

# ***AN EVALUATION OF PUBLIC AQUARIUMS IN SÃO PAULO (BRAZIL) IN LIGHT OF THE “GLOBAL AQUARIUM STRATEGY FOR CONSERVATION AND SUSTAINABILITY”***

Uma avaliação de aquários públicos em São Paulo (Brasil) considerando a “Estratégia Global dos Aquários para a Conservação e Sustentabilidade”

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## **ABSTRACT**

*The purpose of this study was to determine to what extent a sample of seven Brazilian public aquariums adhered to the guidelines of the World Association of Zoos and Aquariums – WAZA, in their in situ and ex situ efforts at environmental education, research and biodiversity conservation. Information was collected with a questionnaire containing 34 items covering the 9 pillars of the WAZA. Although all aquariums provided some form of environmental conservation, many were unfamiliar with important WAZA, EAZA and IUCN documents. Brazilian public aquariums are advised to join the WAZA community, assume greater responsibilities for conserving local ecosystems, create action plans and in-house animal ethics and welfare codes, intensify breeding programs, raise funds for biodiversity conservation and develop research policies. The study suggests how researchers, activists and aquarium managers can contribute to making the planet an ecologically healthier and safer place for present and future generations, and provides subsidies for further projects reflecting the role of public aquariums in the context of the current environmental crisis of the Anthropocene.*

**Keywords:** *aquarium, conservation, sustainability, environmental education, biodiversity, WAZA.*

## **RESUMO**

*O objetivo deste estudo foi avaliar uma amostra de sete aquários públicos brasileiros e determinar até que ponto eles aderiam às diretrizes da Associação Mundial de Zoológicos e Aquários – WAZA, em suas atividades de educação ambiental, pesquisa e conservação da biodiversidade, in situ e ex situ. As informações foram coletadas através de um questionário contendo 34 itens, abrangendo os nove pilares da WAZA. Apesar de todos os aquários realizarem ações em prol da conservação ambiental, muitos não estavam familiarizados com documentos importantes da WAZA, EAZA e IUCN. Os aquários públicos brasileiros devem integrar-se aos esforços conservacionistas da comunidade da WAZA, assumir maiores responsabilidades para a conservação de ecossistemas locais, criar planos de ação e códigos de ética e bem-estar animal próprios, intensificar os programas de reprodução, arrecadar fundos para a conservação da biodiversidade e desenvolver políticas de investigação. O estudo sugere como pesquisadores, ativistas e gestores de aquários podem contribuir para tornar o planeta mais sustentável e seguro para as atuais e futuras gerações, e fornece subsídios para projetos que explorem o papel dos aquários públicos no contexto da atual crise ambiental do Antropoceno.*

**Palavras-chaves:** *aquário, conservação, sustentabilidade, educação ambiental, biodiversidade, WAZA.*

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## INTRODUCTION

Since the onset of the industrial revolution, the impact of human action on earth has been so massive that many researchers hold the view that we have entered a new geological epoch: the Anthropocene. Coined in 2002 by Nobel prize winning atmospheric chemist Paul Crutzen, the term Anthropocene has over the past decade become a household name in the scientific community (Steffen *et al.*, 2007; Zalasiewicz, 2010; Martini & Ribeiro, 2011; WWI, 2013; ICS, 2014). Starting approximately 11,500 years ago, with the waning of the last Ice Age, the Holocene, the period immediately preceding the Anthropocene, was an epoch of unusually stable weather (Figure 1). Amenable climate conditions favored the development of human civilizations and allowed for the advent of organized agriculture and the establishment of urban centers. Currently, more people live in urban areas than in rural areas. In fact, the urban world population has grown rapidly since 1950, from 746 million to 3.9 billion in 2014 (United Nations, 2014). As a result of this exponential populational and industrial growth, a severe environmental crisis, and possibly collapse, looms ahead. Unbridled production and waste of consumer goods irrespective of planetary resource limitations is compromising the sustainability of modern human civilization (Zalasiewicz, 2010; WWI, 2013). Human activities have affected the Earth's climate, the chemistry of the oceans, vital terrestrial and aquatic habitats, air and water quality and the cycles of water, carbon, nitrogen and phosphorous, among others, thereby offsetting the balance between the components necessary for life on the planet.

Anthropic changes are now so extensive that human civilization may be considered the greatest geophysical force acting on the planet (Steffen *et al.*,

2007). Therefore, the International Commission on Stratigraphy (ICS), the aim of which is to establish a global geological time scale, recently assigned a multidisciplinary team of experts to define, until 2016, the point of transition between the Holocene and the Anthropocene (ICS, 2014).

In fact, several international organizations committed to conservation on a global scale, such as the Intergovernmental Panel on Climate Change (IPCC), the International Union for the Conservation of Nature (IUCN), World Wildlife Fund (WWF) and the Worldwatch Institute (WWI), have concluded that the limits of planetary sustainability have been exceeded (Nobre *et al.*, 2012; WWI, 2013).

Steffen *et al.*, (2007) used the expression "the Great Acceleration" to describe the exponential growth observed in the Anthropocene associated with demographic explosion, extinction of species, overfishing, concentration of chemical compounds in the biosphere, improper use of soil, water and energy, and other negative developments (Figure 2). A change in these nature-hostile development patterns to more efficient and ecologically correct models is therefore urgent. Environmental education is bound to play a crucial role in this process.

Public aquariums and zoos (generally referred to as "public" whether they be private or government-owned) are important tools of environmental education due to their ability to strengthen our bond with Nature and promote the concepts of sustainability and conservation of biodiversity (Mann, 2014). Some consider them the world's most successful cultural institutions because they are visited by over 700 million people annually, corresponding to 10% of the world's population (WAZA, 2009; Gusset & Dick, 2011, 2014). This is more than the attendance at soccer matches

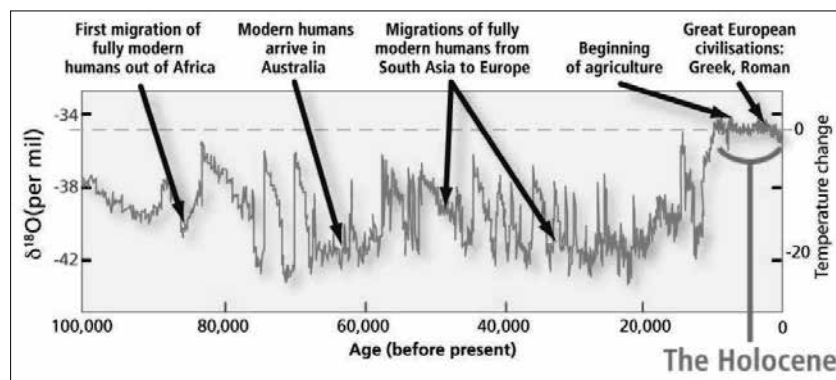


Figure 1 - Temperature change over the last 100,000 years, highlighting the stability of the climate in the Holocene epoch (IGBP, 2014).

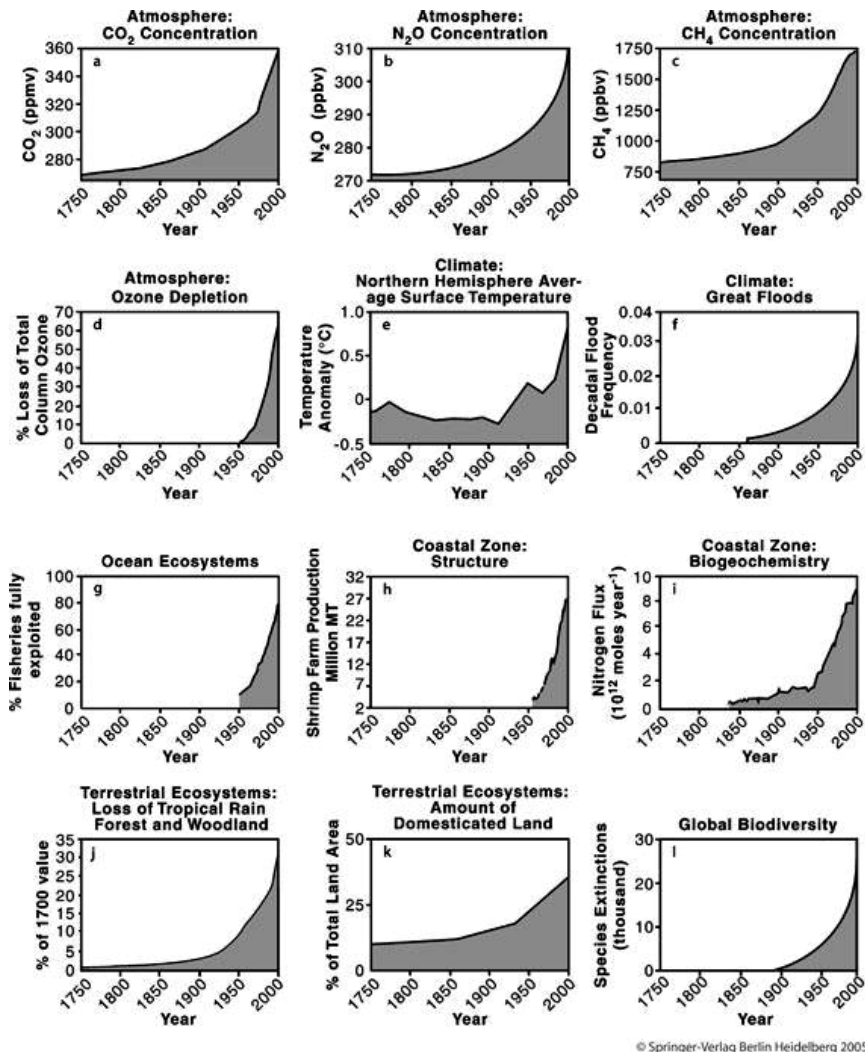


Figure 2 - Examples of the “Great Acceleration” of the Anthropocene epoch: exponential changes in key parameters of sustainability and conservation (Young & Steffen, 2009).

worldwide. In Brazil alone, over 20 million people visit zoos and aquariums every year (Barros, 2013).

Many large public aquariums have been built on all continents over the past decades. Technological advances have made it possible to increase the size of the tanks, such as in the Chinese theme park Chime-Long Ocean Kingdom which features a 22.8 million liter tank housing 10 whale sharks. Inaugurated in April 2014, Chime-Long has already beaten five Guinness world records (Guinness, 2014). Over the next three years, three large public aquariums (Acquário Ceará, AquaRio and Aquário do Pantanal) are expected to open in Brazil.

In 2000, the World Association of Zoos and Aquariums (WAZA) was founded to provide leadership and support for zoos, aquariums, and

partner organizations of the world in animal care and welfare, conservation of biodiversity, environmental education and global sustainability, as aptly expressed in the slogan “United for Conservation”. Currently, WAZA membership includes over 1,300 of the world’s core zoos and aquariums organized in national or regional associations.

As a result of an international collaboration of experts, in 2005 WAZA published the World Zoo and Aquarium Conservation Strategy (WZACS), with the subtitle “Building a Future for Wildlife”, urging zoos and aquariums to promote the concept of global biodiversity conservation. In 2009, WAZA published another strategic document entitled “Turning the Tide: A Global Aquarium Strategy for

Conservation and Sustainability” proposing norms, policies and practices for aquariums interested in providing environmental education towards a more sustainable use of resources.

The purpose of the present study was to determine to what extent Brazilian public aquariums are aligned with WAZA’s Global Aquarium Strategy for Conservation and Sustainability in their *in situ* and *ex situ* efforts at environmental education, research and biodiversity conservation.

## MATERIAL AND METHODS

Initially, a sample of seven Brazilian public aquariums was defined, all of which located in the state of São Paulo by virtue of the availability of logistic and financial resources. The managers, environmental educators and appointed staff of the sampled aquariums were then interviewed using a semi-structured questionnaire containing 34 items covering the nine pillars of the WAZA strategy: 1) integrating conservation, 2) conservation of wild populations, 3)

science and research, 4) population management, 5) education and training, 6) communication, marketing and public relations, 7) partnerships and politics, 8) sustainability, and 9) ethics and animal welfare (WAZA, 2009). The interviews were conducted in the period June 17-25, 2014, and lasted 50 minutes on the average. The answers were grouped into four categories according to the elements and ideas expressed: i) WAZA guidelines, ii) conservation of biodiversity, iii) research, and iv) environmental education.

In addition, the facilities of the seven aquariums were observed *in loco*, and the literature on the subject (both printed and online) was reviewed. The collected information was organized into spreadsheets and figures using the software Microsoft Excel.

## RESULTS AND DISCUSSION

### *Brazilian public aquariums*

Brazil currently has 22 public aquariums in activity and at least 6 under construction (Table I),

Table I - Brazilian public aquariums in activity (white cells) or under construction (gray cells), according to geographical region.

North	Northeast	Midwest	Southeast	South
Amazonário (PA)	Aquário de Natal (RN)	Aquário de Bonito (MS)	Acqua Mundo (SP)	Aquário do Passeio Público (PR)
	Oceanário de Aracajú (SE)	Aquário Municipal de Justino Malheiros (MT)	Aquário de Aparecida do Norte (SP)	Aquário Marinho de Paranaguá (PR)
	Aquário Ceará (CE)	Aquário do Pantanal (MS)	Aquário de Guarapari (ES)	Aquário Municipal Dr. Rômulo Martinelli (PR)
			Aquário de Peruíbe (SP)	Oceanário Brasil (RS)
			Aquário de Santos (SP)	
			Aquário de São Paulo (SP)	
			Aquário de Ubatuba (SP)	
			Aquário do Rio São Francisco (MG)	
			Aquário do Sabina (SP)	
			Aquário do Zoo de Baurú (SP)	
			Aquário do Zoo do Rio de Janeiro (RJ)	
			Aquário Municipal de Campinas (SP)	
			Aquário Municipal de Iacanga (SP)	
			Aquário Municipal de Piracicaba (SP)	
			Mundo das Águas (MG)	
			AquaRio (RJ)	
			Aquário de Maricá (RJ)	

PA=Pará; RN=Rio Grande do Norte; MS=Mato Grosso do Sul; SP=São Paulo; PR=Paraná; SE=Sergipe; MT=Mato Grosso; CE=Ceará; ES=Espírito Santo; MG=Minas Gerais; RJ=Rio de Janeiro.

which were designed to meet the needs of diversified, multicultural audiences and feature innovative and interactive educational exhibits for visitors of all ages.

### Description of the sampled aquariums

Most of the 22 public aquariums in activity are located in the Southeast (eleven in São Paulo alone), which differ with regard to ownership (government/private), size and age, Figure 3 shows the location of the seven aquariums in our sample.

Each aquarium is unique. For example, Aquário de Santos, the country's oldest and most traditional one. Aquário de Ubatuba has a strong conservationist component. Though small, Aquário de Mongaguá is located inside a large ecological park ("A Tribuna") with a view of the sea. Likewise small, but well structured, Aquário de Peruíbe works extensively with local schools. On the other hand, AcquaMundo de Guarujá is more heavily frequented by tourists and offers excellent facilities. Aquário da

Sabina Escola Parque do Conhecimento is part of a large and busy educational compound in Santo André (a county of São Paulo State). Finally, Aquário de São Paulo has excellent thematic exhibits, a great diversity of terrestrial and aquatic animals and a considerable scientific production. Table II shows the characteristics of the public aquariums sampled for the study.

### Aquarium associations

Only one of the seven aquariums in the sample was not a member of any aquarium/zoo association. Six were members of Sociedade Paulista de Zoológicos (SPZ), four were members of Sociedade de Zoológicos do Brasil (SZB) and one was a member of WAZA (Figure 4).

Although recognizing the importance of joining associations to accomplish their missions and goals, many Brazilian aquariums are still not properly networked. The main reasons given for this were



Figure 3 - Location of the seven public aquariums sampled for the study.

Table II - Characteristics of the public aquariums sampled for the study.

Name of aquarium	Opening date	Visitors per year (n)	Tanks (n)	Total water volume (L)	Largest tank (L)	Covered area (m <sup>2</sup> )	Species (n)	Specimens (n)
Aquário de Santos	June, 1945	700,000	31	1,400,000	450,000	3,000	75	1,500
Aquário de Ubatuba	February, 1996	180,000	27	150,000	80,000	1,350	123	350
Aquário de Mongaguá	December, 1996	20,000	14	17,900	7,000	200	26	60
AcquaMundo (Guarujá)	December, 2000	250,000	45	1,500,000	800,000	3,500	150	8,000
Aquário de São Paulo	June, 2006	120,000	41	2,000,000	1,000,000	3,000	300	3,000
Aquário da Sabina	April, 2008	170,000	3	243,000	120,000	2,000	26	90
Aquário de Peruíbe	July, 2009	50,000	25	18,000	16,000	500	150	500

financial and bureaucratic difficulties. However, the WAZA strategy suggests that larger networked aquariums encourage unaffiliated aquariums to join local, national and international associations.

### WAZA guidelines

The interviewees at five of the seven sampled aquariums were familiar with the document entitled “Turning the Tide: A Global Aquarium Strategy for Conservation and Sustainability” (WAZA, 2009) (Figure 5). The WAZA strategy provides a shared philosophy and high-level aspiration for zoos and aquariums across the globe in the form of guidelines and actions that could or should be adopted at different levels ranging from individual public aquariums through to national and regional aquarium/zoo associations.

WAZA recommend the technical guidelines of the International Union for the Conservation of Nature (IUCN) with regard to *ex situ* populations (IUCN, 2002) for all aquariums, encouraging regional and national associations to make these guidelines available to all their members. At the time of the study, only one of the aquariums in our sample was familiar with the IUCN guidelines (Figure 5). It should be noted that the document was recently updated with the “IUCN Guidelines on the Use of *ex situ* Management for Species Conservation” (IUCN/

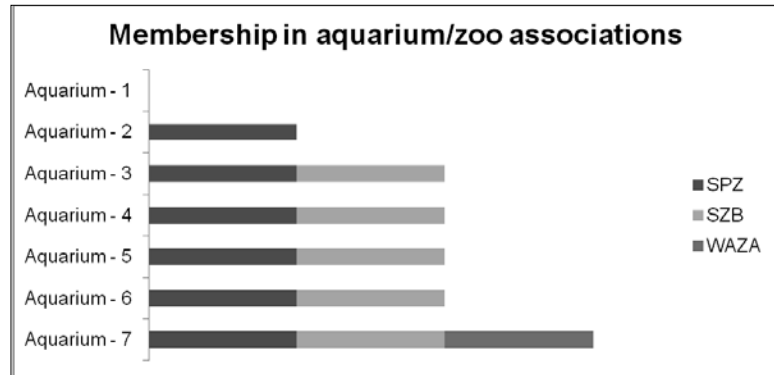


Figure 4 - Membership of the sampled aquariums in aquarium/zoo associations.

SSC, 2014). Wildlife management is regulated in Brazil by IBAMA (Institute for the Environment and Natural Renewable Resources) through IN #169/2008 regarding aquariums and zoos, by SisFauna (National System of Wildlife Management) and by the Convention on Biological Diversity (CBD). It should be pointed out that, by way of Supplementary Law #140/2011, wildlife management responsibilities have been transferred to regional and local agencies, such as the Coordination of Biodiversity and Natural Resources (CBRN) in São Paulo, and the State Department of the Environment (SEMACE) in Ceará.

As part of the International Species Information System (ISIS), the internationally standardized and integrated Zoological Information Management System (ZIMS) was designed to keep detailed records of successive generations of animals in captivity, even those with relatively short life spans such as colonial organisms. WAZA advises all aquariums to join the ZIMS project, but none of the aquariums in our sample were members of ISIS or participated in the ZIMS project (Figure 5), although two informed they were preparing to join in the near future.

All the aquariums in our sample stated they complied with IBAMA regulations with regard to the registration of animals. In addition, the records of certain species are kept in regional, national and international studbooks collected by ISIS and made available to the global community of aquariums and zoos.

In 2003, WAZA published guidelines on the acceptance of seized or confiscated animals, recommending that the document be received and adopted by regional

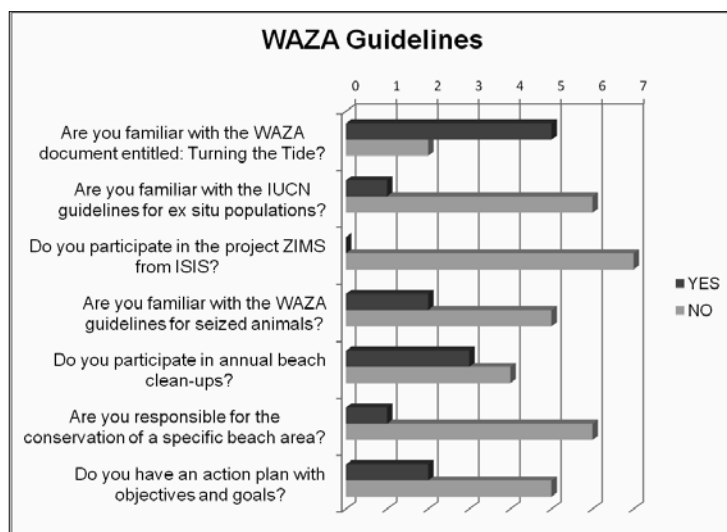


Figure 5 - Answers of managers, environmental educators and appointed staff of the sampled public aquariums with regard to the guidelines set forth in “Turning the Tide: A Global Aquarium Strategy for Conservation and Sustainability” (WAZA, 2009).

associations and disseminated to their respective member institutions and that any proposed acquisition be in accordance with CITES regulations (Convention on International Trade in Endangered Species of Wild Fauna and Flora). Only two of the aquariums in our sample were aware of these WAZA guidelines (Figure 5) though all complied with IBAMA regulations regarding the acceptance of seized animals. Adherence to WAZA guidelines confers international recognition on aquariums, distinguishing them from zoos; in contrast, current IBAMA regulations do not acknowledge the difference between aquariums and zoos (IN #169/2008).

Beach clean-ups are a popular way of building awareness of aquatic ecosystem conservation. WAZA guidelines suggest aquariums develop a practical program committing to at least one beach, river or pond clean-up each year, and take responsibility for permanently conserving and cleaning one or more specific areas. Four of the aquariums in our sample participated in annual beach clean-ups, and one reported providing permanent conservation of a specific beach area (Figure 5).

In addition, WAZA recommends the adoption of customized, written aquarium action plans, incorporating specific, measurable, achievable, realistic and time-bound objectives ('SMART'). Only two of the aquariums in the sample had an action plan with objectives and goals, and the plan was in a format different from that proposed by WAZA. Two other aquariums are currently preparing a plan (Figure 5).

### ***Conservation of biodiversity***

One of the main objectives of the WAZA initiative is biodiversity conservation (Gusset *et al.*, 2011, 2014). The actions taken by the seven public aquariums in the sample to conserve biodiversity are shown in Figure 6. According to WAZA, preserved ecosystems are crucial for the welfare of life on earth. Therefore, aquariums should have sustainability projects and/or exhibits showing the importance of conserving aquatic ecosystems. Five of the aquariums in our sample featured exhibits with a conservationist theme to a greater or lesser degree (Figure 6). The WAZA document also suggests aquariums develop external facilities involving natural habitats with naturally-occurring indigenous species representing local ecosystems managed in a sensitive, responsible and sustainable way.

To be fully effective, the conservation of aquatic ecosystems and biodiversity should be closely linked to the management of terrestrial

environments (WAZA, 2009). Thus, aquariums should have exhibits illustrating the complex relationship between these two spheres. Highlighting the services aquatic ecosystems provide to human well-being makes the exhibits more relevant to the public and helps understand the need for support to *in situ* and *ex situ* conservation initiatives (Falk, 2014, Street, 2014). Five of the aquariums in our sample illustrated relationships between terrestrial and aquatic environments (Figure 6).

Threatened aquatic species may be used as symbols to transmit conservation-related messages, create a better understanding of complex ecological processes and obtain public participation and engagement in conservation projects (Braverman, 2014). Three of the seven aquariums used one or more species (manatee, turtle, shark and penguin) as symbols in their conservation strategies (Figure 6).

The WAZA document stresses the importance of avoiding destructive fishing methods, regardless of the context (industrial, sport or subsistence). Global fishing resources are threatened by overfishing, by-catch, global warming, ocean acidification, pollution, the introduction of exotic species and the continual degradation of aquatic and coastal environments, especially mangroves and coral reefs. FAO has estimated that 70% of commercial fishing resources in the world are currently exploited, over-exploited or exhausted (FAO, 2012). WAZA guidelines also recommend that seafood used to feed animals or for consumption in aquarium restaurants come from well-managed sustainable fisheries and that products for sale in aquarium gift shops accord with sustainability and fair trade guidelines. Five of the aquariums in the sample promoted sustainable fishing methods (Figure 6).

To ensure the well-being of aquarium animals and the communication of conservationist messages in aquarium exhibits, WAZA suggests institutions create an in-house animal ethics and welfare code. Adherence to the code and regular evaluations should be monitored by an animal ethics and welfare committee composed of staff representing different segments, in addition to external collaborators. None of the aquariums in our sample had an in-house animal ethics and welfare code, but all reported complying with municipal, state or national ethics codes. However, four of the aquariums had an animal ethics and welfare committee composed primarily of technical staff and directors (not all segments, as proposed by WAZA) (Figure 6). The WAZA document also endorses the work of the Marine Aquarium Council (MAC) in setting

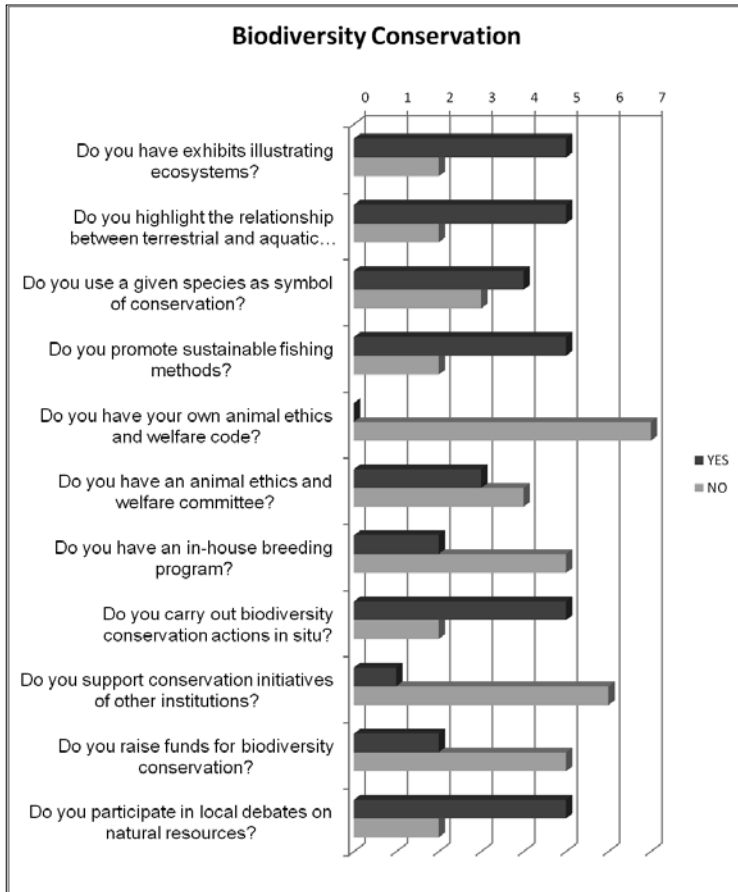


Figure 6 - Actions taken by the seven public aquariums in the sample to conserve biodiversity.

international welfare and sustainability benchmarks in the acquisition, care, management and transportation of livestock (WAZA, 2009).

The WAZA aquarium community supports the creation of breeding programs, especially for threatened species, similar to those successfully implemented in many zoos (Braverman, 2014). Such initiatives require cooperation with other institutions and government agencies, particularly programs involving translocation and re-introduction. Institutional policies should be developed and regularly revised concerning the transfer of surplus livestock to other reputable institutions, or their release into the wild when perfectly adequate and authorized. Two of the aquariums in our sample had breeding programs (Figure 6) and reproduced penguins, starfish, seahorses, rays and jellyfish.

Aquariums and aquarium associations are advised by WAZA to formally support at least one important conservation project *in situ*, for example by hiring or aiding professionals conducting field work, offering professional courses, developing competences or running campaigns to raise funds for the

conservation of wildlife and habitats. Importance is given to close liaisons with NGOs, aquatic conservation agencies and IUCN specialist groups. Five of the seven aquariums in the sample carried out biodiversity conservation actions *in situ*, but only two aquariums were engaged in raising funds for such projects, and one aquarium supported conservation projects at other institutions (Figure 6).

Public aquariums possess a huge potential to build awareness around questions of biodiversity, water resources, environmental legislation, environmental impacts, coastal management, pollution and sustainable fisheries. According to WAZA, to help conserve the local biodiversity, aquariums should participate in local debates on the use of natural resources. In our sample, five aquariums reported participating in such debates (Figure 6).

## Research

Because information is more easily collected from organisms in captivity, researchers often resort to aquariums in order to study the reproductive biology, genetics, behavior, physiology, nutrition, veterinary care, husbandry and re-introduction of animals and plants (Minteer & Collins, 2013). It is therefore convenient to employ aquariums as specialized research centers. Figure 7 shows the research actions developed at the seven aquariums sampled for the study.

WAZA recommendations for research at aquariums include the adoption of an institutional research policy and the development or support of at least one research project *in situ* and one *ex situ*. The policy should define institutional research priorities and should be regularly evaluated and, if necessary, revised. Three of the aquariums in our sample had an institutional research policy (Figure 7).

Research can be made more effective and comprehensive through affiliations with universities, NGOs and other entities. In addition, research projects may be conducted in partnership with other aquariums. Five of the seven aquariums worked in partnership with other institutions. Scientific discoveries should be shared with the global aquarium community and with the scientific community in general through the publication of



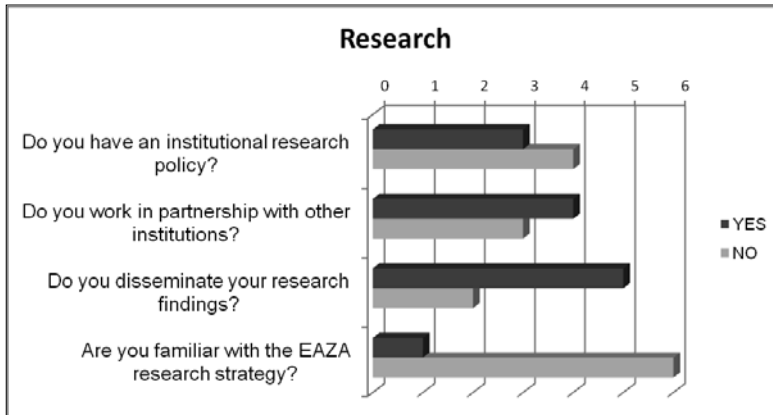


Figure 7 - Research actions developed at the sampled aquariums.

papers, reports and web posts. Five of the seven aquariums disseminated their research findings in one form or another (Figure 7).

In response to the first set of WAZA guidelines (2005), the European Association of Zoos and Aquaria (EAZA) published a document entitled “Developing the Research Potential of Zoos and Aquariums: The EAZA Research Strategy” (EAZA, 2008), containing a generalized action plan which can be customized for specific research purposes. Only one aquarium was familiar with the EAZA research strategy.

### Environmental education

According to WAZA (2009), education is one the main reasons for the existence of aquariums and zoos. Visitors of all ages should be offered learning experiences employing basic signage, interactive interpretation and advanced electronic communication systems. In addition to self-explanatory exhibits, visitors’ programs should include lectures capable of sensitizing the public to current

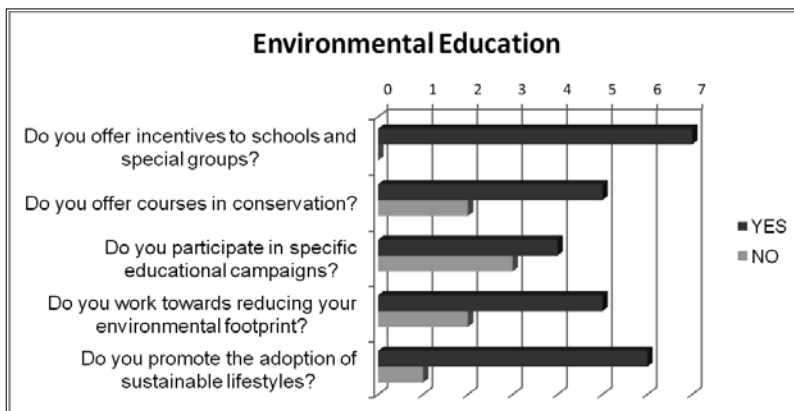


Figure 8 - Environmental education activities developed by the sampled aquariums.

environmental issues. Moreover, tutors may be assigned to accompany small groups for informal interpretation and closer interaction. Figure 8 shows a summary of the environmental education activities conducted by the sampled aquariums.

Aquariums should fundamentally serve as a complement to formal and non-formal education, regardless of visitors’ focus and background. All the aquariums in our sample offered incentives for schools and special groups (Figure 8), such as discounts or even free entrance. Some of the aquariums partnered with the municipal government to provide transportation for visiting students.

Five aquariums offered education in conservation through courses, workshops and lectures (Figure 8) attended mostly by teachers, university students and aquarium staff, but in many cases also by the general public. The frequency of these activities ranged from monthly to semiannual, with the greatest concentration during school vacations.

Aquariums are particularly appropriate for educational campaigns aimed at sensitizing the public to the importance of conservation and the possibility of joint action towards common objectives (Falk, 2014). Four aquariums reported participating in such campaigns (e.g. the movement Zoos and Aquariums for 350, the Decade on Biodiversity (2011-2020), beach clean-ups, protection of sea turtles and migratory fish.

Environmental education should include among its priorities the promotion of environment-friendly techniques and sustainable lifestyles. The aquarium should set an example of sustainability by permanently working towards reducing its environmental footprint. This should include minimizing water and energy consumption, treating and correctly disposing of liquid and solid waste, and reducing the consumption of disposable supplies. The construction of the aquarium also should reflect concern for the environment. In addition, environmentally responsible suppliers should be given preference. Five aquariums worked towards reducing their environmental footprint (Figure 8).

Strengthening the concept of environmental responsibility is a WAZA priority. Indeed, integrating environment-friendly elements into exhibits and setting an example of environmental responsibility can positively influence the behavior of aquarium visitors. The global aquarium community must become fully aware of the role aquariums can play in turning the tide of irresponsible resource use. The present study is meant as a contribution to our current understanding of aquariums as a means of behavior change and as an incentive to the adoption of internationally acknowledged conservation strategies.

## CONCLUSIONS

Adherence to WAZA guidelines for conservation and sustainability was partial in our sample of seven Brazilian public aquariums. Although all the aquariums provided some forms of environmental conservation activities many were unaware of the existence of important reference documents issued by WAZA, EAZA and IUCN. A number of recommendations are in place: Brazilian public aquariums should i) join the WAZA community, ii) regularly exchange information on species, iii) assume greater responsibilities for conserving local ecosystems, iv) create action plans and in-house animal ethics and welfare codes, v) intensify breeding programs for conservation, vi) raise funds for biodiversity conservation initiatives, vii) support initiatives of other institutions, and viii) develop institutional research policies for *in situ* and *ex situ* projects.

It was shown in this study that the role of public aquariums in society goes far beyond tourism, leisure and entertainment. In fact, the promotion of environmental responsibility, research and biodiversity conservation are among the main reasons for the existence of aquariums. Hundreds of millions of visitors are exposed to exhibits and activities in aquariums and zoos around the world every year. Considering this, and in view of the environmental challenges humanity will face in the coming decades, public aquariums possess an enormous potential for building ecological awareness and mitigating local and global damage to wildlife. The global aquarium community must become fully aware of its role as an agent of transformation in this context. It is hoped the present study will help show researchers, activists and aquarium managers how Brazilian public aquariums can contribute to making the planet an ecologically

healthier and safer place for present and future generations, and provide subsidies for further studies and projects reflecting the role of public aquariums in the context of the current environmental crisis of the Anthropocene

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## REFERENCES

- Barros, Y.M. *Zoos e aquários têm papel importante na conservação*. Portal da Associação O Eco. Disponível em: <http://www.oeco.org.br/convidados/27224-zoos-e-aquarios-tem-papel-importante-na-conservacao/> Acesso em 29 de outubro de 2014.
- Braverman, I. Conservation without nature: the trouble within situ versus ex situ conservation. *Geoforum*, v. 51, p. 47-57, 2014.
- EAZA. *EAZA Strategy 2009-2012*. EAZA Executive Office, Amsterdam, 2009.
- Falk, J.H. Evidence for the educational value of zoos and aquariums. *WAZA Magazine*, v.15, p.10-13, 2014.
- FAO. *The state of the world fisheries and aquaculture 2012*. Food and Agriculture Organizations, Rome, 2012.
- GUINNESS. *China's Hengqin Ocean Kingdom confirmed as world's largest aquarium*. 2014. Disponível em: <http://www.guinnessworldrecords.com/news/2014/3/chinas-hengqin-ocean-kingdom-confirmed-as-worlds-largest-aquarium-as-attraction-sets-five-world-records-56471/> Acesso em 31 de outubro de 2014.
- Gusset, M. & Dick, G. The global reach of zoos and aquariums in visitor numbers and conservation expenditures. *Zoo Biology*, v.30, p.566-569, 2011.
- Gusset, M.; Moss, M. & Jensen, E. Biodiversity understanding and knowledge of actions to help protect biodiversity in zoo and aquarium visitors. *WAZA Magazine*, v.15, p.14-17, 2014.

- Mann, J.; Ballantyne, R. & Packer, J. International research on zoo and aquarium visitors – some new perspectives. *WAZA Magazine*, v.15, p.18-21, 2014.
- Minteer, B.A. & Collins, J.P. Ecological ethics in captivity: balancing values and responsibilities in zoo and aquarium research under rapid global change *ILAR Journal*, v.54, n.1, p.41-51, 2013.
- Nobre, C.A.; Reid, J. & Veiga, A.P.S. *Fundamentos científicos das mudanças climáticas*. Rede Clima/IMPE, São José dos Campos, 2012.
- ICS. International Commission on Stratigraphy. Subcommission on Quaternary Stratigraphy. *What is the “Anthropocene”? – current definition and status*. Disponível em: <http://quaternary.stratigraphy.org/workinggroups/anthropocene/> Acesso em 31 de outubro de 2014.
- IGBP. International Geosphere-Biosphere Programme. *Anthropocene*. Disponível em: <http://www.igbp.net/globalchange/anthropocene.4.1b8ae20512db692f2a680009238.html>. Acesso em 05 de novembro de 2014.
- IUCN *Technical guidelines on the management of ex situ populations for conservation*. Gland Switzerland. Species Survival Commission, 2002.
- IUCN/SSC. *Guidelines on the use of ex situ management for species conservation*. Version 2.0. Gland Switzerland. Species Survival Commission, 2014.
- Luebke, J.F.; Kelly, L.D. & Grajal, A. Beyond facts: the role of zoos and aquariums in effectively engaging visitors in environmental solutions. *WAZA Magazine*, v.15, p.27-30, 2014.
- Steffen, W.; Crutzen, P.J. & McNeill, R.S. The Anthropocene: are humans how overwhelming the great forces of nature? *Ambio*, v.36, n.8, 2007.
- Street, W. Conservation education Impact research at Sea World Parks. *WAZA Magazine*, v.15, p.36-40, 2014.
- United Nations. *World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352)*. Department of Economic and Social Affairs, Population Division. New York, 2014.
- Vernon, C. Measuring Monterey Bay Aquarium’s role in inspiring ocean conservation. *IZE Journal*, n.45, 2009.
- WAZA - World Association of Zoos and Aquariums. *Building a future for wildlife - the World Zoo and Aquarium Conservation Strategy*. Bern, 2005.
- WAZA - World Association of Zoos and Aquariums. *Turning the tide: a global aquarium strategy for conservation and sustainability*. Bern, 2009.
- WWI - Worldwatch Institute. *Estado do Mundo 2013: A Sustentabilidade Ainda é Possível?* Erik Assadourian e Tem Prugh org., Salvador, 2013.
- Young, O.R. & Steffen, W. “The Earth system: sustaining planetary life-support systems”, p.295–315, in Chapin III, F.S.; Kofinas, G.P. & Folke, C. (eds), *Principles of ecosystem stewardship: resilience-based natural resource management in a changing world*. Springer, 401 p., New York, 2009.
- Zalasiewicz, J. *et al.* The new world of the Anthropocene. *Environment Science & Technology*, v. 44, p.2228-2231, 2010.