

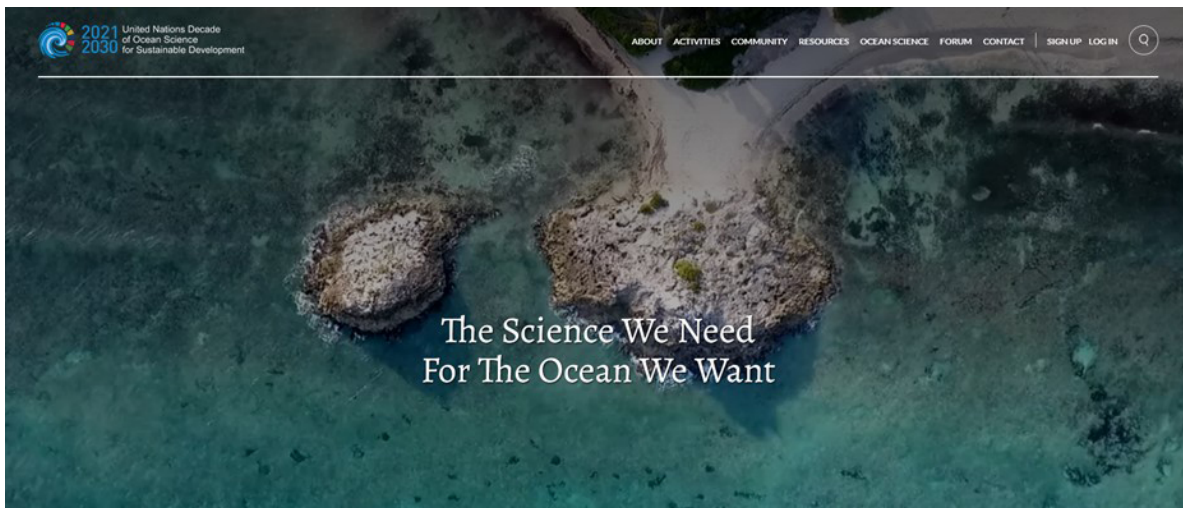
(How) Will New Data Technologies Support Oceans Governance?

Written by Elizabeth Havice, Lisa M. Campbell

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It is a celebratory moment for ‘new data technologies’ (see Terminology below) as marine and data scientists reveal previously unknown physical and ecological properties of oceans and human activity in and impacts on them. General issues of data deficiency and scientific uncertainty have long constrained oceans governance, and new data technologies employed above and below the oceans' surfaces promise to overcome knowledge gaps and help resolve management challenges. The classic lament ‘we cannot manage what we cannot see’ is taking on a more optimistic tone: ‘If you can see it, you can change it’. This sentiment is perhaps most succinctly captured with the United Nations (UN) Decade of Ocean Science for Sustainable Development tagline: ‘The Science We Need for the Ocean We Want’.





UN Decade website, accessed September 2021. Note the seemingly unpeopled 'blank slate' of the anonymous ocean/coast and an undifferentiated 'we' behind the ocean decade.

As the UN Decade gains momentum, what kinds of work will scholars and policy makers expect new data technologies to do in the world, in both their technological and political dimensions? While new data technologies appear... well, 'new'... they also have already been mobilized for oceans governance; such examples provide opportunity to reflect on the role of new data technologies and inform expectations for the Ocean Decade. To this end, here we draw on our work exploring how new data technologies have been developed and used in management efforts for two iconic marine species over the past two decades: Atlantic bluefin tuna and marine turtles (Havice et al., 2018; Havice et al. 2022; Campbell and Godfrey 2012). We offer brief background on the case studies and highlight three key findings broadly relevant to efforts to use and develop new data technologies for the work that lies ahead in the Ocean Decade.

Before we proceed, a brief note on terminology that we develop and deploy for our work in this area. We use the term new data technologies to encapsulate the platforms for, and methods of, data collection and generation; the data themselves; the analytical techniques; and supporting computer software and hardware required to 'make sense' of data, as well as to store it. In contrast to the term 'big data', new data technologies highlights that data are situated and made meaningful within a broader assemblage of infrastructure, techniques and relationships among them (see Havice et al., 2022). We are interested in exploring new data technologies in the particular contexts of oceans. Oceans, plural, contrasts to ocean, singular. The latter has recently been promoted (e.g. see #oneocean) to signify connectivity, common challenges, and the need for global ocean management. This 'generalizing' (see Liborion 2021) has the potential to obscure important difference, for example, amongst diverse coastal communities. We use 'oceans' in an effort to complicate 'one ocean' universalism, and to remind of heterogeneity.

The Cases: 'Seeing' Atlantic Bluefin Tuna and Marine Turtles

Both Atlantic bluefin tuna and marine turtles are long-lived and highly migratory, routinely crossing multiple political jurisdictions and the high seas. Humans assign high, but different, values to Atlantic bluefin tuna (commodity) and marine turtles (conservation). These differences matter for management: Atlantic bluefin tuna

management is focused on fisheries, while marine turtle management is predominantly focused on species protection. These differences are further reflected in international organizations. The International Commission for the Conservation of Atlantic Tunas (ICCAT, est. 1966) is the inter-state body that manages Atlantic bluefin tuna. Its mandate is to achieve maximum sustainable yield, based on the best available science. In contrast, The Marine Turtle Specialist Group (MTSG, also est. 1966) of the International Union for the Conservation of Nature (IUCN) is an 'expert' scientific body. Its main purpose is to assess marine turtle species status against the IUCN Red List of Threatened Species criteria. The MTSG lacks a state-based management mandate and function, but its information products are often used to inform a wide array of conservation efforts.

Like many long-lived and highly migratory oceanic species, Atlantic bluefin tuna and marine turtles are difficult to 'know' scientifically, and data deficiencies and resulting scientific uncertainty have posed challenges for ICCAT and MTSG. Beginning in the 2000s, scientists applied new data technologies to address some long-standing unknowns. For example, satellite tagging and tracking of individual animals revolutionized understanding of Atlantic bluefin tuna and marine turtle movements. Tracking data have since been combined with other newly available data (e.g., from genetic and stable isotope analyses), and advances in data analyses and modeling have resulted in what is undeniably a better understanding of Atlantic bluefin tuna and marine turtles - their populations and movements, habitat and prey preferences, and relationships at different life stages and between breeding and foraging grounds. But what kinds of effects has this enhanced understanding - made possible by new data technologies - had in management practices and politics?



Inserting satellite tags into Atlantic Bluefin tuna. Credit: Andre Boustany.



A tagged loggerhead turtle heads off to sea. Credit: Matthew Godfrey.

New Data Technologies, Old (Geo)Politics

New data technologies arise from and are mobilized within political debates about ocean access, use, and resource allocation. Debates influence where scientific activity is directed, for what purpose, and how new information is interpreted. This is a co-production argument and, although it seems obvious, we emphasize it because of the common geographic imaginary that oceans are frontiers, empty of people and politics and thus, ripe for scientific discovery that can shape new political intervention.

For instance, in the 1980s, ICCAT members acted on a growing understanding that there were two populations of Atlantic bluefin and established a line in the middle of the Atlantic Ocean - at 45 degrees longitude - to create two distinct management units (Figure 1). According to one of our interview informants involved in designating the line, “everyone knew it was a convenient fiction” that, in the absence of better scientific information on Atlantic bluefin tuna populations - particularly their migrations throughout the Atlantic Ocean, the Gulf of Mexico and the Mediterranean Sea - created a desired political outcome in the context of inter-state management.

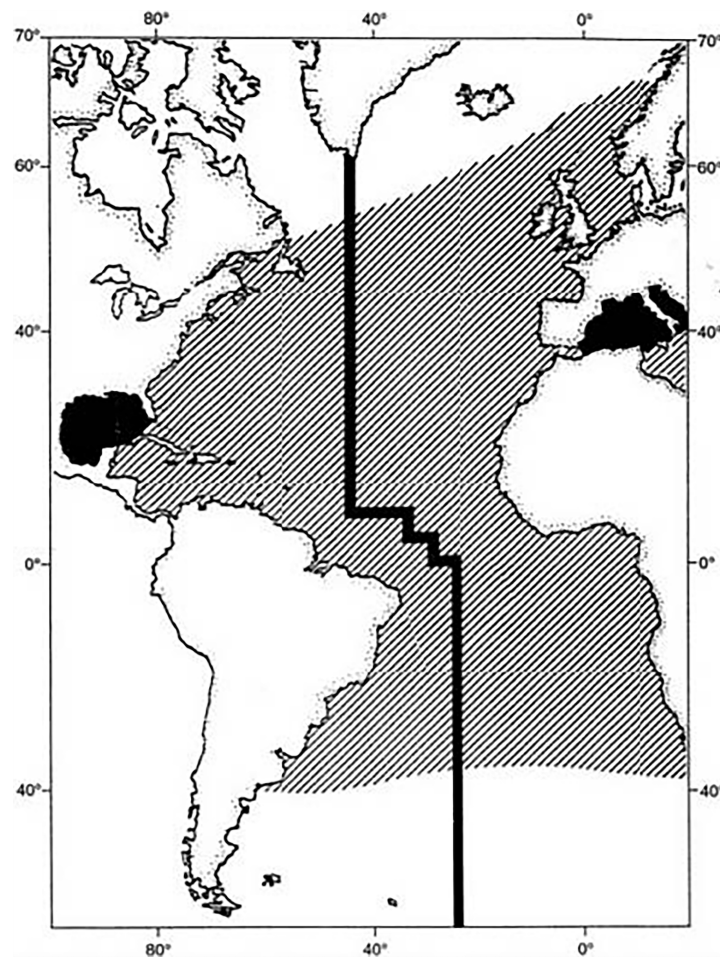


Figure 1: The ICCAT 45° line. Source: National Research Council, 1994.

To improve scientific understanding of Atlantic bluefin tuna populations, biologists mobilized new data technologies – specifically satellite tracking – and over time their work has revealed the scope and extent of Atlantic bluefin migrations across the 45 degree line. Atlantic bluefin tuna mobility can now be incorporated into the stock assessment process, at increasingly fine resolution. However, the scientific committee informing ICCAT still provides management advice around the 45 degree line. This is because political and economic interests have formed around this political artifact over decades. New data technologies must work within and engage this frame, and their technical and political possibilities are shaped by it.

The political legacies shaping how new data technologies are developed and mobilized also are evident in the marine turtle case. In the 2010s, the Marine Turtle Specialty Group took the bold step of pooling and modelling large, heterogeneous forms of data in order to spatially demarcate *global* sea turtle populations into Regional Management Units (RMUs). Regional Management Units were based on and advanced new understanding of populations and the risks and threats to them, however, the MTSG's motivation was as much political as scientific. The MTSG had experienced decades of infighting over the veracity, accuracy, and utility of conducting IUCN Red List assessment of marine turtles at the global scale, based only on assessment of selected 'index' nesting beaches (Campbell 2012). The MTSG's work to establish Regional Management Units was possible because of new data technologies, but emerged from a political need to resolve conflict and to reassure the IUCN that the MTSG remained a legitimate and credible scientific authority.

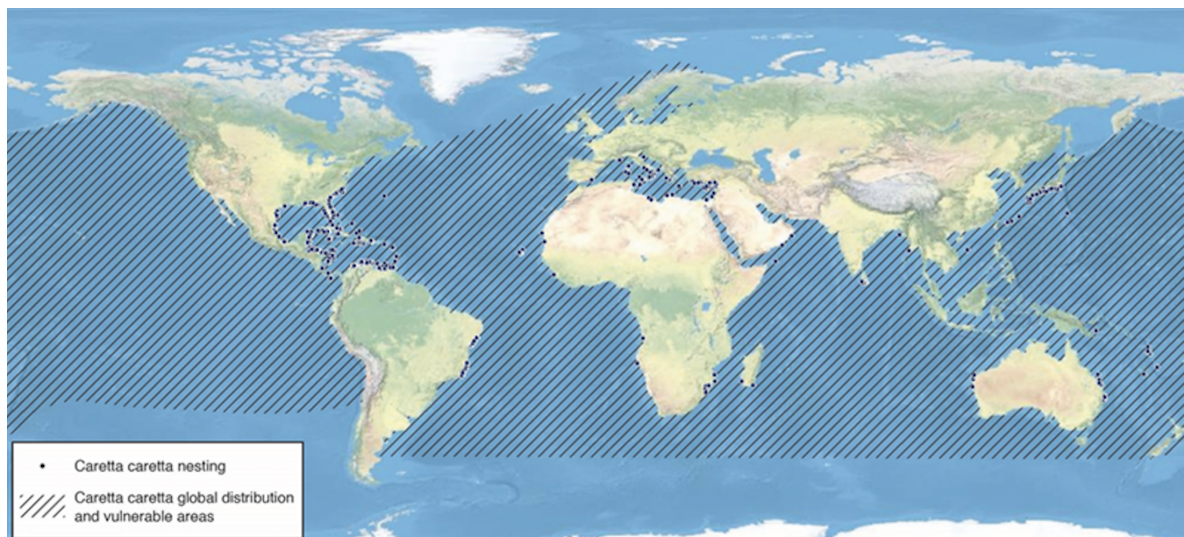
There is no 'blank canvas' on which new data technologies unfold. As they are mobilized to provide new understandings of oceans and resources, these will be employed in political contexts with existing boundaries, authorities, and long political relationships, even in the oceans that are often characterized by their governance 'gaps'.

Multiple, Rather than Circumscribed, Options for Policy and Governance

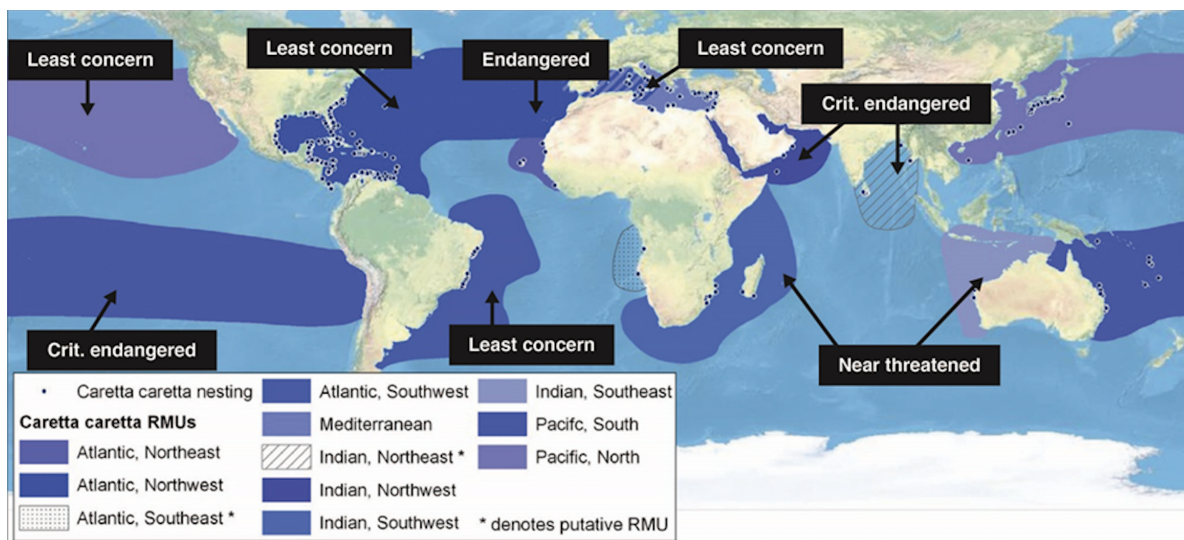
Part of the enthusiasm for new data technologies is that they might solve, simplify, or 'fix' management challenges. Indeed, part of what first drew us to this work was the ways that new data technologies might offer clear renderings of problems and

actionable solutions. However, we found that new data technologies can instead multiply management possibilities.

In the marine turtle case, Regional Management Units resolved concerns about the meaning of global Red Listings for each marine turtle species. For example, loggerhead turtles (*Caretta caretta*) went from one global listing (vulnerable), to 11 RMU listings, each with its own assessment of risks and threats (Figures 2A and 2B). Green turtles (*Chelonia mydas*) went from one global listing (endangered) to 18 RMU listings. Overall, the MTSG created 58 species-specific Regional Management Units and listings across the seven marine turtle species. The IUCN applauded this effort as transparent, powerful and innovative, saying, “Through the creation of [Regional Management Units], the global view of marine turtles just came into better focus” (IUCN, 2010).



Figures 2A and 2B: From one global RedList listing ('vulnerable') (above), to 11 regional RMU listings for loggerheads (below). Source: modified from Wallace et al., 2010.



But, once the fix was in place, new concerns emerged. In some Regional Management Units, a species was listed as less threatened than it was under its global listing: some scientists and advocates worried that this ‘downlisting’ would reduce policy attention and research funding in those areas, and potentially undermine decades of conservation efforts. Previous concerns about the vagueness of seven global listings of marine turtle species were replaced by concerns about the implications of using 58 Regional Management Unit listings. To ease tension, the MTSO argued that Regional Management Units and global listings should be used in tandem to reflect that any and all successes are the result of past conservation efforts. They urged that all species need to be considered ‘conservation dependent,’ a new category independent of either listing outcome. The solution offered by new data technologies – the Regional Management Units – did not, ultimately, replace its scientifically problematic predecessor, which remained politically useful in some cases.

Likewise, in the Atlantic bluefin case, with more and higher resolution data, Atlantic bluefin models have evolved: from assuming a single population; to two populations, one on each side of the Atlantic (Figure 1); to two populations that mix and that can be spatially and temporally designated into seven ‘boxes’ and according to stock of original, seasonality, and life stage (Figure 3). The new mixing model raises the possibility of moving away from East-West management around the 45° line to more precise management in time and space throughout the Atlantic. Yet, rather than offer a single path forward for management, the new Atlantic bluefin tuna model opens a wide range of technical (and political) possibilities.

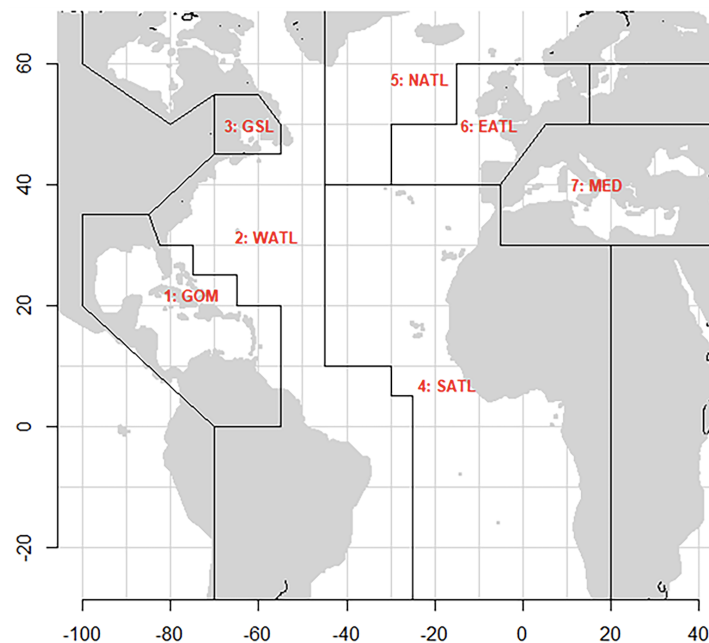
Scientific advancement enabled by new data technologies can yield new understandings. Yet, as “the real” comes into focus, possibilities for management can multiply and reconfigure, rather than resolve.

Uncertainty

This multiplication of management options is closely entangled with questions around uncertainty and complexity. As new data technologies “resolve” one area of uncertainty (e.g., where do Atlantic bluefin go?), they can destabilize and introduce uncertainty into others (e.g., population models). This is again contrary to a notion that new data technologies can reveal and simplify problems and solutions. In both cases, we found that complexity and uncertainty increased when new data technologies are put to work.

Let's return to the move to seven boxes in the Atlantic bluefin case. To incorporate data on movement, the Atlantic bluefin stock assessment model had to change dramatically. Changes include:

- Shift model resolution from two spatial zones to seven (Figure 3)
- Disaggregate tuna by stock of origin to estimate how many and which fish are 'Eastern' or 'Western'
- Disaggregate tuna into three age classes
- Refine temporal analysis from "annual" to 4 seasons throughout a year



Standing Committee on Research and Statistics model areas used as a basis for examining Atlantic bluefin tuna movement. Source: Operating model Summary, Draft June 2019.

The ICCAT scientific committee actively debates if using these data will lead to a “better” modeling outcome, or if data quality and increased complexity introduces too much uncertainty. If the uncertainty results in poor management advice, this could destabilize ICCAT. Some members suggest “scaling back” the modeling exercise by running a mixing model at a the old two-box scale, both because of these uncertainties and because it is not clear that ICCAT as an institution is politically willing or able to implement “a more complex spatial management arrangement

than what is currently in place” (SCRS email communication, March 3, 2020; Sissenwine and Piece 2017).

The marine turtle case also yielded concerns about what uncertainties new data technologies reveal. After years of working towards the Regional Management Units and creating accessible data portals to bring turtle conservation needs into clearer view, some Marine Turtle Specialty Group members raised concern over the risks that would come if the assessments are taken as “real” or complete. One MTSG member asked:

"What is the positive outcome for [a region] – or scientific truth in general – if a colleague or media outlet or policy maker assess the regional dataset and then makes conclusions about the status of sea turtles in the region based on this subset of information while believing (because the MTSG has explicitly said it to be so) that they are looking at “all of the information regarding a specific RMU”? Basically the user is just pulling marbles out of a bag *with no idea – and no way to know* – what percentage of the data they are accessing relative to an RMU. I think this is (really) dangerous for conservation." (Message sent to MTSG listserve, June 2017, emphasis and punctuation in original)

These examples illustrate that more complex data and modeling increase uncertainty. Some questions about uncertainty cannot be resolved by getting the models ‘right’ with data or improved data technologies. They are political and social

questions about how new data technologies work in the world and within existing debates.

Conclusions

New data technologies are squarely positioned in the current expansion of oceans governance. And new data technologies are revolutionizing how scientists, policy makers, advocacy groups and the public see and understand the oceans not as a frontier “out there” (see also, Havice and Zalik, 2018), but intimately intertwined with fragile futures of earth systems and our own fates on this planet.

Looking back at how new data technologies have been engaged for management challenges points to the ways that more data, and new data technologies, do not in and of themselves make problems and solutions clear. This is in part because “the oceans” and the “we” enrolled in the UN Decade are not singular, universal or generalizable. Both are historical, differentiated and always in-the-making. As the UN Decade of Ocean Science for Sustainable Development advances alongside a proliferation of ocean data science initiatives, the lessons from our cases position new data technologies as the grounds for debate - using William Rankin’s (2016) terminology, the new geo-epistemology - in oceans governance that will determine control over contested spaces and valuable resources. From a practical standpoint, this means that as investment in new data technologies to “fix” challenges in the oceans expands, there is an urgent need for simultaneous, and meaningful investment and reflection in how existing and new institutions will be able to engage and navigate the new data technologies and emergent governance relations that are sure to result.

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Elizabeth Havice is Professor of Geography at the University of North Carolina at Chapel Hill. She uses the lens of governance to explore distributional outcomes in

marine spaces, food systems, and global value chains. She and Lisa Campbell are cofounders of the Digital Oceans Governance Lab (<https://www.dogl.info/>) that explores intersections of data technologies and oceans governance.

Lisa M. Campbell is the Rachel Carson Professor of Marine Affairs and Policy in the Nicholas School of Environment at Duke University. She is broadly interested in how new technologies underwrite contemporary interest in oceans conservation and development.