Marine Policy 51 (2015) 394–400

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

# Bio-logging of marine migratory species in the law of the sea

James Kraska [a,b,*], Guillermo Ortuño Crespo [a], David W. Johnston [a]

[a] Division of Marine Science and Conservation, Nicholas School of the Environment Duke University Marine Laboratory, 135 Duke Marine Lab Road, Beaufort, NC 28516, USA

[b] Stockton Center for the Study of International Law, United States Naval War College, Newport, RI, USA

ARTICLE INFO

*Article history:*
Received 2 June 2014
Received in revised form
22 August 2014
Accepted 22 August 2014
Available online 23 October 2014

*Keywords:*
Bio-logging
Bio-tagging
Exclusive economic zone
Territorial sea
Law of the sea
UNCLOS

ABSTRACT

The use of advanced and emerging remote data-collection technologies, and in particular bio-logging of marine migratory species, raises fundamental questions about the scope of authority of coastal states to regulate marine scientific research in the waters under their jurisdiction. Bio-logging involves the attachment of devices to marine animals that collect and transmit data about their movements and aspects of the local marine environment, and is now routinely used by marine scientists to support conservation programs and augment oceanographic data collection. Tagged marine life, including seabirds, marine mammals, sea turtles and pelagic fishes, may interact unpredictably with the territorial seas and exclusive economic zones (EEZs) of numerous coastal states. This article explores the legal implications of bio-logging within the legal regime of marine scientific research in the law of the sea. Although bio-logging is a form of marine scientific research, when it is initiated outside a coastal state's jurisdiction it does not later fall within it, even if the tagged animals subsequently enters a coastal state's territorial sea or EEZ.

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## 1. Introduction

Breakthroughs in technology that facilitate efforts by scientists to monitor the movements of marine migratory species and collect and transmit environmental data gives rise to new questions in the law of the sea [1]. The law of the sea recognizes the special importance of highly migratory species as critical shared resources, although this list is no longer comprehensive. (Appendix A1). Rules for deployment of research vessels and the conduct of traditional MSR are set forth in the United Nations Convention on the Law of the Sea (UNCLOS).[1] Coastal states have the right to regulate and authorize MSR in offshore areas under their sovereignty and jurisdiction, including a 12-nautical mile (nm) territorial sea and 200-nm EEZ. Unlike traditional MSR, coastal states lack authority to regulate marine animal bio-logging and tracking of species that may be found inside their territorial sea and EEZ when the research is initiated by scientists outside of these areas. Even though tracking and collection of data through devices on marine animals that have transited or at least partially inhabit a coastal state's territorial sea and EEZ might appear to implicate the sovereignty and jurisdiction of the coastal state, it does not because the marine species are autonomous and entirely independent of any human programming or control.

Coastal states have authority over marine scientific research (MSR) that is conducted in their territorial sea and exclusive economic zone (EEZ). Traditionally, MSR was done from a ship operating in the EEZ, and the presence of the ship in water under the sovereignty or jurisdiction of the coastal state required the consent of the coastal State. Bio-logging, however, is a new form of MSR that is not similarly constrained. Bio-logging permits the collection and use of data transmitted or retrieved from devices affixed to marine animals [2]. When the devices are attached to marine migratory species on the high seas or in any other area outside of the jurisdiction of a particular coastal state, and the animals subsequently migrate into the territorial sea or exclusive economic zone (EEZ) of that state, it is not entitled to require permission or withhold consent for the MSR even though the data were collected in areas under its sovereignty or jurisdiction.

Coastal states enjoy sovereignty over the territorial sea, although their authority is not unlimited. Ships of all states, for example, may exercise the right of innocent passage, and entry into the territorial sea in case of *force majeure* is lawful as well. Likewise, coastal states have sovereign rights and jurisdiction over the living and non-living resources in the EEZ, as well as jurisdiction over some types of vessel-source pollution. Similarly, in the EEZ, although the coastal state enjoys exclusive sovereign rights

* Corresponding author at: Division of Marine Science and Conservation, Nicholas School of the Environment Duke University Marine Laboratory, 135 Duke Marine Lab Road, Beaufort, NC 28516, USA.

*E-mail address:* james.kraska@usnwc.edu (J. Kraska).

[1] *United Nations Convention on the Law of the Sea*, opened for signature 10 December 1982, 1833 UNTS 397, (entered into force 10 November 1994) (UNCLOS).

http://dx.doi.org/10.1016/j.marpol.2014.08.016
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"for the purpose of exploring and exploiting, conserving and managing" marine species, they do not claim exclusive ownership over migratory species, such as sea turtles, "at least not while they are swimming freely in their natural habitat – the oceans."[2] Furthermore, coastal states are presumed to authorize their consent for marine scientific research (MSR) in their EEZ, although they are entitled to withhold consent under some circumstances. Bio-logging and tracking of marine migratory species is a form of MSR, however, that bypasses the traditional method of marine science conducted from a dedicated research vessel, thereby complicating (or even erasing) the coastal state's exclusive authority to control it.

## 2. Bio-logging

Animal tagging and tracking with remote instruments – now often referred to as bio-logging – is one of the most efficient and accurate methods of assessing a species movement ecology, habitat-use and behavior [3]. Advances in very small, low power, microelectronics have generated a bevy of new monitoring devices that can be attached to marine animals in order to collect scientific data and transmit it remotely, often by satellite or other wireless technologies [3]. Data collected through these techniques generally includes information on the behavior and activities of tagged animals such as diving behavior, foraging movements and migration patterns [3]. In some cases these instruments can also provide data on the surrounding ocean, such as salinity, currents and temperature, providing details on the environment the animal is swimming through [2]. Several forms of bio-logging platforms are in use, and they can be separated out by their mode of data collection and recovery.

The simplest forms of bio-logging instruments emit a radio signal that is tracked via satellite [4] or VHF antenna [5] and animal locations are estimated via triangulation/Doppler-shift techniques [6]. Advanced forms of these platforms can relay dive information as well over radio frequencies. These devices are used on a variety of marine organisms; however, their use is restricted to animals that surface periodically or fly (e.g. marine turtles, seabirds, marine mammals and some large pelagic fishes) as radio signals are not propagated through the water. In contrast, many bio-logging platforms are archival, where data is collected (often including higher resolution location data derived from GPS systems) and stored onboard the devices and then downloaded/transmitted after the deployment finishes [6]. In some cases archival tags must be recovered (usually by tracking it with a co-located radio beacon as above) and the data downloaded manually. This can be accomplished if the platform is released from the animal at a certain time or, in the case of small animals, during a recapture period where the tag is removed during animal handling at a rookery or haulout [7]. In some cases, data can be collected over an extensive period of time and then transmitted when the tag is shed from the study animal [8], or it spends enough time onshore for data to be transmitted from the tag [9]. This is especially true for platforms developed for pelagic fishes that employ light-based geo-location techniques. These tags calculate positions of animals using ambient light levels and these data are transmitted to researchers via satellite relay when the tag is shed from the animal and floats to the surface [10]. In many cases real-time tracking is not possible with many archival bio-logging platforms.

### 2.1. Bio-logging in marine science and conservation

The use of telemetry and bio-logging devices on all the major taxa of marine top predators, including fishes, marine reptiles, seabirds, and marine mammals, promotes novel marine scientific research without the need for expensive and conventional research cruises. The surge in demand for marine science data and the cost and challenge to secure ship time at sea has made governments and scientists seek alternatives to traditional approaches. In many cases, bio-logging is an attractive method for collection of biological and physical data [2].

Bio-logging is now playing an important role in the conservation of many highly mobile marine species and the habitats they rely on. This includes, amongst other things, providing data on the interactions of marine species with fisheries [11,12], identification of foraging regions and relationships with static and dynamic ocean features at various scales [13–15], and providing data critical for calculating more precise abundance estimates [16,17]. The utility of bio-logging for marine resource management is now widely accepted by marine ecologists and oceanographers [2].

UNCLOS obligates states to conserve wide-ranging and valuable species.[3] The use of bio-logging has particular salience for the management and conservation of threatened migratory species [18]. The Convention on Migratory Species (CMS), for example, has classified species that are in peril of extinction,[4] and identifies those subject to special protective measures.[5] The ability to effectively manage such species; however, is hampered by the requirement to undergo lengthy, expensive and sometimes unsuccessful administrative and logistical processes to obtain permission to conduct MSR in coastal state EEZs. Long-range migratory species may not only enter several countries EEZs individually and as a species, but do so in an unpredictable manner. The new modality of bio-logging improves our understanding of the life histories of migratory species and contributes to international management and conservation of them.

#### 2.1.1. Jurisdictional complexity of bio-logging

A rapid survey of geospatial data in the OBIS SEAMAP[6] archive demonstrates the large number of EEZs that are crossed, entered, and transited by specific marine highly migratory species (Table 1). For example leatherback turtles, one of the most widely ranging marine turtle species, have been recorded in 67 coastal state EEZs. Humpback whales, a mammalian species that makes extensive yearly migrations from feeding to breeding grounds have been recorded in 57 coastal state EEZs. Atlantic Bluefin tuna are found in at least 17 different EEZs. Perhaps most importantly, the movements of these widely ranging marine species are defined by the unpredictable nature of individual behaviors and dynamic migration routes. These complexities are illustrated below using examples of telemetry data from across the major taxa studied through bio-logging techniques in marine systems.

The distribution and migration routes of many marine species are dynamic and unpredictable, varying among individuals and species and from season to season. For example, data from two loggerhead sea turtles tagged at the same location at Reunion Island (Fig. 1) illustrate completely different movement paths, with one animal moving North to Yemen and Oman, while the other animal moved south to visit the South African EEZ for some time – despite being part of the same population and tagged in the same year.[19]

[2] UNCLOS, art. 56 and *WTO Appellate Body Report on U.S. – Import Prohibition of Certain Shrimp and Shrimp Products*, WT/DS58/AB/R (October 12, 1998), para 133.

[3] UNCLOS, art. 239.

[4] *Convention on the Conservation of Migratory Species of Wild Animals* opened for signature 23 June 1979, 1651 UNTS 356, (entered into force 1 November 1983), Appendix A1.

[5] CMS, Appendix II.

[6] Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations http://seamap.env.duke.edu/http://seamap.env.duke.edu/.

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