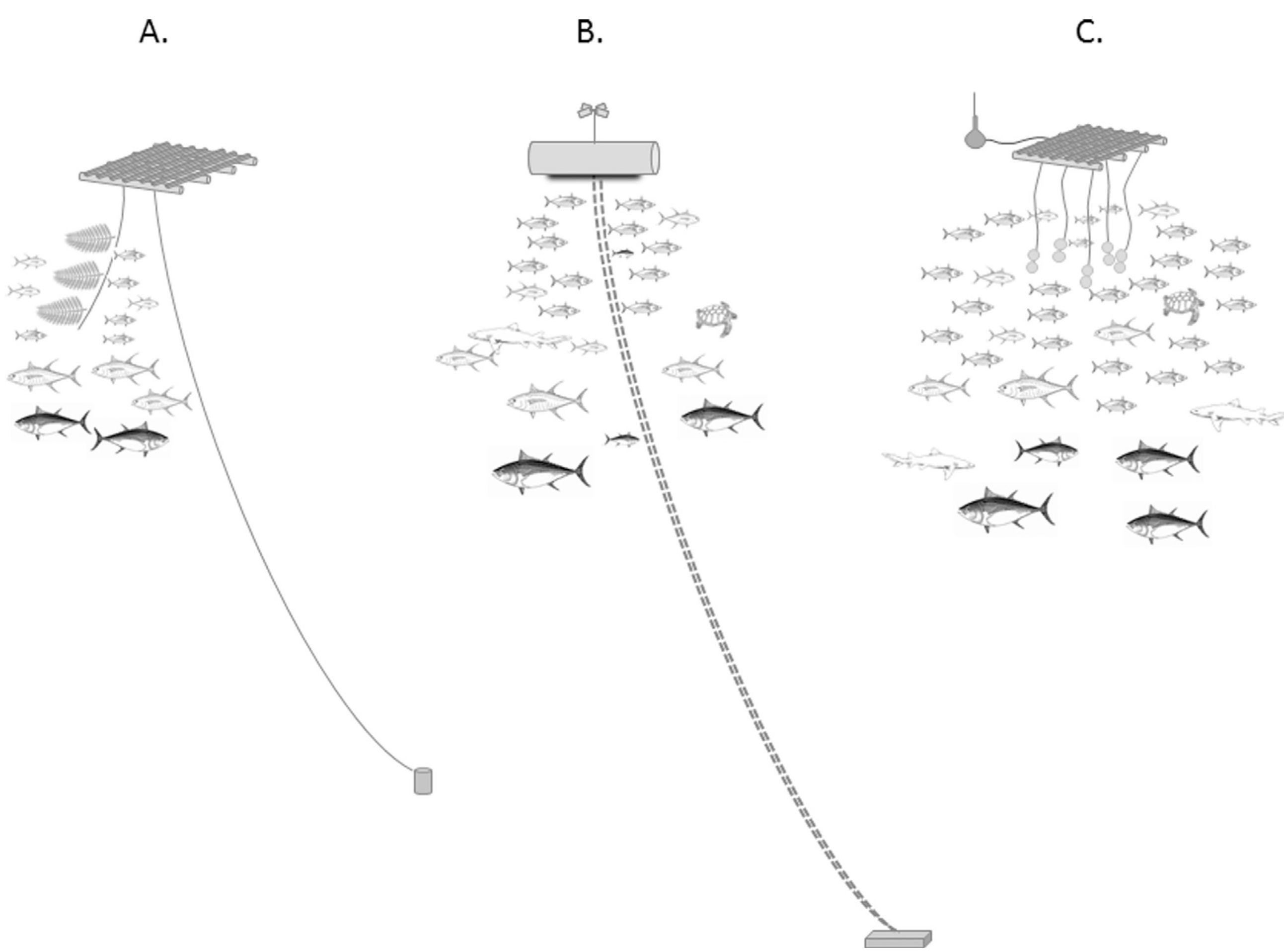

Fig. 3 – Schematic drawing of three FADs. (A) Coastal anchored FAD; (B) Archipelagic anchored FAD; (C) Drifting oceanic FAD. Adapted from Miller (2014).

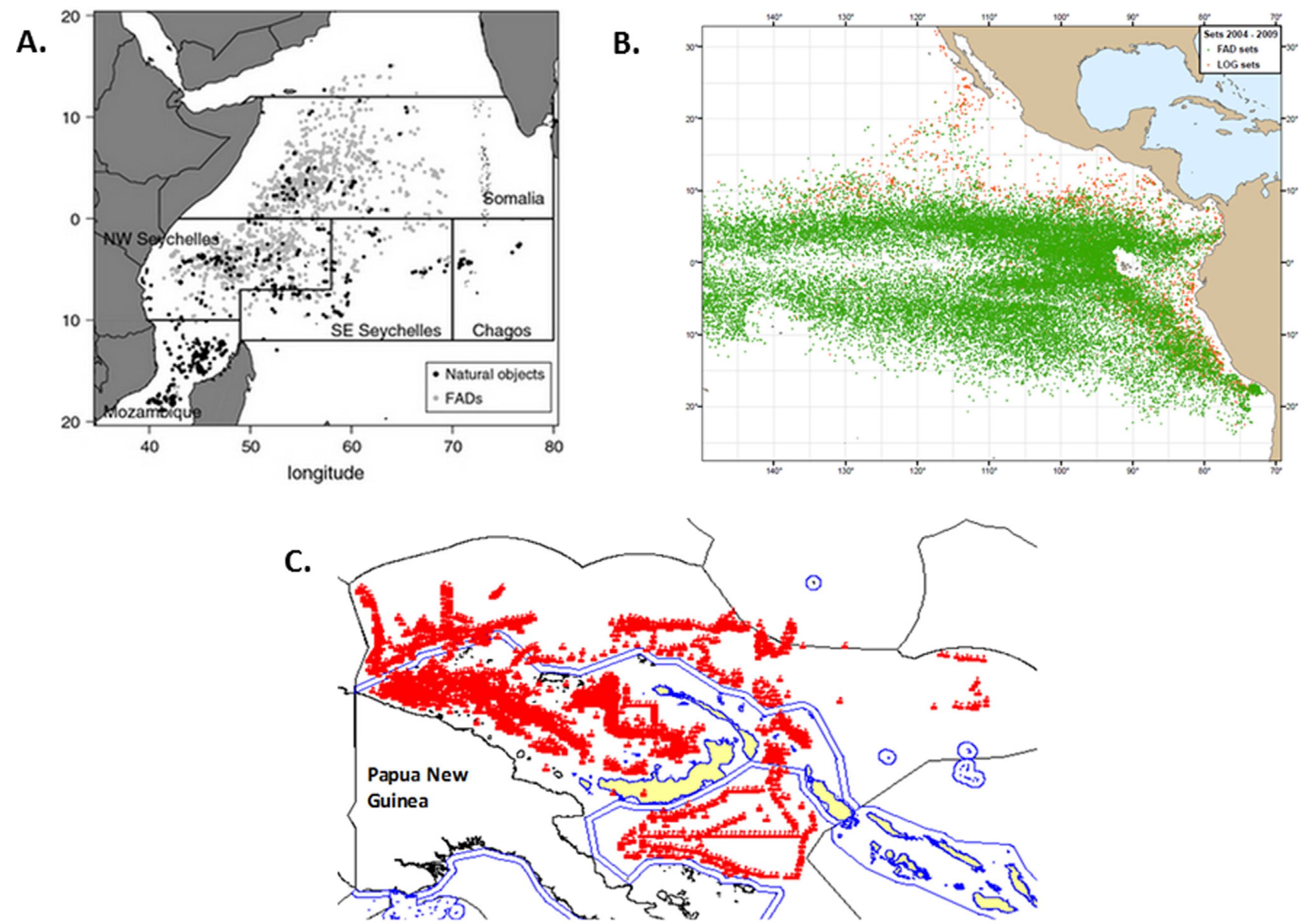

Fig. 4 – Representation of FAD distributions in different RFMOs. (A) Map representing all FADs (black) and logs (grey) recorded by observers during 2007 and 2008. *Source*: Dagorn et al. (2013a). (B) Purse seine sets on FADs (green) and logs (red) in the eastern Pacific Ocean 2004–2009. *Source*: Hall and Roman (2013). (C) Distribution of anchored FADs (red) around Papua New Guinea. *Source*: Kumoro (2002). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

efficiency to remain profitable. However, it is widely recognised that without better transparency of information on the location and use of FADs and without their improved management and governance, FADs will continue to be framed as an unsustainable gear (Dagorn et al., 2013b; Leroy et al., 2013). Indeed, the combination of poor information and monitoring, as well as models of fisher behaviour in assessment and management, further abstract FADs as homogenised, placeless points in the oceanic environment. Instead, we argue that understanding FADs as nodes at the crossroad of ecological and social networks and flows opens up a better conceptualisation of FADs as oceanic places, while at the same time providing new insights on how governance arrangements can be better designed to foster their sustainable use.

For this, we argue that anchored and drifting FADs can be (spatially) defined in three categories: oceanic, archipelagic and coastal FADs (Fig. 3). In technical terms, oceanic FADs are mobile floating objects deployed in both sovereign EEZs and areas beyond national jurisdictions (ABNJ), with advanced levels of search and sensor technology. They are often dropped from the air in distant waters, and owned and exploited predominantly by capital intensive and often internationally operating purse seine vessels – both from adjacent coastal states or distant water fishing nations. Archipelagic and coastal FADs are anchored and hence sedentary floating objects at different distances from the shore. Differences in materials, different levels of sensor technology employed, and different (local to national) ownership and governance arrangements of adjacent coastal states distinguish archipelagic FADs from coastal artisanal FADs. In sociological terms then, all types of FADs can be understood as constituted by global networks of fisherman, ecosystems and regulation, and by flows of fish, information and capital. Understanding placed FADs not only and primarily by what they are made of and where they are located, but rather as globally networked social–ecological places, can offer new insights in the governance of sustainable tuna exploitation.

3. FADs as places

We argue that FADs are defined by the locally delimited intersection of global social, ecological and social–ecological relations that structure their deployment and use; and in

Table 2 – Comparison of drifting and anchored fish aggregating devices (FADs).

Descriptor	Drifting	Anchored	
	Oceanic FADs	Archipelagic FADs	Coastal (artisanal) FADs
Ecology	Multiple tuna and non-tuna species; Evidence of impact on fitness of associated fish potentially leading to reduced (evolutionary) fitness.	Multiple tuna and non-tuna species; Evidence of impact on fitness of associated fish potentially leading to reduced (evolutionary) fitness.	Multiple tuna and non-tuna species; Evidence of impact on fitness of associated fish potentially leading to reduced (evolutionary) fitness.
Ownership and access	Private but not fully controlled; industrial scale purse seine vessels;	Private with use agreements; mix of industrial purse seine and pole and line vessels and coastal community hand line fisheries;	Private or community based ownership; predominantly coastal communities and (handline/pole and line) vessels
Regulation and control	Mix of seasonal closures and vessel day scheme	(Formal) access control	Mix of formal and informal access control
Monitoring/information Technology	Search and sensor technology	(Some) sensor technology	None
Sense of place and identity	No sense of place and identity	Limited sense of place and identity	Concrete sense of place and local identity

doing so FADs create a series of spatially interconnected places over time (Murdoch, 2006). To understand the challenges of governing FADs as places, we use a range of material and relational characteristics that are constituted by networks and flows. These characteristics include the biology of the species being exploited, the degree of access that FADs offer to marine biological resources, the kind of ownership and management of FADs, the means and networks of regulatory control employed over FADs, the technologies they are designed with, and the ways and extent to which they define (and are defined by) a sense of place and identity (see Table 2).

3.1. *Drifting oceanic FADs*

Drifting oceanic FADs are deployed in both EEZ and high seas areas with the aim of increasing the efficiency of high volume purse seine fishing. Drifting FADs are relatively low cost, constructed as bamboo rafts with material hanging off to depths between 10 and 100 m, and as such have a relative short life time (Taquet, 2013). They are particularly efficient in aggregating large schools of mixed tuna species, and important for high volume purse seine fisheries selling into the global canned market. They help to improve the catchability of the main tuna target species skipjack from approximately 63% to 75% of the volume of each set (Dagorn et al., 2013b). Although data are poor on the exact number of drifting oceanic FADs deployed each year, estimates range between 47,000 and 105,000 FADs globally (Baske et al., 2012). And with a presumed surplus of 'inactive' FADs still attracting fish, they have transformed high sea areas from a homogenised space into a network of place-based tuna fish and tuna fishing practices.

The negative impacts associated with drifting oceanic FADs are associated with their aggregated effect on migratory fish. There is a long standing hypothesis that (multiple) FADs create an ecological trap that modifies the migration patterns of tuna and carries tuna – and other attracted fish species – to parts of the ocean that are unsuitable for feeding, growth or increase their natural mortality (Fonteneau et al., 2000a; Hallier and Gaertner, 2008). However, as argued by Dagorn et al. (2013b), conclusive evidence for such an effect is lacking and more research is needed to assess the ecological impacts of FADs. This is not only important for understanding ecological effects, but also to estimate what implications FADs hold for the governance of sustainable tuna fisheries, given that FADs may contribute to the redistribution of tuna between waters with different exploitation rules and rights.[1]

A barrier to information and governance of FADs relates directly to ownership and accessibility. Oceanic FADs are released by large purse seine fishing companies, but ownership remains a problematic category as they are placed often without licenses in ABNJ. In management and control of private FADs information is of key importance. Although nascent programmes for FAD monitoring are in place in some RFMO areas, public data on the location and use of FADs, including on the numbers released, remain poor (Baske et al., 2012; Dagorn et al., 2013b; Leroy et al., 2013; Taquet, 2013). This does not mean that data is completely absent; the power of both search and sensor technologies is considerable, providing information on where which FADs are located and on the composition of fish beneath them. It is this private, company-owned and -managed technology that makes drifting FADs accessible and efficient for commercial use. But the poor public transparency of private information flows produced from these technologies, providing detailed place-based information on fish ecology that extend globally, also curtails the ability of public bodies to understand and regulate impacts on stocks. The fragmented and highly competitive nature of boat ownership, coupled with the complexities of national catch licencing and enforcement (see Campling et al., 2012), only further complicates access and use of this public information.

[1] FADs are unlikely to be the major factor in the movement of tuna stocks. Instead climate variability, influencing oceanic productivity is predicted to be a more significant factor in the distribution of fish stocks globally (Lehodey et al., 2006).

Despite having poor information on the ecology of FADs, public management and control measures are in place over predominantly industrial distant water fishing vessels. Conservation and management measures in place regulate both fishing effort (such as seasonal or areas closures and days-at-sea, see Havice, 2013) by monitoring and controlling where and when fishing occurs (through, for example, compulsory on-board GIS systems), and a more limited range of output controls around FADs (such as bycatch, see for example Gilman, 2011). Steps have also been recently made for the incorporation of existing private information from fishing companies deploying drifting FADs into RFMO management plans; but uptake of this information has been slow (see Table 1, Dagorn et al., 2013b; European Parliament, 2014). FADs are therefore anything but local, and purse seine fishers have no sense of local place and identity with these FADs. Instead drifting FADs are places at the confluence of global networks constituted by mobile fishers, migrating tuna, trans-boundary regulation and information flows.

3.2. *Anchored archipelagic and coastal FADs*

Anchored FADs are found in coastal and archipelagic waters. Like drifting FADs, they are also employed to improve the efficiency of fishing, but access is not restricted to purse seine vessels. Indeed, the use of anchored FADs in purse seine fisheries is limited to the western sector of the Pacific, including the Solomon Islands, Indonesia and the Pacific (Williams and Terawasi, 2011). Other gears, including pole-and-line and handline vessels, also fish on or near to anchored FADs with the same intent of reducing their search effort and increasing fishing efficiency. Anchored FADs are often more robust than their drifting counterparts, made of either large styrofoam blocks or iron, and anchored with concrete blocks attached to ropes of several hundred metres to up to 3 km long. Largely because of their expected longevity relatively high investments are made by those owning them (Dempster and Taquet, 2004). However, in regions such as Southeast Asia, customary FADs (variously named *payaos* in the Philippines, *ujang* in Malaysia and *rompon* in Indonesia and) fished by handline vessels are also made of bamboo and palm fronds (ibid).

The impact of anchored FADs are thought to be much the same as the ecological trap hypothesis for drifting FADs. It is thought that they alter migration patterns and affect the overall fitness of the fish that associate with them. The specific impact may be less pronounced than with drifting FADs because of the different behaviour of tuna in coastal waters (e.g. Dagorn et al., 2007; Jaquemet et al., 2011). Nevertheless, it is assumed that anchored FADs do have some effect on the movement of tuna in and around coastal and archipelagic areas where concentrations of fish may be higher, but again there remains uncertainty around the evidence for such claims (Dagorn et al., 2007, 2010).

The largest impact of anchored FADs may simply be the efficiency with which they allow fish to be caught, including non-target species. In archipelagic countries such as Indonesia and the Philippines, anchored FADs have accounted for up to 90% of tuna catches in the 2000s, but are now thought to be declining due to overfishing (Leroy et al., 2013). One of the drivers of this overfishing is the lack of regulation and enforcement of anchored FADs in coastal and archipelagic waters. Both anchored and drifting FADs within EEZs often need a state license to be placed in these sovereign waters, but are not directly under the influence of conservation and management measures set out by RFMOs (Sunoko and Huang, 2014). Spacing requirements for FADs have been designated in countries like Indonesia and the Philippines, but have been poorly policed due to a lack of resources and political will (Bailey et al., 2012). In Indonesia regulations pertaining to FAD usage have only recently been reinstated (in 2014) after having lapsed two years earlier.

Weak state regulation and implementation of FADs also means that the distribution of access of coastal FADs in particular is determined largely by informal agreements between fishing companies and communities, and between fishing companies utilising different types of gear (see for example Bailey et al., 2013). Archipelagic FADs, outside inshore areas, can be distinguished by their corporatist ownership structure – defined by company investment in FADs exploited by purse-seine and or pole and line vessels (Pollnac, 2007). In the Philippines there is evidence that FAD ownership and use is set out in grids – with companies assigned specific fishing areas. In contrast, coastal FADs involve a mix of corporate and customary ownership arrangements involving handline vessels, with investment coming directly from communities or local patron traders (Oostenbrugge et al., 2001). Access is defined by these ownership structures, with some tendency of reciprocal access rights between vessels using the same gear. However, conflicts have been noted between gears (Pollnac, 2007), again demonstrating a clear socio-economic stratification in investment and ownership/accessibility of FADs.

The importance of coastal FADs is also based on their contribution to local economies. Despite concerns over their sustainable use, they do allow fishers to spend less time searching for fish (e.g. days at sea), and even improving the contribution of fishing to already vulnerable livelihoods and reducing fishing effort in vulnerable habitats by not placing FADs in these habitats (e.g. coral reefs) (Adams, 2012). Indeed, coastal FADs have been associated with both development and conservation attempts in coastal regions for over three decades (Beverly et al., 2012).

The different ownership, use and regulation structures around anchored coastal FADs means they hold greater place-based meaning and identity among fisherman and local communities than drifting oceanic FADs. Their ownership and access also reflect wider social relations of patronage that underlie production in coastal fishing communities (e.g. Davis and Bailey, 1996). At least in the case of coastal FADs in countries such as Indonesia and the Philippines, this identity is reinforced by the dependence on local ecological knowledge due to a lack of investment in advanced technology. Fishing success is dependent on the expertise of boat captains in placing FADs and how and when they should be fished. This social regulation and control in turn sets barriers for entry into the tuna fishery and reinforces the identities of fishers exploiting these FADs.

4. Governing FADs as places

So what implications does a place-based understanding of tuna fisheries, conceptualised through networks and flows, hold for sustainability governance? We argue that even in a highly mobile natural and social environment of tuna fisheries 'oceanic place' matters. Furthermore, FADs can be defined as places: localised settings where society and ecology relate, sustainability issues emerge and governance measures deployed. The characterisation of FADs as networked places illustrates that homogenised global governance arrangements for tuna fisheries, with equal value, architecture and outlook across different places, may be limited.

But by the same token the governance of FADs should move beyond a localised delimitation of place, where decisions are specified by local social, ecological and material processes of fish and fishing. FADs may be localised settings in the marine environment where fishing occurs, but as illustrated above the governance of sustainable FAD use is to varying degrees determined by extra-local networks and (trans)national flows. The governance of coastal artisanal FADs, anchored close to the coast and with localised ownership and access arrangements, is to a significant extent embedded in and dependent on sub-national regulatory networks and sub-national capital and informational flows. This means that while local community identity, ownership, access rules, capital and trade relations are important to how FADs are used, they have to be placed within a wider context of migratory tuna, the activities of distant water fleets, and regional conservation agreements to have any real meaning to tuna sustainability.

Archipelagic FADs are places at which tuna fisheries are clearly structured through national and transnational networks and flows, of social and ecological nature. But while these FADs are anchored, they cannot be considered local places. The governance of sustainable archipelagic FAD use can only be analysed and designed if the combined influence of national and transnational (fishing/processing/trading, regulatory and ecological) networks and (capital, information, vessel and fish) flows are understood and taken into account. The regional and even global spatiality of capital flows and social relations of production, technology and regulatory systems, as well as international trading and processing systems into which tuna are traded have a direct influence over decisions on how these FADs are used (Campling, 2012; Campling et al., 2012). Likewise, the lack of identity and sense of place attached to these anchored FADs, because of the corporatist ownership structures surrounding them, make sustainability governance less a matter of local place-based structures and more a matter of (trans)national governance arrangements stretching over larger spaces.

Although tuna fisheries based on drifting oceanic FADs contrast in many ways to fisheries operating on coastal anchored FADs, they are not placeless. The governance of oceanic drifting FADs address the fishing practices of transnationally operating purse seiners employed at these global places. The place-based fishing practices at oceanic FADs, as well as the governance arrangements that aim to make these practices more sustainable, are determined by global networks and by global flows of capital, information, regulation and fish. As illustrated above, there is a disconnect in the way place is incorporated in the governance of FADs. The proprietary nature of transnational capital limits the flow of information on FAD location and tuna biomass to public trans-boundary governance bodies (e.g. Gilman, 2011), who in turn set placeless conservation and management activities on fishing practices around FADs. The integration of this place-based information with regional regulation demonstrates that drifting oceanic FADs are by definition networked places, and in turn may be better governed through public-private networks and partnerships.

How such networked approaches to understanding FAD governance relate to the state-based RFMO governance that prevails over transboundary tuna stocks remains an open question. Like many multilateral regimes, the RFMO system is constrained within the rights and interests of its member states (Cullis-Suzuki and Pauly, 2010). It is also constrained by weak control over private networks and flows in areas beyond national jurisdiction (Campling, 2012). Calls for greater transparency around private FAD information from fishing companies remains ineffective because of the limits of state jurisdiction in the high seas, making disclosure voluntary. These multilateral regimes cannot effectively regulate because they are unable to keep up with the fast pace of technology development around FADs (Taquet, 2013). It therefore appears salient to refocus attention to FADs as networked places, and base governance arrangements around the formation and management of the networks and flows that constitute and codetermine (un)sustainable fisheries at FADs. This is especially the case when considering that innovation in tuna fisheries is often created through globally networks of public and private actors (Miller, 2014). Understanding FADs in this way builds directly on debates over so called 'eco-FADs' (Davies et al., 2014; Dagorn et al., 2013b)[2], turning a top down (poorly) regulated fishing gear from sites of contestation into sites of innovation in networks of tuna fisheries.

5. Conclusion

FADs bring together mobile organisms in fluid marine ecosystems with locally and globally networked social relations of production and governance. In network terms, FADs therefore aggregate more than tuna; they create places in a seemingly placeless marine environment, within which social and biological networks and flows concentrate and connect. FADs therefore become places within which the material flow of tuna, the economic flows of money and capital, and the informational and regulatory flows connected to governance come together. The degree of localness and global-ness of these networks and flows differs per kind of FAD, but all demonstrate the need for approaching sustainability an

[2] 'Eco-FADs' are made of materials designed to minimise by-catch of sharks and turtles due to entanglement. This term has also been used to refer to the development of FADs made from biodegradable materials. Research has focused on maintaining fishing yields by using these FADs while reducing the effects of ghost fishing (Dagorn et al., 2013b; Davies et al., 2014).

alternative governance approaches to those homogenise social practices and ecological processes in the marine environment.

Sustainability governance of FADs can be interpreted as place-based or place-centred; but it has often little to do with localisation, local identities and sedentarism. Governing FADs goes beyond a localised understanding how they are employed, what effect they have on the marine environment, and how they reflect identity and environmental connectedness of fishermen with the marine ecosystem. Governing FADs is more about how supra-local and global networks and flows constitute and configure fishing practices around FADs, and in turn how these wider networks can be used to reconfigure how FADs are sustainably governed. As such, our study shows the relevance of place for sustainability governance, but also the need to detach place from its localised normative connotation and connectedness. Place can be local but can also be what Castells (1996), among others, has called 'placeless': places which are structured and defined, and hence need to be sustainably governed, beyond the localness of place. So-called 'placeless places' are decontextualised from their immediate geographic surrounds and universalised across wider geographies. In contrast to much of the sustainability governance literature, we emphasise that placeless places are not necessarily worse (nor better) than localised places in terms of sustainability. But they *are* analytically different; constituted by different networks and flows, and requiring different sustainability governance arrangements.

Our case of FAD-based tuna fisheries is of course a typical case, and conclusions on how to bring place more centrally into sustainability governance are not universally applicable. Nevertheless, there are other resources and environmental flows that behave like tuna; as deterritorialised flows in a placeless environment. For example, carbon emissions may be point-source, but the governance of sequestering carbon from the atmosphere is often regarded as placeless – despite the place based nature of the technologies that fix carbon. In other cases, localised place will continue to play a role, such as local organic food. Sustainability governance of food is then to a larger extent localised, related to local identities and sense of place, and sedentary, as production and consumption takes place within a geographically confined territory, and relations and flows are strongly place-based. In both cases, however, place is central to the design of sustainability governance; and in both cases it is crucial first to determine how place is constructed, and second to analyse and understand how sustainability decisions within these places are influenced by distinct global and/or local networked social relations and flows.

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