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Marine Animals and Human Care Toward Effective Conservation of the Marine Environment

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Definitions

A **public aquarium** (plural: public aquaria or public aquariums) is the aquatic counterpart of a zoo, which houses living aquatic animal and plant specimens for public viewing. Most public aquaria feature tanks larger than those kept by home aquarists, as well as smaller tanks. Since the first public aquaria were built in the mid-nineteenth century, they have become popular, and their numbers have increased. Most modern accredited aquaria stress conservation issues and educating the public (AZA 2007).

Animals that are held by humans and prevented from escaping are said to be in *captivity*. The term is usually applied to wild animals that are held in *confinement* but may also be used generally to describe the keeping of domesticated animals such as livestock or pets. This may include, for example, animals in farms, private homes, zoos, and laboratories. Animal captivity may be categorized according to the particular motives, objectives, and conditions of the confinement. When applied to *public aquaria* or ***zoos***, this term has recently been changed to ***human care***, since "captivity" had a rather negative charge to it.

Animal husbandry is the branch of agriculture concerned with animals that are raised for meat, fiber, milk, eggs, or other products. It includes day-to-day care, selective breeding, and the raising of livestock.

The *collection* of marine animals is the act of removing them from nature and placing them under human care. There are multiple methods for doing so safely, the majority of which described by Correia and Rodrigues (2017).

Introduction

Zoological parks (i.e., zoos and public aquaria) emerged at the end of the nineteenth century as "windows" into the natural world, at a time when the general public had no means to access, or visit, such wonders. One century later, these institutions face growing controversy, and an increasing choir of voices that beckon for their immediate termination and release of all captive animals back to the wild. While some institutions have indeed failed in complying with modern legislation (e.g., the European Union's "Zoos Directive," regulated by Council Directive 1999/22/EC of 29 March 1999), the vast majority have adopted this directive and, in fact, surpassed its scope.

W. Leal Filho et al. (eds.), *Life Below Water*, Encyclopedia of the UN Sustainable Development Goals,
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Marine Animals and Human Care Toward Effective Conservation of the Marine Environment, Fig. 1 Oceanário de Lisboa. Photo by Michał Maćkowiak

Quoted directly from the European Commission, "The Zoos Directive seeks to promote the protection and conservation of wild animal species by strengthening the role of zoos in the conservation of biodiversity. In practice, the greatest efforts for the conservation and sustainable use of biodiversity need to focus on measures in the wild. This is the primary focus of the EU's policy: through the Birds and Habitats Directives, the EU Biodiversity Strategy, the Regulation on Invasive Alien Species and EC wildlife trade regulations implementing CITES, all of which contribute to achieving objectives of the Convention on Biological Diversity & other international agreements."

However, protecting wild animal species outside their natural habitat is also important for biodiversity conservation. In this context, the EU adopted Council Directive 1999/22/EC of 29 March 1999 on the keeping of wild animals in zoos. The Zoos Directive aims to strengthen the role of zoos in the conservation of biodiversity. It calls on Member States to adopt measures for the licensing and inspection of zoos in order to ensure that zoos respect certain conservation and protection measures, including appropriate accommodation of the animals.

Member States are responsible for applying the provisions of the Zoos Directive and ensuring their necessary enforcement. There is a very limited EU role in implementation as the Directive does not foresee the need for a committee or reporting obligations to the Commission. However, a lot of good practice approaches have been developed to help zoos increase their contribution to biodiversity conservation.

It is this chapter's objective to demonstrate how these goals are being met – and surpassed – by a vast number of public aquaria, most likely the majority.

For more information visit https://ec.europa.eu/environment/nature/legislation/zoos/index_en.htm.

Those who do not secure a job in the zoological parks world – which includes zoos, aquaria, shelters, rehabilitation centers, etc. – are often surprised by two main traits that are personified by all individuals that work in this field. The first is an unwavering respect – indeed passion – for animal life and the well-being of all organisms, both captive and wild. The second is the lengths to which these professionals will go to ensure the quality of the lives of those animals under their care, which includes complete and utter sharing of information among all who work in this field. This openness is unparalleled in any other industry, with companies typically striving to get ahead of others while protecting their secrets. Nothing could be farthest from this philosophy when it comes to the human care of wild animals, with platforms such as ZIMS (Zoological Information Management System – www.species360.org) linking (electronically) hundreds – indeed thousands – of zoological institutions around the globe, who freely share husbandry information regarding the animals under their care with each other. Such information ranges from dietary needs to pathology, medications, and surgical events, in a rare display of selfless distribution of information, the likes of which are not easily found in other areas. As an example, Conde et al. (2019) recently reported on the need for demographic data – namely, birth and death rates – to be incorporated in effective conservation policies for wild animal populations throughout the world. Regrettably this data is quite often inexistent, but zoos and aquaria – mostly through the aforementioned ZIMS link among institutions – provide such information on an increasing scale.

The Elasmobranch Husbandry Manuals I and II (Smith et al. 2004b, 2017) are another prime example of an impressive compilation of information, specifically on sharks and rays, covering every conceivable aspect of elasmobranch husbandry techniques. These books are distributed freely throughout the Internet by their editors and also the authors of nearly 100 chapters, who generously donated their time and expertise to favor better husbandry practices worldwide. "Animal Professional" (www.animalprofessional.com) also offers electronic access to every oral presentation done in specialty conferences themed on captive care held around the world. While access is not free, the content of these thousands of talks, given by professionals in this field, offer valuable insight into state-of-the-art husbandry practices, including the trials and errors that come with pushing boundaries on a new subject.

Multiple professionals involved in this field have written memoirs in which the constant struggle for the improvement of the well-being of the animals under their care is blatantly patent, such as Clark (1969), Powell (2001), and Correia (2015, 2016, 2017, 2019), among others. Likewise, the transport of marine animals from their collecting grounds to their end destination, and also between institutions that strike breeding loans among each other, is subject to a myriad of technical and operational difficulties, with those involved in this field freely sharing their expertise with their peers. Some examples include Smith (1992), Correia (2001), Young et al. (2002), Smith et al. (2004a), Correia et al. (2008, 2011), Rodrigues et al. (2013), and Correia and Rodrigues (2017).

Modern zoological parks have put a healthy distance between themselves and "old" zoos and aquaria that offered little more than (literally) a window into exotic species. At the dawn of the twenty-first century, these institutions are at the forefront of conservation and educational efforts throughout the world, and this chapter will provide multiple examples of these efforts while debating their significance in the struggle to preserve natural habitats.

It is therefore the objective of this chapter to demonstrate how public aquaria all over the world may assist the UN's Sustainable Development Goal (SDG) 14, specifically in bringing it to the attention of the public's eye while, simultaneously, funding activities in each of these areas.

UN's Sustainable Development Goal

The UN's Sustainable Development Goal (SDG) 14 consists of Conserve and sustainably use the oceans, seas and marine resources for sustainable

development (SDG14). These are broken down into ten separate areas of action, listed below:

14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.
14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans.
14.3 Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels.
14.4 By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics.
14.5 By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information.
14.6 By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation.(1)
14.7 By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism.
14.a Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries.
14.b Provide access for small-scale artisanal fishers to marine resources and markets.
14.c Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in the United Nations Convention on the Law of the Sea, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of "The future we want."

Conservation "Powered by" Zoos and Aquaria

As stated by Penning et al. (2009), "There are well in excess of 300 substantial public aquariums in the world and more than 100 have been opened since 1990. Collectively, including those operated within zoos, they may attract as many as 450 million visitors each year, and therefore have a very large educational and economic impact. This rapidly growing 'Aquarium Industry' (ranging from commercial businesses through to municipal institutions, research establishments and charitable trusts) is often associated with economic regeneration projects to revive socially impoverished, run down docklands and industrial areas." These authors compiled a lengthy 90 pages report that comprehensively lists multiple conservation efforts conducted by zoos and aquaria throughout the world and the impact that a strong education message may have in over an estimated 650 million annual visitors worldwide. One decade after publication, these numbers are expected to be substantially larger, particularly with the tremendous increase of new public aquaria in Asia, specifically in China.

Only 1 year after, Gusset and Dick (2010) compiled valuable information from 113 in situ conservation projects funded by zoos and aquaria. According to these authors, "Our results show that

thanks to the investment made by zoos and aquariums, particularly financial, these projects reached overall impact scores of a magnitude suggestive of an appreciable contribution to global biodiversity conservation. The present first global appraisal of the contribution of the world zoo and aquarium community to in situ conservation from a supported project's perspective thus suggests that zoos and aquariums are on track for 'Building a Future for Wildlife'." The projects examined by these authors were categorized under "Education," "Training," "Habitat protection," and "Research." Covering a wide range of taxa, such as mammals, birds, reptiles, amphibians, invertebrates, and non-taxon specific, the financial expenditure of projects was typically in the range of US$10,000–100,000 year (41%), with the duration of projects often being longer than 10 years (46%).

A quick search through the "Conservation" and "R&D" areas of websites from the largest and most prominent public aquaria worldwide will reveal a multitude of in situ (and ex situ) conservation efforts throughout the globe, with literally *millions* of dollars – and euros – involved. Below is a brief list of such examples.

The Monterey Bay Aquarium's (MBA) page "Conservation & Science" features research projects on the population biology of great white sharks, bluefin tuna, and sea otters. This aquarium operates with its *sister* research institution, the Monterey Bay Aquarium Research Institute (MBARI), and their joint efforts have allowed, among many other aspects, to identify what has become known as the "White Shark Café," an area in central California where large amounts of great white sharks congregate (Chapple et al. 2011; Jorgensen et al. 2012). This institution also started the "Seafood Watch" card initiative, which has been replicated throughout multiple public aquaria worldwide. This card is offered freely not just to aquarium visitors but also to patrons eating at nearby restaurants, and helps consumers and businesses choose seafood that has been fished or farmed in ways that support a healthy ocean, now and for future generations. The card's recommendations indicate which seafood items are best choices or good alternatives and which ones should be avoided.

The Oceanário de Lisboa, Portugal's largest public aquarium and voted "Best Aquarium in the World" by TripAdvisor users in 2015, 2017, and 2018, features an impressive list of projects that the institution is currently funding – or funded in the past – under its "Conservation" webpage:

"Rebreath" monitors the effect of climate change in juvenile fish and invertebrate communities in intertidal areas.

The "Angelshark Project" monitors *Squatina squatina* populations (a critically endangered species) in the Canary Islands.

"Manta Catalog Azores" monitors mobulid occurrences in the Azores islands and the importance of preserving their habitat.

"Fly with Bull Rays" has similar objectives with *Pteromylaeus bovinus*, also a critically endangered species, along Macaronesia, West Africa, and East Africa up to Mozambique.

"Octoparque" monitors *Octopus vulgaris* in the Luiz Saldanha Marine Protected Area, a local marine reserve which was in fact founded – and originally monitored – thanks to the joint efforts of the Oceanário and the Gulbenkian Foundation (see "Margov" in this list).

"Fish and Aquatic Invertebrate Taxon Advisory Group" comprises multiple groups that operate under the European Union of Aquarium Curators (EUAC; www.euac.org) and the European Association of Zoos and Aquaria (EAZA; www.eaza.net). These groups monitor captive populations from a diverse array of marine creatures, ensuring they are genetically viable within and between institutions, while promoting captive breeding and minimizing collections from the wild.

"Sea Turtles in São Tomé and Príncipe" actively promotes the conservation of these animals in this West African archipelago, with an emphasis on educating local populations and shifting their hunting activities to ecotourism and other non-detrimental practices.

"Project Piaba" focuses on studying and protecting ornamental fish species in the Amazon

and Black Rivers, also with the involvement of local native populations.

"Shark Tag" focuses on monitoring *Sphyrna zygaena* populations and migrations throughout the Atlantic Ocean, through telemetry and tagging.

"Behavior, Predator-Prey Interactions, and Interaction with Fisheries of *Mola mola*" focuses on tagging and tracking oceanic sunfishes while attempting to study their feeding, migrations, and how does climate change affect its migration patterns, among a myriad of other objectives about this intriguing species.

"Adopt a Marine Prairie" focused on monitoring marine prairies in the south of Portugal, since these are tremendously endangered habitats due to urban development and fishing, among other factors; this project was the first of its kind in Portugal and in fact turned the tide on the constant scenario of degradation that was seen before, with multiple recent examples of recovery.

"Distribution of river lamprey" focused on studying this extremely endangered species in Portuguese rivers.

"Protection and Integrated Management of Sea Turtles in Cabo Verde and Program Sada in the Island of Príncipe" encouraged local populations to protect sea turtles, rather than hunting them, thus profiting from ecotourism ventures while sparing the lives of countless individuals from these critically endangered species.

"Margov" was a co-management project that brought multiple stakeholders together with the objective of effectively managing the newly created Luiz Saldanha Marine Reserve.

"Clean Eel" focused on studying severely declining European eel populations.

While the list above features an impressive number of projects that have been supported by the Oceanário de Lisboa along its two decades of existence, the list pales in comparison with that of the Zoological Society of London (www.zsl.org), with its most prominent example undoubtedly being the acclaimed "Seahorse Project," a brilliant partnership with Guylian chocolates that brought the plight that seahorses face to the public's eye. The ZSL was created in 1826 with the objective of creating a zoo in London, with the intent of "interest and amuse" the public (Scherren 1905). Needless to say that, one century later, modern zoos and aquaria have placed a healthy distance between the objectives they boast now, and those from older times, and the ZSL, in particular, has been the main driving force for countless in situ and ex situ research and conservation programs.

While attempting to list those zoological institutions that are actively engaged in conservation and education of the public, the New England Aquarium offers a rather unique tale of political lobbying, since it successfully managed to divert a shipping lane – in the Bay of Fundy – to protect southern right whales (Vanderlaan et al. 2008). This is but one example of a multitude of other research efforts conducted by this institution and its scientific counterpart, the Anderson Cabot Center for Ocean Life.

The more than 50 Sea Life Centres around the world (www.visitsealife.com), particularly in the UK, have long held a mutually beneficial partnership with Shark Trust (www.sharktrust.org) a charitable organization founded in the UK in 1997, which is dedicated to promoting the study, management, and conservation of sharks, skates, and rays in the UK and internationally. Some of the more recent campaigns promoted by Shark Trust include "The Great Egg Case Hunt," where children and adults alike are encouraged to comb beaches for shark and ray egg cases and then log them into an app. This is a perfect example of "popular science" that is both financed and disseminated by public aquaria worldwide, particularly those belonging to the Sea Life Centre chain. These institutions' mother company, Merlin Entertainments (www.merlinentertainments.biz), also recently funded a study that involved the Portuguese University of Aveiro, which focused on developing a relatively quick and non-intrusive method for detecting cyanide traces in ornamental fish imported from worldwide distributors. While it has been commonly believed that cyanide fishing for ornamental fish – which supplies both the aquarium and hobbyist trades – was a *thing of the*

past, this study demonstrated that, regrettably, the presence of cyanide in fish imported into the European Union is a more common occurrence than earlier anticipated (Vaz et al. 2012).

The Ozeaneum (www.ozeaneum.de) and ZooAquarium Madrid (www.zoomadrid.com) are both actively engaged in an in situ coral propagation project that's occurring in the Maldives, with massive funding by the European Union of Aquarium Curators and other aquarium-related institutions. The purpose of this project, and others similar to it, also funded by the public aquarium industry, is to actively promote propagation of corals in the wild, therefore minimizing collection of specimens from nature for both aquarium collections and the hobbyist trade, while assisting in the recovery of coral reefs throughout the world, which have been suffering greatly with climate change, something that has been reported in scientific literature as far back as 1999 (Hoegh-Guldberg 1999; Hoegh-Guldberg et al. 2007).

The list of other zoological institutions that offer on their webpages a diverse range of conservation programs currently being supported includes, but is certainly not limited to:

Nausicaá in Boulogne-sur-Mer, France, www.nausicaa.fr

The Monaco Blue Initiative, promoted by the Museé Océanographique de Monaco, www.oceano.mc

L'Oceanogràfic in Valencia, Spain, www.oceanografic.org

Chester Zoo in Chester, United Kingdom, and its very relevant in situ work done in defense of orangutans in Borneo.

Vancouver Aquarium, Canada, www.vanaqua.org

Aquarium of the Pacific in Long Beach, USA, www.aquariumofpacific.org

The Florida Aquarium in Tampa, USA, www.flaquarium.org

Georgia Aquarium in Atlanta, USA, www.georgiaaquarium.org

Shedd Aquarium in Chicago, USA, www.sheddaquarium.org

Tennessee Aquarium in Chattanooga, USA, www.tnaqua.org

Dubai Aquarium and Underwater Zoo, UAE, www.thedubaiaquarium.org

Aquamarine Fukushima in Iwaki, Japan, www.aquamarine.or.jp

Okinawa Churaumi Aquarium in Motobu, Japan, http://churaumi.okinawa

Osaka Aquarium Kaiyukan in Osaka, Japan, www.kaiukan.com

Ocean Park in Hong Kong, China, www.oceanpark.com.hk

Planet Neptun in St. Petersburg, Russia, www.saint-petersburg.com/museums/oceanarium/

Two Oceans Aquarium in Cape Town, South Africa, www.aquarium.co.za

AquaRio in Rio de Janeiro, Brazil, www.aquariomarinhodorio.com.br

Among the millions of dollars and euros spent by the institutions listed above (and many others not listed here), professional organizations that regulate the activities of zoological parks around the globe attribute, themselves, sizeable funding to conservation and education initiatives, such as:

The European Union of Aquarium Curators (www.euac.org), which funds conservation and education projects around the globe.

The European Association of Zoos and Aquaria (www.eaza.net), which has now donated millions of euros to conservation programs covering bushmeat, rainforest, tigers, shellshock, rhinos, Madagascar, amphibians, carnivores, apes, and Southeast Asia, to name a few.

Its American counterpart, the Association of Zoos and Aquariums (www.aza.org), has also donated millions of dollars to conservation efforts covering groups as diverse as amphibians, apes, Asian horses, citizen science, climate change and wildlife, elephants, marine mammals, oceans, pollinators, and tigers.

Likewise, the World Association of Zoos and Aquariums (www.waza.org) offers freely publications – translated to ten languages – highlighting conservation efforts that are underway throughout the world, financed by zoos and aquaria alike.

Zoos, aquaria, and professional organizations don't hold a monopoly on funding conservation efforts, because multiple private organizations affiliated with the public aquaria industry do so as well, such as:

CLEAR REEF (www.clear-reef.com), a private company that builds public aquaria, awards funding to individuals and organizations with projects that focus on conservation. The Fund is totally philanthropic and exclusively financed by CLEAR REEF's income. No additional contribution is requested from other partners. The Fund is also meant to be at the crossroads of individuals' social/self-development needs, marine research, and conservation issues. It is intended to promote local initiatives being brought forward by regular citizens (students, researchers, unemployed, retirees, or any person of good will) seeking a financial help to run a project directly or indirectly related to marine research and/or conservation. It is also intended to improve the personal situation of an individual and promote marine research/conservation at the same time.

Flying Sharks (www.flyingsharks.eu), a collections and consulting company, has also been awarding small research grants mostly to students and researchers throughout the globe. The Flying Sharks Research Fund began in 2008 and quickly developed to include, promote, and finance the "Portuguese Week of Shark Protection," which consists of 1 week packed with lectures about sharks in schools, universities, and public aquaria all over the Portuguese mainland. These weeks dedicated to shark protection also include an annual shark tag and release tournament, with tags generously donated by the American National Marine Fisheries Service. Thus far, the Portuguese Association for the Study and Conservation of Sharks (www.apece.pt), which has received financial support from both the Oceanário de Lisboa and Flying Sharks since its inception in 1997, has tagged and released more than 500 blue and mako sharks while promoting this practice among Portuguese sports-fishing companies. In 2015, in conjunction with a Portuguese governmental agency, this company published Portugal's first underwater bilingual photo identification book, *Marine Fishes of Portugal* (Rodrigues 2015). In 2018, with the support of the aforementioned European Union of Aquarium Curators, Flying Sharks sponsored the traveling required for the production of the first book on fish identification in the West African archipelago of São Tomé and Príncipe, as well as a poster highlighting species that are locally exploited by commercial fishermen (Rodrigues et al. 2018).

Dynasty Marine (www.dynastymarine.net) and Cairns Marine (www.cairnsmarine.com) both share similar focus to Flying Sharks' while promoting captive breeding and sustainable collections from the wild. These two collection companies, based in the USA and Australia, respectively, additionally fund small research projects as well.

Impact of Collections

Adams et al. (1999), Ziemann (2001), and multiple other authors report on the impact of collections driven by the aquarium and food industries on some fish populations. The latter author, however, further mentions how both public aquaria and hatcheries are successfully breeding an increasing number of fish species, which not only significantly reduces pressure from wild populations but may also contribute to their recovery through controlled – and approved – releases of captive bred animals. Tlusty et al. (2012, 2014) also address this issue and provide insight into the impact such collections have in the environment, but it's important to note these authors are themselves part of the aquarium community, while being actively involved in initiatives that focus on minimizing the impact of collections in the wild environment, mostly through captive breeding and ensuring fisheries are conducted in a sustainable fashion. Earlier than these authors, Calado (2006) offered a wide range of possible management strategies for this trade, to ensure sustainable and "eco-friendly" collection

practices. Rhyne et al. (2014), all public aquarium professionals, suggested the creation of a Coral Reef Socio-Ecological System (CRSES), which would encourage sustainable collection practices, with benefits for local native communities and also the trade itself.

"Old-School" Public Aquaria

While North American and European public aquaria, with a few notable exceptions in other continents – listed above – boast a predominantly conservation-oriented mission, with matching funding, that is not the case in other areas of the planet, particularly in Asia's rising economies, including China, Vietnam, and Russia. Again, with a few exceptions, these countries mostly exhibit a more *outdated* approach, overly focused on the display of live "colorful," "large," and "exotic" animals, with factors such as well-being, conservation, and education relegated to second place. But one shouldn't succumb to the temptation of "pointing our fingers" in accusation to these institutions because, after all, they are merely following the steps the "western world" dictated for one century, until multiple organizations drove public opinion to demand an eco-friendl*ier* approach. It is therefore "our" job, as "westerners" who have walked the same path for far longer than we should have, to ensure that our "rising" neighbors adopt the same practices we now consider to be acceptable, preferably in a much shorter time interval than the one "we" took to change our formerly ignominious behavior.

Shifts in Perception "Powered by" Public Aquaria

In recent years, particularly since the dawn of the new millennium, two groups have seen a major shift in the public's perception, unlike any other before. Those groups are sharks and cetaceans.

Sharks

Vilified by the popular press since Peter Benchley's *Jaws* (1974) was released, sharks have been the object of pet hatred from most members of the public, with publications titled *The Jaws of Death* (Maniguet 1996) echoing that sentiment. Movies such as the "Sharknado" saga, which began in 2013 and is now on its sixth edition, do little to deviate the public's eye from such a gory perspective. However, the role public aquaria have played in elucidating the public about the true nature of sharks, including televised efforts from the Discovery Channel – and others – such as its acclaimed annual "Shark Week," has played a definitive role in significantly improving sharks' "image" near the public. Social media is also behind what almost feels like a concerted "PR" campaign focused on the betterment of sharks' image. Consider the effect a video on a shark culling has on social media users these days, which are welcomed with outrage and contempt by the general public, who demand authorities to immediately cease all culling activities, even when these were triggered by an incident involving sharks, usually with detrimental results for humans. Conversely, social media is populated with bold initiatives of concerned citizens who bravely do their best to return beached large sharks to the ocean, putting their own lives at risk. It seems therefore that sharks' image has improved considerably in recent years, and mainstream media is most certainly *not* the cause for it, since well over half of all shark-related stories are focused on their perilous nature and only 11% on conservation aspects (Muter et al. 2012), such as the plight they face due to overfishing and finning. This full shift in perception has been echoed in government policy, namely, in Australia, where a culling is no longer the immediate and standardized form of response to an incident involving sharks and humans (Gibbs and Warren 2015). As mentioned, while mainstream media is most certainly not behind this shift in perception, public aquaria are undoubtedly driving this new way of looking at sharks.

One notable exception, however, merits some distinction, and that is the role the National Geographic Society (NGS) has played in shaping readers' – and more recently viewers' – minds for over 120 years. As far back as 1932, Ellison reported on the Australian shark fishing industry but focused on the role these animals play in oceanic food webs and how perilous it could be

to overfish them to the point of disrupting those same food webs. Over the years, the NGS regularly published stories that depicted sharks in a positive and ecologically sound fashion, unlike their counterparts in mainstream not-science-based media. In fact, La Gorce (1952) wrote about Marineland, then known as "Florida's giant fish bowl," where sharks were brought to the public's eye for the first time. But few articles have (positively) influenced the public's perception as gloriously as Eugenie Clark's (1981) "Sharks: Magnificent and Misunderstood." This is the "same" Eugenie Clark who had published her iconic memoir *The Lady and the Sharks* in 1969, where she narrated the beginnings of her work with sharks in a rudimentary research facility (Cape Haze Marine Laboratory) which would later become the world-famous Mote Marine Laboratory. This prestigious institution has played a key role in clarifying the (wrong) notion that "sharks don't get cancer," published by Lane and Comac (1992), and indeed focusing its research on the physiological mechanisms that sharks use to eliminate tumors from their organisms more efficiently than other vertebrates while attempting to medically administer that ability to humans (Ostrander et al. 2004; Walsh et al. 2006). After keeping sharks in captivity for research purposes for decades, the Mote Marine Laboratory opened its own aquarium in 2017 and now offers deeper insight to its visitors about the marvels of shark physiology while alerting the public for the dangers of pseudo-science, which is what (mistakenly) drove thousands to purchase shark cartilage pills, believing they would "cure" cancer. This had dire consequences to shark populations worldwide and did little, or nothing, to "cure" anyone who ingested them.

Interestingly, over recent years, the notion that "live sharks" are financially worth significantly more than dead ones has been finding increasing evidence, and lest we not ignore the role that public aquaria have played in pushing that shift in perception (Anderson and Waheed 2001; Topelko and Dearden 2005; Clua et al. 2011).

Cetaceans

Unlike sharks, cetaceans – namely, whales and dolphins – have always enjoyed enormous popularity within the public that visits public aquaria. Interestingly, even orcas, often referred to as "killer whales" and known for the aggressiveness with which they hunt – and kill – newborn baby seals, have always welcomed nothing but warm and radiant affection from the general public. The release of the 1993 movie "Free Willy," however, impacted negatively – and quite strongly – against the maintenance of whales and dolphins in captivity. This animosity grew stronger over the following two decades, fuelled by other dramatic documentaries, such as "The Cove" (2009) and "Blackfish" (2013), which depict the "less colorful" – and often cruel – side of keeping cetaceans under human care. While the release of "Free Willy" led to an outcry from the public, demanding Keiko – the "actor" orca – to be released, the latter two, especially "Blackfish," rippled beyond all expectations, driving Anheuser-Busch, the owner company of SeaWorld parks, to immediately cease their in-park orca breeding program and eventually phase out their theatrical orca whale shows altogether (due to state legislation in California that banned shows using orcas) starting in San Diego (ABC News 2016). It was announced, later in the same year, that SeaWorld would build their first park without killer whales and outside of the USA, in Abu Dhabi, UAE.

Wearing et al. (2011) present an interesting analysis on the "Free Willy" effect, which has driven the whale (and dolphin) watching industries to grow exponentially, with the public avid for an opportunity to witness these majestic animals in the wild, not in captivity. Likewise, Brammer (2015) categorizes the "Blackfish" effect as a rather adverse reaction from a more enlightened public, which prefers to see large animals in the wild, rather than in captivity, and much less in "shows" where they are forced to perform acrobatics.

Conclusions

While addressing a large crowd mostly comprised of aquarium curators at the EUAC's scientific annual meeting, Smith (2017) coined the role played by modern public aquaria as "The Altruistic Genie," meaning that zoological institutions may have fulfilled their mission "too well," driving the public to appreciate wildlife to such an extent that observing it in captivity may no longer be tolerated within a relatively short time interval. It falls therefore on public aquaria to demonstrate the *value* in displaying live animal collections, which will help drive hundreds of millions through admission gates, after which they may be "indoctrinated" with powerful conservation messages. In this author's words, "To remain effective and relevant aquaria must: (l) Set an example of sustainability; (2) Continue to optimize industry best practice; (3) lncrease pure and applied research activities; (4) lncrease conservation activities, especially *in situ*; (5) Advance well-researched and practical advocacy; and (6) Augment up, to date and effective education. Aquaria must actively advance each of these domains, more coherently police the industry's best practice, better connect their visitors to the wild spaces they represent and work together to more effectively communicate their value to the environment and society" (op. cit.).

Public Aquaria and SDG14

While public aquaria worldwide may not play a direct role in fulfilling the ten action points highlighted under the UN's Sustainable Development Goal 14 – listed in the beginning – the former examples demonstrate beyond any doubt the profound indirect impact they play in these, specifically through these two major roles: (1) educating the public about these issues, through a concept commonly referred to as "edutainment," and (2) actively contributing financially toward research groups that are directly involved in these ten action points listed under SDG14.

Society is evolving in the direction of banning zoological parks, which is a natural progression in the evolution of human consciousness and its appreciation for the natural world. However, the vast majority of the hundreds of zoological facilities that are functioning today are enforcing their mission more than adequately, through bringing the dangers of microplastics, climate change, deforestation, overfishing, and so many other ailments that plague the world's oceans today, to the public eye, and actively funding research and conservation efforts that strive to right these wrongs. And this is indeed why public aquaria actions are fully aligned with the UN's SDG14.

Cross-References

- ▶ Economic Value
- ▶ Higher Education and Sustainable Development of Marine Resources
- ▶ Marine Animals and Human Care Towards Effective Conservation of the Marine Environment
- ▶ Marine Protected Area and Biodiversity Conservation
- ▶ Public Awareness of Marine Biodiversity Functions

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