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Improving Captive Marine Mammal Welfare in the United States: Science-Based Recommendations for Improved Regulatory Requirements for Captive Marine Mammal Care

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1. Introduction

Congress passed the Animal Welfare Act[1] (AWA) in order "to ensure the humane care and treatment of various animals used in research or for exhibition or kept as pets.[2] To this end, the Act requires, inter alia, that the Secretary of Agriculture 'promulgate standards to govern the humane handling, care, treatment, and transportation of animals by dealers, research facilities, and exhibitors.'"[3] The Animal and Plant Health Inspection Service (APHIS), the agency under the U.S. Department of Agriculture responsible for implementing the AWA, first promulgated regulations pertaining to the care of marine mammals in captivity[4] in 1979 and has updated various aspects of these regulations on a limited basis since then. The last time the marine mammal care regulations relating to the physical conditions under which these species are held were substantively revised was in 1984.[5] On 3 February 2016, APHIS published a proposed rule to amend the captive marine mammal regulations.[6] The agency took 14 years to issue this proposed rule[7] and had it under consideration for 20 years.[8]

APHIS's marine mammal care regulations are intended to "insure that animals intended … for exhibition purposes … are provided humane care and treatment."[9] The statute does not, however, define the term "humane." In the absence of a statutory definition, it is appropriate to "look to the common usage of words for

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1 7 U.S.C. § 2131.
2 Animal Legal Def. Fund v. Espy, 29 F.3d 720, 722 (D.C. Cir. 1994).
3 *Id.* (quoting 7 U.S.C. § 2143(a)(1)).
4 9 C.F.R. § 3.113 (2016) (concerning the humane handling, care, treatment, and transportation of marine mammals in captivity).
5 Animal Welfare; Marine Mammals, 81 Fed. Reg. 5629, 5630 (February 3, 2016).
6 *Id.*
7 Animal Welfare; Marine Mammals, 67 Fed. Reg. 37731 (May 30, 2002).
8 *See, e.g.*, Marine Mammal Negotiated Rulemaking Advisory Committee; Establishment, 60 Fed. Reg. 27049 (May 22, 1995); *see also* Animal Welfare; Marine Mammals, 66 Fed. Reg. 239 (January 3, 2001).
9 7 U.S.C. § 2131(1) (1976).

their meaning."[10] The *Merriam-Webster Dictionary* defines "humane" as being "marked by compassion, sympathy, or consideration for humans or animals."[11] The *Cambridge Dictionary* defines it as "showing kindness, care, and sympathy toward others, esp[ecially] those who are suffering."[12] A Google search for the definition of "humane" provides the two following definitions: (1) "having or showing compassion or benevolence"; and (2) "inflicting the minimum of pain."[13] It is also reasonable to look to definitions found in other statutes, including those that are related to the relevant statute. For example, the Marine Mammal Protection Act (MMPA) states that "[t]he term 'humane' in the context of the taking of a marine mammal means that method of taking which involves the least possible degree of pain and suffering practicable to the mammal involved."[14]

Throughout the proposed rule, APHIS requests relevant scientific data in the form of peer-reviewed studies or other documentation to inform the agency's efforts to update the regulations.[15] In several places, APHIS claims it is not aware of any relevant scientific data on which to base its deliberations.[16] However, there is, in fact, a considerable and growing body of published peer-reviewed literature that is relevant to the various regulations in question, notably the requirements for space, temperature, lighting, and water quality, as well as regarding health and disease issues and noise.[17]

Several studies (e.g., Ugaz et al. 2009; Scheifele et al. 2012; Clark 2013) have noted the paucity of research on the welfare of captive marine mammals, particularly cetaceans. Unlike many other species, whether terrestrial wildlife or domesticated animals (see, e.g., Morgan and Tromborg 2007; Whitham and Wielebnowski 2013; Hartstone-Rose et al. 2014), captive marine mammals, especially cetaceans, have only rarely been subjects of welfare or non-husbandry-related research (Hill and Lackups 2010; Hill et al. 2016). The zoo and aquarium community controls access to its exhibit animals and only infrequently allows outside researchers to conduct studies that interfere with performance schedules (Hill and Lackups 2010).

In contrast, marine mammal field biologists have been prolific in the past 15–20 years. As noted in Wells (2009) and Couquiaud (2005), and as a general rule in animal welfare science (see, e.g., Morgan and Tromborg 2007; McPhee and Carlstead 2010; Whitham and Wielebnowski 2013), and as even APHIS acknowledged in its proposed rule,[18] research from free-ranging wildlife and an understanding of their

[10] Animal Legal Def. Fund v. U.S. Dep't of Agric., 789 F.3d 1206, 1216 (11th Cir. 2015) (quoting Consol. Bank, N.A., Hialeah, Fla. v. U.S. Dep't of Treasury, 118 F.3d 1461, 1464 (11th Cir. 1997)).

[11] *Humane*, MERRIAM-WEBSTER.COM, http://www.merriam-webster.com/dictionary/humane (last visited December 31, 2016).

[12] *Humane*, CAMBRIDGE DICTIONARY, http://dictionary.cambridge.org/us/dictionary/english/humane (last visited December 31, 2016).

[13] *Humane definition*, GOOGLE, https://www.google.com/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=humane+definition (last searched December 9, 2016).

[14] 16 U.S.C. § 1362(4) (2003).

[15] *See, e.g.*, Animal Welfare; Marine Mammals, 81 Fed. Reg. 5629, 5633 (February 3, 2016).

[16] *Id.* at 5629.

[17] *See, e.g.*, INTERNATIONAL WHALING COMMISSION, REPORT OF THE STANDING WORKING GROUP ON ENVIRONMENTAL CONCERNS (2016) (citing numerous studies on health, disease, and noise, although not necessarily on the environmental conditions of natural habitat). *Available at* https://archive.iwc.int/pages/search.php?search=%21collection73&k= (click on Annex K).

[18] Animal Welfare; Marine Mammals, 81 Fed. Reg. at 5639.

natural behavior and ecology are key to informing appropriate welfare standards for animals in captivity.

Based on the present state of scientific knowledge on the behavior and ecology of free-ranging marine mammals, the proposed amendments to the AWA regulatory standards for captive marine mammals are not sufficient to maintain their welfare. This review makes several recommendations for improvements to the proposed rule, keeping in mind that the AWA establishes only minimum standards. The goal of this review is to make a determination of such real-world, achievable conditions.

2. General weaknesses in the proposed rule

APHIS states that it will base its captive marine mammal regulatory proposals on "current industry and scientific knowledge and experience."[19] However, the proposed rule did not cite a special issue of *Aquatic Mammals* (one of marine mammal science's principal peer-reviewed journals), titled "A Survey of the Environments of Cetaceans in Human Care" (Couquiaud 2005). This publication's findings arose from a comprehensive survey of marine mammal facilities globally and were intended to showcase industry best practice. It therefore should be a starting point for any regulatory amendments based on "current industry and scientific knowledge and experience."[20] Couquiaud (2005) addresses only captive cetaceans, but several of her recommendations (e.g., for water quality standards) are applicable to all marine mammals.

Furthermore, while the proposed rule refers to peer-reviewed papers for proposed changes to some standards (e.g., lighting requirements,[21] which the agency proposes to make "more specific"[22]), it claims it is "unaware"[23] of such scientific papers for other standards and therefore proposes no substantive changes (e.g., temperature requirements[24]). However, such papers do exist (e.g., Yeates and Houser 2008). Indeed, the agency claims that appropriate temperature ranges for marine mammals "[are] not readily tabulated,"[25] yet Table 2.3 of Couquiaud (2005, p. 299) does, in fact, present species-specific temperature ranges for all regulated cetacean species in tabulated form.

In several instances, the proposed rule makes no changes to existing standards, through a failure either to amend existing regulations or to add new regulations.[26] For example, APHIS chose not to amend the current space requirements for captive marine mammals. It cited a lack of "sufficient scientific or other supporting data to propose space requirements [*sic*] changes at this time,"[27] despite the large body of recent research demonstrating the fine-scale daily movement patterns of

[19] *Id.*
[20] *Id.*
[21] 9 C.F.R. § 3.102(c) (2016).
[22] Animal Welfare; Marine Mammals, 81 Fed. Reg. at 5634.
[23] *Id.* at 5633.
[24] 9 C.F.R. § 3.102(a) (2016).
[25] Animal Welfare; Marine Mammals, 81 Fed. Reg. at 5633.
[26] Animal Welfare; Marine Mammals, 67 Fed. Reg. 37731 (May 30, 2002) (discussing possible new regulations).
[27] Animal Welfare; Marine Mammals, 81 Fed. Reg. at 5635.

various species within every taxon of marine mammals, including killer whales, *Orcinus orca* (see, e.g., Durban and Pitman 2012), bottlenose dolphins, *Tursiops truncatus* (see, e.g., Gubbins 2002), beluga whales, *Delphinapterus leucas* (see, e.g., Hauser et al. 2014), polar bears, *Ursus maritimus* (see, e.g., Amstrup et al. 2001), sea otters, *Enhydra lutris* (see, e.g., Bodkin et al. 2004), manatees, *Trichechus* spp. (see, e.g., Deutsch et al. 2003), and pinnipeds (see, e.g., Cunningham et al. 2009; Kuhn and Costa 2014).

Finally, in several instances, the proposed rule replaces easily enforced quantitative (resource/engineering-based) standards, using parameters that can be measured, with difficult-to-enforce, more qualitative (performance-based) standards.[28] There is a long history of poor enforcement of performance-based standards,[29] and thus they can be justified only when engineering-based standards cannot be established using current science or industry best practice. Ideally, animal welfare standards would be animal-based, that is, based on measurements of an animal's behavioral or physical state (Whitham and Wielebnowski 2013), and many zoos are moving toward such standards. However, it is unlikely that regulators will ever be in a position to implement and enforce such standards, given the infrequent nature of inspections; therefore, clear, resource- or engineering-based standards are the most pragmatic.

3. Detailed review

3.1. *Definitions*[30]

The proposed rule amends the definition of "interactive program" to include all marine mammals "except for potentially dangerous marine mammals, such as, but not limited to, polar bears."[31] All marine mammals are potentially dangerous. Even sea otters are capable of inflicting serious bite wounds (Kirkpatrick et al. 1955), while pinniped bites can cause serious infections (Hunt et al. 2008). Bottlenose dolphins and killer whales have inflicted serious injuries and even killed people (Santos 1997; Parsons 2012). The proposed language implies that the only marine mammal

[28] *Resource-based* (or engineering-based) standards are strictly quantitative, requiring specific management practices and specific facility conditions to be provided to the animals. *Performance-based* standards tend to be more qualitative, requiring management practices, facility conditions, or animal behavior to attain or demonstrate certain subjective states, such as "sufficient," "adequate," or "normal." What constitutes these qualities is not universally agreed.

[29] In *Animal Legal Defense Fund, Inc. v. Glickman*, the court generally acknowledged the inherent superiority of resource-based or "engineering standards" to performance-based standards in the AWA context with respect to primates. 204 F.3d 229, 232 (D.C. Cir. 2000); *see also* Joyce Tischler, *A Brief History of Animal Law, Part II (1985–2011)*, 5 Stan. J. Animal L. & Pol'y 27, 65 (2012) (observing that "just a few years" after *Animal Legal Defense Fund, Inc. v. Glickman*, "the USDA itself admitted that its AWA [performance-based] regulations were inadequate to provide guidance to its own inspectors"). Citing the USDA Employee Opinions on the Effectiveness of Performance-Based Standards for Animal Care Facilities (APHIS) 1996, Tischler notes, "As early as … 1996, the USDA was aware that there were significant problems with the vague 'standards' established by its" 1991 final regulations for primates. "Facility inspectors were unable to determine whether the facilities were providing adequate enrichment to the primates, or whether the plans were actually being implemented." *Id.*

[30] 9 C.F.R. § 1.1 (2016).

[31] Animal Welfare; Marine Mammals, 81 Fed. Reg. at 5632.

species that should not be used in interactive programs is the polar bear, a large ice-dependent predator. The proposed rule should at the very least also include "killer whales" in the definition, given the species' history of seriously injuring and killing trainers and others when in captivity (Parsons 2012).

The agency has excluded exhibits where members of the public can hand-feed and touch marine mammals from the proposed definition of "interactive program."[32] The public does not necessarily enter the animals' enclosures in such exhibits, but they handle and provide food to the animals—an activity that is otherwise restricted to trained personnel. The regulations state: "food, when given to each marine mammal individually, must be given by an employee or attendant responsible to management who has the necessary knowledge to assure that each marine mammal receives an adequate quantity of food to maintain it in good health."[33] By definition, these feeding and petting exhibits violate this section of the proposed regulations. Furthermore, the public has been known to offer non-food items at such exhibits or to drop fish on the ground, retrieve them, and then feed them to marine mammals (WDCS and HSUS 2003). The proposed rule should either prohibit feeding and petting exhibits or should include them in the definition of "interactive program" and establish regulations specific to them.

The current definition of "attending veterinarian" does not include a required number of years of experience with the "species being attended."[34] This is inappropriate for marine mammals, given their highly specialized needs. Adding the requirements found in the currently suspended interactive program regulations for attending veterinarians (i.e., "has at least the equivalent of 2 years full-time experience (4,160 or more hours) with [relevant marine mammal species] medicine within the past 10 years")[35] to the general definition of "attending veterinarian" would ensure that a marine mammal veterinarian has the necessary experience to address specific medical issues that arise with these taxa.

3.2. Indoor facilities[36]

3.2.1. Ambient temperature

3.2.1.1. Cetaceans. The current standards arguably allow housing species from widely divergent geographic regions, for example, beluga whales (Arctic) and bottlenose dolphins (temperate/tropical), in the same enclosure. This would likely compromise the welfare of both species.

Bottlenose dolphins have been tested for cold-water tolerance. The results from Yeates and Houser (2008), along with other relevant temperature data (e.g., Table

[32] *Id.*

[33] 9 C.F.R. § 3.105(c) (2016).

[34] "'Attending veterinarian' means a person who has graduated from a veterinary school … [and] has received training and/or experience in the care and management of the species being attended." 9 C.F.R. § 1.1 (2016).

[35] 9 C.F.R. § 3.111(c)(5) (2016).

[36] 9 C.F.R. § 3.102 (2016).

2.3 in Couquiaud 2005; Toth et al. 2011), establish a science-based lower temperature limit for bottlenose dolphins. Adults-only enclosures should be maintained at no less than +12°C, one degree higher than the lowest critical temperature for the smallest adult dolphin in the Yeates and Houser (2008) sample. Enclosures housing adults and calves should be no less than +14°C, which corresponds to the lowest temperature of the water in which dolphins of all age classes were found in the Toth et al. (2011) study. These lower temperature limits would ensure that the most vulnerable dolphins, including calves, are adequately protected from cold stress.

While free-ranging bottlenose dolphins can adapt to year-round living in waters as cold as +9°C to 10°C (Wilson et al. 1999; Couquiaud 2005), there are physiological consequences. These consequences may constitute the mechanism limiting this species' distribution into higher latitudes (Wilson et al. 1999). Populations of bottlenose dolphins found in colder regions have a higher prevalence and severity of skin lesions, which could signal that the immune response of these dolphins is challenged in ways the immune response of dolphins in warmer climates is not (Wilson et al. 1999). Therefore, failing to set a lower temperature limit for this species may compromise the health of captive animals.

For belugas, water temperatures should be no greater than +5°C for the three winter months. For the rest of the year, an upper limit of no greater than +10°C should be used (Couquiaud 2005). For other cetacean species, Table 2.3 in Couquiaud (2005) offers appropriate temperature ranges in tabulated form. These temperature ranges offer science-based guidelines that would preclude housing belugas (0°C to 10°C) and bottlenose dolphins (10°C to 30°C) in the same enclosure.

3.2.1.2. Polar bears. Average January temperature in the Arctic ranges from about -40°C to 0°C, and winter temperatures can drop below -50°C.[37] Average July temperatures range from -10°C to +10°C. Mean daily temperatures in Canada's Arctic (where approximately 60 percent of the world's polar bears live or range)[38] is -15°C to -5°C. Summer temperatures reach a mean of +10°C in Canada's Arctic, with southern ranges reaching a summer mean of +15°C.[39] Despite these freely available data, most polar bears in zoos and aquariums in the United States are frequently subjected to temperatures far in excess of +25°C and may never experience temperatures even approaching freezing. This failure to maintain natural temperature variation in indoor polar bear enclosures may be a major contributor to the poor welfare this species generally suffers in captivity (Clubb and Mason 2003, 2007; Morgan and Tromborg 2007).

The Association of Zoos and Aquariums (AZA) notes the following in its *Polar Bear (*Ursus maritimus*) Care Manual* (AZA Bear TAG 2009, 9):

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[37] *The Arctic Winter*, U. of Guelph, http://www.arctic.uoguelph.ca/cpe/environments/climate/climte_present/temp/arc_winter.htm# (last visited November 23, 2016).

[38] *Summary of Polar Bear Population Status per 2014*, Polar Bear Specialist Group, Species Survival Commission, The International Union for Conservation of Nature, http://pbsg.npolar.no/en/status/status-table.html (last visited November 23, 2016).

[39] *The Arctic Winter*, *supra* note 37.

> There has been no scientific determination of minimum or maximum temperatures for polar bears cared for in zoos and aquariums. Though polar bears originate from an arctic environment, most are tolerant of fluctuating temperatures, as summers in Churchill, Manitoba can average 64°F (17.8°C), but can reach more than 79°F (26°C) degrees. It is not known if there is an optimal temperature range for polar bears or if and how they utilize environmental resources to thermoregulate within this wide range of environmental conditions.

The AZA states "most" polar bears are tolerant of summer temperatures in the southernmost region of the species' distribution (AZA Bear TAG 2009), but, in fact, these are not typical maximum temperatures for "most" polar bears. Only one population, in Western Hudson Bay, inhabits this extreme southern edge of the species' distribution, and it has been in decline in recent years due to climate change impacts (Stirling and Derocher 2012). No other populations experience summer temperatures much above +15°C, and many rarely experience temperatures warmer than +10°C or even +5°C.[40] Polar bears are ice-dependent, and there is evidence of population decline related to rising temperatures and a clear lower latitude range limit set by the species' susceptibility to heat stress. Hyperthermia is a more significant health concern than hypothermia, which the AZA acknowledges by stating that "[h]eat stress is a greater risk to healthy polar bears than cold" (AZA Bear TAG 2009, 9). It is therefore not logical or science-based to maintain polar bears year-round in temperatures that correspond to Arctic summers.

Air temperature standards for indoor polar bear enclosures should be set at no greater than 0°C for at least the three winter months and the rest of the year at no greater than +12°C. This is mid-range between Arctic summer highs of +10°C and +15°C.[41] Water temperature requirements should be similar, with at least the three winter months at no greater than +5°C and the rest of the year at no greater than +10°C.

3.2.1.3. Pinnipeds. Given that temperature can be controlled indoors, the principal temperature-related health threat to tropical, temperate, and subarctic pinnipeds (i.e., heat stress) should not be a significant concern in indoor facilities. Walruses (*Odobenus rosmarus*), however, face the same problems as polar bears when housed in indoor facilities. The same temperature standards should be used for walruses as for polar bears: air temperature maintained at no greater than 0°C for at least the three winter months and the rest of the year at no greater than +12°C. Water temperature should be no greater than +5°C for at least the three winter months and the rest of the year no greater than +10°C. At least 50 percent of the substrate in dry resting areas should be cooled to near freezing temperature for at least the three winter months as well, because in the wild, walruses can spend up to 17 percent of their time hauled out on ice (Udevitz et al. 2009).

[40] See *Polar Bear Population Map*, Polar Bear Specialist Group, Species Survival Commission, The International Union for Conservation of Nature, http://pbsg.npolar.no/en/status/population-map.html (last visited November 23, 2016) for a map of the 19 known polar bear populations and their distributions.

[41] *The Arctic Winter*, *supra* note 37.

3.2.1.4. Sirenians. In contrast to polar bears and walruses, sirenians are susceptible to cold stress (Deutsch et al. 2003). There is a clear lower temperature limit of +19 to 20°C for this species. A lower water temperature limit for sirenians should be established at +22°C, as this is the upper limit of the lower temperature range individual manatees have been found to tolerate (Deutsch et al. 2003).

3.2.2. Lighting

The proposed rule requires at least six hours of uninterrupted darkness during each 24-hour period,[42] which is insufficient to safeguard the well-being of polar marine mammals. As noted in Morgan and Tromborg (2007, 268), "Lighting conditions in captive environments are designed for human convenience." The statement in the proposed rule that "six hours [is] a reasonable minimum, since we think it may correspond with typical work hours at a facility"[43] highlights this perfectly. The convenience of the staff at a licensed facility is not a legal standard found in the AWA. All polar marine mammals experience seasonal periods with near or total 24-hour darkness and near or total 24-hour daylight. Indoor facilities housing polar marine mammals should provide a minimum of 18 hours of darkness during the three winter months with a natural, gradual transition from shorter to longer "day-length" from one season to the next.

3.3. Outdoor facilities[44]

3.3.1. Environmental temperatures

3.3.1.1. Pinnipeds. Morgan and Tromborg (2007) note that enclosure substrates may have thermal properties, including color, that make thermoregulation easier or more difficult for wildlife. In captive enclosures, lighter-colored substrate reflects light, which can cause the development of overheated microclimates within a pinniped enclosure, even when shade is provided (Langman et al. 1996). Conversely, free-ranging California sea lions (*Zalophus californianus*) prefer rookeries with lighter-colored substrate and larger-sized rocks (for shade) because in natural habitat, these result in cooler microclimates (González-Suárez and Gerber 2008). While cooler microclimates are achieved with opposing substrate colors in captivity and the wild, both result in reduced heat stress for the animals.

Given the broad range of temperatures in which pinnipeds find themselves, there is some difficulty in tabulating meaningful species-specific temperature ranges for the various pinniped species found in captivity. However, APHIS should establish a minimum requirement to provide substrate that is colored to minimize heat stress, particularly during summer months. Highly reflective surfaces are also a problem for ocular health in pinnipeds (Colitz et al. 2010; Gage 2011); therefore, requiring less reflective surfaces for temperature control would address two significant health concerns simultaneously.

[42] Animal Welfare; Marine Mammals, 81 Fed. Reg. 5629, 5634 (February 3, 2016).
[43] *Id.*
[44] 9 C.F.R. § 3.103 (2016).

3.3.2. Lighting

Many facilities, particularly those in theme parks, have artificial lights well into nighttime hours, so the animals in outdoor enclosures do not have any uninterrupted darkness at night (NAR personal observation). This is an inconsistency with the indoor facility requirements. The agency should develop a requirement that allows marine mammals held in outdoor facilities to experience at least six hours of uninterrupted and full darkness every night.

3.4. Space requirements[45]

3.4.1. General

Research indicates that ranging patterns in marine mammals are generally tied to food distribution or prey movements; other factors, such as habitat characteristics, also determine ranging patterns. Zoos and aquariums have suggested that captive marine mammals do not need to range widely because they have food provided for them.[46] However, if a species has become physiologically adapted to large home ranges or migratory movements, then individuals must travel these distances to maintain their health and safeguard their welfare (Clubb and Mason 2003, 2007; McPhee and Carlstead 2010).

This section currently states:

> Marine mammals must be housed in primary enclosures that comply with the minimum space requirements prescribed by this part. These enclosures must be constructed and maintained so that the animals contained within are provided sufficient space, both horizontally and vertically, to be able to make *normal postural and social adjustments with adequate freedom of movement*, in or out of the water.[47]

It is impossible for this general standard to be met for any species of marine mammal held in captivity with the current AWA space requirements. The current space requirements are inadequate and based neither on current science nor industry best practice.

3.4.2. Cetaceans

3.4.2.1. Killer whales. For up to two killer whales, a facility must at a minimum provide a circular tank with a diameter twice as wide and a depth half as deep as an average adult killer whale is long (Table 1). This standard does not allow killer whales to "make normal postural and social adjustments with adequate freedom of movement"[48] both horizontally and vertically. Killer whales routinely swim multiple kilometers in straight lines and are capable of travelling as many as 225 km a day for up to 30–40 days without rest (Durban and Pitman 2012; Matthews et al. 2011; Eisert

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[45] 9 C.F.R. § 3.104 (2016).

[46] See, e.g., *SeaWorld Responds to Questions About Captive Orcas, "Blackfish" Film*, CNN (October 28, 2013, 11:27 AM), http://www.cnn.com/2013/10/21/us/seaworld-blackfish-qa/, in which SeaWorld's Vice President of Communications, Fred Jacobs, stated the following in a CNN interview: "While a killer whale can and occasionally might travel as much as 100 miles in a day, it should be said that swimming that distance is not integral to a whale's health and well-being. It is likely foraging behavior . . . . Killer whales living in our parks are given all the food they require."

[47] 9 C.F.R. § 3.104(a) (2016) (emphasis added).

[48] *Id.*

Table 1. Comparison of space requirement standards, *per animal*.

Species	Dimensions (meters (m), m^2, and m^3)	Current AWA standard	Couquiaud (2005) minimum identified[1]	United Kingdom	Italy	Brazil	Alliance of Marine Mammal Parks and Aquariums (AMMPA)	Recommendations[2]
Killer whales (*Orcinus orca*)	MHD[3]	14.64	n/a	15	n/a	n/a	n/a	100
Average adult length:	Minimum depth[4]	3.66		12			5.25[9]	15
7.32 m — AWA	Min surface area	31.55[5]		2,400[8]			n/a	not calculated
5.25 m — AMMPA	Minimum volume	307.89[6]		2,500			959[10]	not calculated
	Min vol each add'l animal[7]	153.95		n/a			539.5[11]	not calculated
Bottlenose dolphins (*Tursiops truncatus*)	MHD	7.32	n/a	7.0	7.0	14.0	n/a	35
Average adult length:	Minimum depth	1.83	n/a	5.6	3.5/4.5[16]	6.0	2.55	6
2.74 m — AWA	Min surface area	4.42[12]	14 *or* 91[14]	n/a	80[17]	n/a	n/a	14 *or* 91
2.55 m — AMMPA	Minimum volume	38.48[13]	46	200[15]	320[18]	800[19]	55.58[20]	63
	Min vol each add'l animal	10.79	46	200	400	400	62.7[21]	63

(*continued on next page*)

Table 1. (Continued)

Species	Dimensions (meters (m), m^2, and m^3)	Current AWA standard	Couquiaud (2005) minimum identified[1]	United Kingdom	Italy	Brazil	Alliance of Marine Mammal Parks and Aquariums (AMMPA)	Recommendations[2]
Beluga whales (*Delphinapterus leucas*)	MHD	8.54	n/a	n/a	n/a	14.0	n/a	50
Average adult length:	Minimum depth	2.14				7.0	3.45	20
4.27 m — AWA	Min surface area	10.74				n/a	n/a	14 *or* 91
3.45 m — AMMPA	Minimum volume	27.56				800[22]	136.8[23]	154
	Min vol each add'l animal	30.63				400	153.9[24]	154

[1]Couquiaud did not identify the cetacean species for these dimensions, but the most commonly held species in her survey was the bottlenose dolphin
[2]All dimensions are additive, except for MHD and minimum depth, which are independent of the number of animals held in an enclosure
[3]Minimum horizontal dimension (in meters)
[4]Minimum depth (in meters)
[5]Minimum surface area per animal (in m^2) — min SA required for 1 *or* 2 animals is twice the per animal min SA, or 63.09 m^2
[6]Minimum volume per animal (in m^3) — min vol required for 1 *or* 2 animals is twice the per animal min vol, or 615.79 m^3
[7]Minimum volume for each additional animal in excess of 2
[8]Minimum surface area required for up to 5 animals is 12,000 m^3
[9]Minimum depth is 2.55 m or one average adult body length of the longest species housed in an enclosure, whichever is greater
[10]Minimum volume required for 1 *or* 2 animals is 1,918 m^3
[11]Minimum volume required for 1 *or* 2 add'l animals is 1,079 m^3
[12]Minimum surface area required for 1 *or* 2 animals is 8.84 m^2
[13]Minimum volume for 1 *or* 2 animals is 76.97 m^3
[14]The minimum surface area identified by Couquiaud was 14 m^2; the median surface area was 91 m^2
[15]Minimum volume required for up to 5 animals is 1,000 m^3
[16]Minimum depth is 3.5 m but must be at least 4.5 m in half of enclosure
[17]Minimum surface area required for up to 5 animals is 400 m^2
[18]Minimum volume required for up to 5 animals is 1,600 m^3
[19]Minimum volume required for 1 *or* 2 animals is 1,600 m^3
[20]Minimum volume required for up to 4 animals is 222.3 m^3
[21]Minimum volume required for 1 *or* 2 add'l animals is 125.4 m^3
[22]Minimum volume required for 1 *or* 2 animals is 1,600 m^3
[23]Minimum volume required for 1 *to* 4 animals is 547.2 m^3
[24]Minimum volume required for 1 *or* 2 add'l animals is 307.8 m^3.

et al. 2015). Home ranges can be 3,000–5,000 km north to south (Dahlheim et al. 2008). They routinely dive to depths in excess of 500 m, and a "shallow" dive is in excess of 7 m. In some populations, individuals dive in excess of 200 m up to a dozen times a day (Reisinger et al. 2015), while in others, they dive deeper than 150 m at least once every five hours (Baird et al. 2005).

It would be unrealistic to require a minimum standard that allows a captive killer whale to perform movements that are consistent with the growing body of data from telemetry studies. However, the standard should, at a minimum, allow a killer whale to move in the horizontal plane in a straight line for at least 10–12 tail strokes[49] (i.e., a minimum horizontal dimension (MHD) of 100 m), and in the vertical plane twice a typical "shallow" dive and also twice the average adult body length (i.e., a minimum depth of 15 m) (Table 1). The other required dimensions of minimum surface area and volume should be calculated per killer whale, based on this MHD and this minimum depth.

This standard is achievable, as at least one US facility proposed to construct such an enclosure. SeaWorld San Diego proposed to build the so-called Blue World Project, with dimensions similar to those proposed above.[50] Therefore, an appropriate enclosure is possible in both an engineering and financial feasibility sense.

3.4.2.1.1. *Impacts under current industry best practice.* The current largest primary enclosure holding killer whales in the United States has an MHD of approximately 23 m and a minimum depth of approximately 10 m (NAR personal observation). These dimensions are not adequate to safeguard killer whale welfare. One of the most obvious physical impacts of insufficient space, leading to insufficient movement, is the fully collapsed dorsal fins that distinguish captive male killer whales from free-ranging males (Ventre and Jett 2015). While not yet identified as a significant health or welfare problem, this physical deformity is emblematic of the inadequacy of the space afforded captive killer whales under industry best practice.

There are, however, measurable welfare impacts on captive killer whales under industry best practice. Survivorship is a significant, albeit not necessarily the most important (Mason 2010), metric for measuring welfare. Captive killer whale survivorship has improved over the past 30 years, but at best it still only matches that of populations of free-ranging whales known to be "endangered" or "threatened" (Robeck et al. 2015; Jett 2016). Robeck et al. (2015) concluded that captive killer whale welfare is now comparable to that of free-ranging whales, but many of these comparable free-ranging whales are experiencing far from optimal welfare; indeed, they have faced famine in recent years[51] (Olesiuk et al. 2005; Ford et al. 2009). Therefore, under current industry best-practice standards, which far exceed the current

[49] Throughout this section of the review, the recommendation to allow a cetacean to move at least 10–12 tail strokes (a tail stroke is roughly equivalent to one body length) in a straight line, *see* 67 Fed. Reg. 37731 (May 30, 2002), is based on the authors' common sense assessment of the taxon's natural history and what is reasonable from an engineering perspective.

[50] Architectural documents available from the California Coastal Commission and also available from NAR on request.

[51] *Killer Whale* (Orcinus orca), NOAA FISHERIES, http://www.nmfs.noaa.gov/pr/species/mammals/whales/killer-whale.html (last visited November 12, 2016).

AWA standards, the captive environment appears to affect killer whale survivorship in ways similar to degraded natural habitats.

Jett and Ventre (2015) also looked at survivorship, but with different methodologies, including the Kaplan-Meier and Cox proportional hazard models. Rather than compare their captive killer whale results with free-ranging populations, they evaluated captive survivorship by sex, facility (US vs. foreign), captive-born vs. wild-captured, pre- vs. post-January 1, 1985, and animal age upon entering captivity (Jett and Ventre 2015). A key result was that Kaplan-Meier survivorship curves noticeably drop at two clear life-history stages in captive killer whales—the juvenile and adolescent life stages. These drops are not necessarily paralleled in free-ranging whales (Jett and Ventre 2015; Matkin et al. 2014; Olesiuk et al. 1990). They concluded that, for juveniles, this was a result of routine separations from mothers and suggested that "managers may be advised to avoid the potentially stressful separation of captive-born calves and mothers between 2.0 and 6.0 years of age as can happen in the transfer of whales between parks" (Jett and Ventre 2015, 1374). For adolescents, "[t]his latter discrepancy suggests that advancing into physical and sexual maturity in the captive environment represents unique challenges to captive-born whales" (Jett and Ventre 2015, 1374).

In addition, at least two captive killer whales have died from mosquito-borne illness in low-latitude, inland areas (Jett and Ventre 2012; St. Leger et al. 2011; Buck et al. 1993). These deaths were likely caused by the relative sedentariness of captive killer whales compared to their free-ranging counterparts and their tendency to float motionless near the surface in excess of 15 minutes, up to hours at a time (Jett and Ventre 2012; NAR personal observation). This behavioral pattern, which greatly differs from the dynamic norm for free-ranging animals (see, e.g., Reisinger et al. 2015; Eisert et al. 2015; Durban and Pitman 2012; Matthews et al. 2011; Baird et al. 2005), can be attributed to the comparatively limited space captive killer whales have to perform normal movements.

Finally, captive killer whales wear and break their teeth because they persistently grind their teeth on the concrete walls and "pop" their jaws on the metal gates of their enclosures (Ventre and Jett 2015; Graham and Dow 1990). Most then have open holes drilled in their teeth, which are flushed regularly by caretakers but still serve as entry points for pathogens into the animals' systems (Ventre and Jett 2015). In all mammals, poor dentition can lead to poor health (Li et al. 2000).

Killer whale teeth in the wild generally do not suffer severe apical wear and only rarely exhibit breakage. When they do, this wear occurs at the population level, typically occurs in both the upper and lower jaws, and is attributed either to prey type or feeding method. For example, in the northeastern Pacific offshore ecotype, severe apical tooth wear is attributed to feeding on sharks (Ford et al. 2011), and in Type 1 North Atlantics, severe tooth wear is associated with suction-feeding (Foote et al. 2009). Northeastern Pacific resident and Type 2 North Atlantic teeth suffer little or no apical wear and only some lateral wear (Ford et al. 2011; Foote et al. 2009).

Given that captive whales' teeth almost never touch their food (fish are dropped directly into the open mouths of stationed whales; NAR personal observation), the etiology of the tooth wear and breakage seen in captive killer whales must be different, such as from stereotypical grinding of the teeth on walls and gates.

3.4.2.1.2. Other standards. The Alliance of Marine Mammal Parks and Aquariums (AMMPA), a professional association, requires certain minimum space requirements for a facility to receive AMMPA accreditation (AMMPA 2008). The AMMPA minimum depth for killer whales is 5.25 m. Its minimum volume per killer whale for the first two whales is 959 m^3 (that is, 1,918 m^3 for up to two whales). For every additional two killer whales, 1,079 m^3 of water must be added (539.5 m^3 per animal, but even if only one killer whale is added, the additional volume of water must be 1,079 m^3). The MHD for at least two killer whales under the regulations of the United Kingdom (UK Regulations) is 15 m, equivalent to the current MHD in the United States. However, minimum depth is 12 m, more than three times the current AWA minimum depth requirement. Under UK Regulations, the minimum volume for 1–5 killer whales is 12,000 m^3 (2,400 m^3 per whale), with 2,500 m^3 required for each additional whale above five (Table 1).

The current AWA volume requirement per whale for up to two killer whales is 307.9 m^3, with each additional whale above two requiring an additional 153.95 m^3. Thus overall the AMMPA and UK dimensions greatly exceed those of the AWA, and the UK depth requirement is similar to the recommendation above. If the AMMPA and UK Regulations are seen as industry best practice, the AWA space requirements for killer whales are highly inconsistent with best practice standards.

3.4.2.2. Bottlenose dolphins. A large number of studies examining movement patterns, habitat usage, diving behavior, and other behavioral and ecological characteristics have now been done on various populations of bottlenose dolphins (see, e.g., Mate et al. 1995; Defran et al. 1999; Gubbins 2002; Ingram and Rogan 2002; Hastie et al. 2003; Corkeron and Martin 2004; Klatsky et al. 2007; Sprogis et al. 2016). These studies have shown a wide variety of home range sizes, daily ranging patterns, habitat usage, and dive profiles. However, a common result of these studies shows bottlenose dolphins ranging far more widely (see, e.g., Mate et al. 1995; showing bottlenose dolphins ranging tens of kilometers per day) and diving more deeply (see, e.g., Klatsky et al. 2007; showing bottlenose dolphins diving up to 450 m) than was generally supposed 30 years ago. Based on this large and still emerging body of science, the currently required MHD of 7.32 m and depth of 1.83 m are inadequate for this species.

The smallest core range for a single bottlenose dolphin in one study was 0.6 km^2 (Gubbins 2002), which equates to 600,000 m^2. The minimum surface area per animal for bottlenose dolphins found by Couquiaud (2005) in her global survey of facilities was 14 m^2 (28 m^2 for up to two animals). The median surface area was 91 m^2 (182 m^2 for up to two animals). Yet the current AWA minimum surface area, for up to two bottlenose dolphins, is a mere 4.4 m^2 or 5.5 m^2 per dolphin, depending on the origin of the animal (Atlantic or Pacific, respectively).[52] The minimum volume Couquiaud (2005) found in her review of the captive marine mammal

[52] Animal Welfare; Marine Mammals, 81 Fed. Reg. 5629, 5652 (February 3, 2016).

industry was 46 m^3 per dolphin, yet the AWA minimum volume is 38.48 m^3 per dolphin (76.97 m^3 for up to two dolphins, regardless of subspecies). The minimum volume required for each additional dolphin under the AWA is 10.79–13.36 m^3 (for Atlantic and Pacific subspecies, respectively (Table 1)). Therefore, the AWA minimum dimensions for up to two bottlenose dolphins are based neither on current science nor industry best practice.

The standard should, at a minimum, allow a bottlenose dolphin to move in the horizontal plane in a straight line for at least 10–12 tail strokes (i.e., an MHD of 35 m), and in the vertical plane at least twice the average length of a dolphin (using the average length of the Pacific bottlenose, the larger of the two subspecies) (i.e., a minimum depth of 6 m). Minimum surface area should be no less than 14 m^2 per dolphin, in line with minimum industry practice (Couquiaud 2005) (any enclosure with an MHD of 35 m will have a surface area in excess of this minimum, however; therefore, another approach would be to set the minimum surface area to Couquiaud's median, i.e., 91 m^2 per dolphin, which would be in line with Italy's standard, as discussed below). Minimum volume should be no less than 63 m^3 per dolphin, in line with minimum industry practice (AMMPA 2008).

Wells (2009) notes that it is difficult to recreate natural social groupings for bottlenose dolphins in captivity. It is important to note that numerous publications clarify that average group size for bottlenose dolphins is generally ten dolphins or fewer (Ingram and Rogan 2002; Cubero-Pardo 2007; Wells 2009; Toth et al. 2011). Therefore, for bottlenose dolphins, if the group size in a licensed facility is more than ten dolphins, at least two enclosures, each meeting the minimum dimensions, should be provided and should be freely accessible to all dolphins at all times. At a minimum, this would provide the animals an opportunity to sort themselves into more natural-sized groups, which may reduce aggression (Bassos and Wells 1996; Couquiaud 2005) and the negative impacts of social stress (Waples and Gales 2002).

3.4.2.2.1. *Effects of enclosure size.* Bassos and Wells (1996, 324) found that dolphins were more active in the larger of two tanks and concluded that "increasing pool size enhances energetic opportunities for the animals and may decrease aggressive encounters." Ugaz et al. (2009) and Ugaz et al. (2013) found similar results, although in these studies the two enclosures differed additionally in that one was "open" (i.e., a sea pen) and larger, while the other was "closed" (i.e., a tank, although using natural seawater). The dolphins were significantly more active, exhibited more natural swimming patterns (Ugaz et al. 2009), and had lower salivary cortisol levels (Ugaz et al. 2013) in the larger sea pen enclosures than in the smaller tank enclosures.

Shyan et al. (2002) approached the question differently by measuring tank preference. They found that the dolphins in their study spent more time in the smaller two of three tanks when allowed free access to all three tanks. The authors therefore concluded that dolphins might prefer smaller enclosures. However, the smaller tanks were shallower and had smaller MHDs than the larger tank. It may be that bottlenose dolphins prefer shallower depths (in this case, the depths were 5.5 m versus

8.2 m, so both were still far in excess of the current AWA minimum depth requirement of 1.83 m), but if depth is similar, they might still prefer greater horizontal space. The enclosures in the other two studies were of similar depth and differed primarily in the horizontal dimension. It may be that bottlenose dolphin enclosures should have varying depths, including shallow areas of 1 m or less, to more closely simulate natural topography.

Additionally, the larger tank had public underwater viewing windows, while the smaller tanks did not. The dolphins may have simply preferred to be "off display" more than "on display." The authors did not address this possibility in their discussion. Furthermore, the dolphins clearly preferred one of the smaller tanks over the other when the two smaller tanks were virtually identical in size and shape and were accessed via similar gates. It is possible that the dolphins had some degree of negative association with the less preferred smaller tank or even the larger tank or strong positive associations with the preferred smaller tank. The authors did address this possibility in their discussion. The study design could not distinguish or eliminate any of these confounding factors.

3.4.2.2.2. *Impacts under current industry best practice.* While bottlenose dolphins do not typically suffer physical deformities to the same extent as those documented for killer whales (NAR personal observation), and their survivorship compares more favorably to free-ranging dolphins than that of killer whales (Small and DeMaster 1995; Venn-Watson et al. 2015), they still suffer direct impacts under industry best practice. For example, they appear to be more susceptible to certain diseases and health conditions than free-ranging dolphins.

The prevalence of hemochromatosis, a disease resulting from excess accumulation of iron in the blood, is striking in captive bottlenose dolphins compared to those in the wild (Johnson et al. 2009; Venn-Watson et al. 2012; Mazzaro et al. 2012; Venn-Watson et al. 2013). Cetaceans (and other marine mammals) in general have much larger stores of oxygen, bound to the iron-based molecules hemoglobin and myoglobin, than terrestrial mammals (Parsons 2013), an adaptation to diving. Free-ranging dolphins spend more than 70 percent of their time fully below the surface (Mate et al. 1995), some portion of that time at depths greater than 10 m, and routinely hold their breath longer than one minute. Captive dolphins spend at least a quarter of their time with their heads above water (Galhardo et al. 1996), never dive below 10 m, and rarely hold their breath for more than a minute (NAR personal observation). In short, these mammals, specially adapted to diving (Klatsky et al. 2007; finding that bottlenose dolphins are capable of dives 450 m or greater) and holding their breath (Corkeron and Martin 2004; finding that bottlenose dolphins are capable of holding their breath for eight minutes or longer), commonly suffer from a disease in captivity that appears to be caused by the very nature of captive conditions, where deep dives are not possible and long breath-holds rarely occur.

At least two captive dolphins are known to have died due to infections after being raked by another dolphin in the same enclosure (Buck et al. 1987; Zappulli et al. 2005). This particularly violent level of aggression (similar to that described for killer whales; Ventre and Jett 2015) is likely a byproduct of the relatively small space provided to captive dolphin groups and the subsequent inability of subordinate animals to escape the aggressive behavior of dominant individuals (see, e.g., Waples and Gales 2002). In addition, dominance hierarchies in the wild are relatively stable and clearly established, leading to reduced aggression (see, e.g., Sachser et al. 1998). In captivity, the relatively frequent transfers of dolphins between facilities likely destabilize dominance hierarchies, which may result in increased aggressive interactions.

3.4.2.2.3. Other standards. The AMMPA minimum space requirements for bottlenose dolphins are a depth of 2.55 m, a volume of 222 m^3 (for one to four dolphins, so 56 m^3 per dolphin), and a volume of 125.4 m^3 for every two additional dolphins above four (63 m^3 per dolphin, but if only one dolphin is added, the additional volume must still be 125.4 m^3) (AMMPA 2008) (Table 1). These exceed or greatly exceed the current minimum space requirements under the AWA.

Three other national jurisdictions have standards for bottlenose dolphins, including the United Kingdom (UK regulations), Italy (Italy regulations), and Brazil (Brazil regulations). Of these, only Italy actually has bottlenose dolphins on captive display. The UK regulation for MHD is 7 m, for minimum depth it is 5.6 m, and for minimum volume for one to five dolphins it is 1,000 m^3 (200 m^3 per dolphin). Each additional dolphin needs 200 m^3. Other than MHD, these dimensions greatly exceed the current minimum space requirements under the AWA. The Italy regulation for MHD is 7 m, the minimum depth is 4.5 m in at least half the enclosure and 3.5 m in the rest, the minimum surface area is 400 m^2 for one to five dolphins (80 m^2 per dolphin), and the minimum volume is 1,600 m^3 for one to five dolphins (320 m^3 per dolphin). Each additional dolphin needs 400 m^3 (Table 1). Again, other than MHD, these dimensions greatly exceed the AWA requirements.

Finally, the Brazil standard for MHD is 14 m, the minimum depth is 6 m, and the minimum volume is 1,600 m^3 for two dolphins (800 m^3 per dolphin). Each additional dolphin needs 400 m^3 (Table 1). These Brazilian standards are the largest minimum dimensions under any known jurisdiction. Best practice within the zoo and aquarium community and the standards in three other national jurisdictions have minimum space requirements that far exceed the current AWA space requirements for bottlenose dolphins.

3.4.2.3. Beluga whales. For up to two beluga whales, a facility must provide an MHD of 8.54 m and a depth of 2.14 m (Table 1). Minimum depth is only half as deep as an average beluga is long, so a beluga could not position itself fully in the vertical plane; its tail would drag on the bottom long before achieving full vertical orientation.

Numerous telemetry studies have been conducted on beluga whales using tags of various designs (see, e.g., Richard et al. 2001; Suydam et al. 2001; Martin et al. 2001; Hauser et al. 2014; Hauser et al. 2015). Before these studies, it was generally believed that belugas were primarily coastal in distribution, relatively sedentary, and favored shallow water (Richard et al. 2001). It is now known that belugas regularly travel 10–20 km per day and can cover 60–70 km in 24 hours (Hauser et al. 2014). More striking, belugas are capable of much deeper dives than was formerly believed; a recent study tracked belugas diving to 900 m and found they dove in excess of 600 m at least once daily (Hauser et al. 2015). Belugas commonly dive between 10 and 50 m (Hauser et al. 2015). Dives up to 16 minutes have been observed (Martin et al. 2001), and belugas regularly dive to the bottom of their habitat (Martin et al. 2001; Kingsley et al. 2001) and spend up to 80 percent of their time below the surface (Kingsley et al. 2001). Based on this still emerging body of science, the current AWA space requirements for this species are inadequate.

Given beluga diving profiles and their Arctic habitat (where coastal topography can drop relatively steeply, as much Arctic coastline was affected by glaciation),[53] this species, perhaps more than delphinids, needs deeper tanks based on average adult body length. The minimum depth requirement should be 20 m—twice the depth of a typical "surface-oriented" dive in the wild (Hauser et al. 2015). The MHD should, at a minimum, allow a beluga whale to move in the horizontal plane in a straight line for at least 10–12 tail strokes (i.e., 50 m). Minimum surface area should be no less than 14 m^2 per beluga, in line with minimum industry practice (Couquiaud 2005), although other approaches would base minimum surface area on the MHD recommended above or on Couquiaud's (2005) median surface area (91 m^2). Minimum volume should be no less than 154 m^3 per beluga, in line with minimum industry practice (AMMPA 2008; see below). All minimum dimensions should be per beluga, which will make enforcement easier (see Table 1).

3.4.2.3.1. *Impacts under current industry best practice.* Captive breeding for belugas has a poor record.[54] Again, while not definitive, a poor breeding record in captivity suggests welfare is compromised (Clubb and Mason 2003, 2007; Mason 2010). Although research on this situation in captive belugas is lacking, it is reasonable to conclude that captive conditions for this species have played a role in this poor breeding record. In addition, data on beluga longevity in the wild (Stewart et al. 2006; Small and DeMaster 1995) suggest that survivorship is lower in captivity. Industry best practice conditions are insufficient to safeguard the welfare of captive belugas.

3.4.2.3.2. *Other standards.* The AMMPA minimum space requirements for beluga whales are a depth of 3.45 m, a volume of 547.2 m^3 (for one to four belugas, so 136.8 m^3 per whale), and a volume of 307.8 m^3 for every two additional belugas above four (153.9 m^3 per beluga, but if only one beluga is added, the additional volume must still be 307.8 m^3) (AMMPA 2008) (Table 1). These dimensions exceed the current minimum space requirements under the AWA.

The Brazil regulations stipulate that belugas shall have an MHD of 14 m, a minimum depth of 7 m, a minimum volume per animal of 800 m^3, and for each additional animal, a minimum volume of 400 m^3 (the MHD and volume values are the

[53] *Continental Shelf*, NAT'L. GEOGRAPHIC SOC'Y ENCYCLOPEDIA, http://education.nationalgeographic.org/encyclopedia/continental-shelf (last visited January 21, 2017).

[54] *Georgia Aquarium Application to Import 18 Beluga Whales*, NOAA FISHERIES (September 29, 2015), http://www.nmfs.noaa.gov/pr/permits/georgia_aquarium_belugas.htm.

same as for bottlenose dolphins) (Table 1). These standards far exceed the current AWA standards.

3.4.2.4. Other cetaceans. Similar arguments regarding the inadequacy of current AWA space requirements can be made for all other cetaceans held in captivity. However, there are few data regarding fine-scale movement patterns for these other species—with the possible exception of pilot whales (*Globicephala* spp.) (see, e.g., Baird et al. 2002; Aguilar et al. 2008) and false killer whales (*Pseudorca crassidens*) (see, e.g., Baird et al. 2008; Baird et al. 2012). Regardless, most other captive cetaceans are delphinids (Couquiaud 2005); therefore, the generic aspects of the information presented above for killer whales and bottlenose dolphins are applicable to them. They are all large, wide-ranging, deep-diving predators, and the current AWA space requirements are inadequate to safeguard their welfare.

3.4.3. Sirenians

Sirenians appear to have two distinct movement patterns: small-scale, local movements and large-scale, longer distance movements (see, e.g., Deutsch et al. 2003; Sheppard et al. 2006; Castelblanco-Martinez 2013). The small-scale movements are on the order of kilometers over the course of several days; the large-scale movements are on the order of hundreds of kilometers over the course of months (Deutsch et al. 1998; Deutsch et al. 2003). Given these ranging patterns, an MHD only two times the average adult body length and a depth half as deep as an average adult body is long are once again inadequate.

Manatees and dugongs (*Dugong dugon*) are slower than cetaceans and are grazers rather than hunters and thus may cope when provided relatively small spaces in captivity, but the current minimum dimensions are still insufficient to allow sirenians to "make normal postural and social adjustments with adequate freedom of movement" both horizontally and vertically. While industry best practice information is lacking, it is likely that the current AWA space requirements are inadequate to safeguard the welfare of captive sirenians based on their natural history and ranging patterns. APHIS should develop new space standards for sirenians based either on industry best practice or the science describing the natural ranging patterns of these species.

3.4.4. Pinnipeds

The ranging patterns of pinniped species vary widely. It has long been assumed that pinnipeds are relatively sedentary (Lesage et al. 2004), at least outside of annual migratory periods. Nevertheless, there is a large and growing body of telemetry studies that indicates that many pinniped species range relatively widely on a seasonal basis (see, e.g., Lesage et al. 2004; Cunningham et al. 2009; Kuhn and Costa 2014), dive fairly deep (see, e.g., Photopoulou et al. 2014; Kuhn and Costa 2014; Lowther et al. 2015), and spend less than a quarter of their time hauled out (see, e.g., Cunningham et al. 2009; Udevitz et al. 2009). However, in many pinniped enclosures, the space dedicated to the tank of water is relatively small compared to the dry resting area offered (NAR personal observation). Given the natural pinniped pattern of time spent in water and on dry land, this tendency is problematic for the animals' welfare.

The current AWA regulations state that "the minimum surface area of a pool of water for pinnipeds shall be at least equal to the dry resting or social activity area *required*."[55] Given how small the current minimum space requirements for dry resting areas are for pinnipeds, it is entirely possible (and legal) for facilities to provide pools of water that are, in fact, much smaller than the dry resting area they provide. This language should thus be clarified as follows: "The minimum surface area of a pool of water for pinnipeds shall be at least equal to the dry resting or social activity area *provided*." Providing equivalently sized dry resting and pool areas for pinnipeds, even when a facility exceeds the minimum space requirements, should be the minimum required.

The minimum surface area for pinniped tanks should be determined based on an animal's ability to swim in a straight line for at least several body lengths (similar to the recommendation for cetaceans), and surface area and volume requirements should be per animal. Minimum depth should be at least twice the average adult body length, as pinnipeds routinely dive to far greater depths than was supposed in 1984 (see, e.g., Kuhn and Costa 2014, 1297; describing a California sea lion dive to 60 m as "shallow"). APHIS should review the size of pinniped enclosures nationwide and determine industry best practice, so that its minimum space requirements are solidly based on current industry practice.

3.4.5. Polar bears

Primary enclosures must provide polar bears with a pool of water, a dry resting and social activity area, and a den.[56] However, the current minimum space requirements for these enclosure elements are neither science-based nor consistent with industry best practice. In nature, polar bears often have home ranges on the order of tens of thousands of km^2 (see, e.g., Amstrup et al. 2001; in Parks et al. 2006, one collared female's home range was determined to be approximately 300,000 km^2). Within these massive home ranges, bears traverse hundreds, if not thousands, of kilometers in a year (see, e.g., Lentfer 1983; Amstrup et al. 2001; Parks et al. 2006). Recent telemetry work has determined that polar bears are also capable of longer breath-holds than was previously supposed; one bear was tracked on a three-minute dive, during which it covered 45–50 m without surfacing (Stirling and van Meurs 2015).

The AWA regulations require a minimum of 37 m^2 of dry resting and social activity area for up to two polar bears, with an additional 3.72 m^2 of dry resting and social activity area for each additional polar bear. Given the natural ranging patterns of this species and the tendency of the species to be solitary outside of the breeding season, these minimum space requirements are inadequate. Indeed, the AZA recommends

[55] 9 C.F.R. § 3.104(d)(3)(i) (2001) (emphasis added).
[56] 9 C.F.R. § 3.104(e) (2001).

that up to two polar bears be given 500 m^2 of dry resting and social activity area, with each additional bear receiving 150 m^2 of area (AZA Bear TAG 2009). While still inadequate, this is an order of magnitude more than the AWA currently requires and represents industry best practice.

The AWA regulations require a pool of water be provided with an MHD of 2.5 m, a minimum depth of 1.5 m, and a minimum surface area of 9 m^2 for up to two polar bears. For each additional bear, the surface area of the pool must be increased by 3.7 m^2. However, the AZA recommends that a polar bear pool have a minimum depth of 3 m and a minimum surface area of 70 m^2. While still inadequate, these industry best practice standards are once again an order of magnitude greater than the AWA standards.

Both the natural history of this species and the research found in zoo literature (see, e.g., Clubb and Mason 2003, 2007) strongly indicate that not even current best practice standards are sufficient to prevent compromised welfare in polar bears. Polar bears are among the zoo species mostly likely to exhibit persistent stereotypies, most notably pacing (e.g., Clubb and Mason 2003). Therefore, it is recommended that a minimum surface area of 250 m^2 per animal be provided for dry resting and social activity areas and no less than 3 m depth and 35 m^2 of surface area per animal for pools.

3.4.6. Sea otters

The AWA minimum depth required for a sea otter tank is currently 0.9 m. At this depth, a sea otter would be unable to position itself fully in the vertical plane. In addition, the mean foraging dive depths for sea otters in Alaska are bimodal—either 8 m or 44 m (Bodkin et al. 2004). Sea otters are capable of diving to 100 m (Bodkin et al. 2004), far deeper than supposed historically. The latest science does not support a tank that is less than a meter deep for this species. Given the "shallow" bimodal foraging dive depth, at a minimum a sea otter tank should be 8 m deep.

Sea otters range up to 50 km along a coastline (Laidre et al. 2009), making the MHD of 3.75 m inadequate. Sea otters in nature spend almost half their time resting/floating in the water (Laidre et al. 2009), a behavioral pattern that does not appear to be replicated in captivity (NAR personal observation). The surface area of the required pool of water in a sea otter enclosure may not encourage "rafting," a behavior where a group of sea otters float within touching distance of each other, often segregated by sex (Riedman and Estes 1990). Any pool for sea otters should at a minimum accommodate this behavior for multiple sea otters.

3.5. Water quality[57]

3.5.1. General

The proposed rule does not amend the standards to include additional quantitative monitoring requirements for enclosure water, such as for chlorine, copper, and

[57] 9 C.F.R. § 3.106 (2001).

ammonia. Table 6.2 in Couquiaud (2005) has water quality standards with a range of values (rather than a point value) for each factor. These ranges should be adopted, as they have a solid basis in current science and industry best practice.

3.5.2. Bacterial standards

The proposed rule has new total and fecal coliform standards and requires tests for *Enterococci*, *Pseudomonas*, or *Staphylococcus* levels.[58] However, a facility need conduct only one of these latter three tests, and which one is at the facility's discretion. All three tests should be made mandatory, given that each of these pathogens indicates a different health problem and water quality concern.

Quantitative standards for additional chemicals, especially, but not necessarily limited to, chlorine, copper, ozone, nitrates, and ammonia, should be established. The current requirement to monitor levels of various unspecified chemicals[59] is meaningless without a quantitative standard and without a specific and comprehensive list of chemicals. Again, Couquiaud (2005)'s Table 6.2 provides constructive guidance.

3.5.3. Salinity

The proposed rule requires salinated water for all relevant marine mammals, but it exempts "pinnipeds where oral administration of sodium chloride (salt) supplements at appropriate levels for the species, as determined by the attending veterinarian, is provided and saltwater eye baths are used on a daily basis."[60] There is no justification, in the species' natural history, current science, or industry best practice, to provide pinnipeds with freshwater only. Only river dolphins should be exempted, as they are the only "marine" mammals that are truly freshwater species.

3.6. Interactive programs

3.6.1. Inspections, health trends, and disease transmission

On page 5632 of the proposed rule, footnote 2 states:

> We note that interactive programs have been operating for over 20 years without any indications of health problems or incidents of aggression in marine mammals, as evidenced by medical records maintained by licensed facilities and observations by experienced APHIS inspectors.[61]

Reporting requirements for interactive programs have been suspended for 17 years.[62] The above statement is based solely on annual inspections, which are insufficient to draw such a comprehensive conclusion. While there are some papers

[58] 81 Fed. Reg. 5629 5638 (February 3, 2016).
[59] 9 C.F.R. §3.106(b)(3) (2001).
[60] 81 Fed. Reg. 5629, 5656 (February 3, 2016).
[61] 81 Fed. Reg. 5629, 5632 (February 3, 2016).
[62] 9 C.F.R. § 3.111 (suspended regulations for swim-with-the-dolphin programs where tourists are allowed to swim and come into physical contact with live marine mammals) (suspended April 2, 1999, *see* 64 Fed. Reg. 15918, 15912 (April 2, 1999)).

offering limited datasets to support the absence of behavioral abnormalities associated with participating in interactive programs (e.g., Miller et al. 2011; Trone et al. 2005), there are apparently no published data regarding the health of marine mammals participating in interactive programs.

Observations by inspectors do not obviate the need for scientific support. Any references to long-term trends in health cannot be supported by anything gleaned from once-yearly inspections. Additionally, unless medical records have been systematically analyzed for trends or correlations with interactive program participation, the footnote is mere supposition.

There are numerous pathogens[63] of concern that are zoonotic[64] (see, e.g., Goertz et al. 2011), as well as potential health risks from chemical contaminants. For example, sunscreen-derived toxins have been found in free-ranging dolphins, and these toxins can be transmitted from mothers to fetuses (Alonso et al. 2015). This raises the possibility that swimmers could, over time, poison marine mammals used in interactive programs, given that professional associations recommend that member facilities only require guests to wash hands and step in foot baths prior to entering the water (e.g., AMMPA 2013).

There are even fewer data available regarding whether interactive programs pose a risk to human participants. Studies of the people who participate in these programs should be undertaken to evaluate the possible human health risks. *Staphylococcus aureus*, including drug resistant strains, is common in dolphins (Venn-Watson et al. 2008) and may be zoonotic (Faires et al. 2009). *Clostridium perfringens* infection has been fatal in at least one captive dolphin (Buck et al. 1987); this is among the most common pathogens responsible for food poisoning in humans[65] and was isolated from the tank water in that case. *Brucella* is also common in cetaceans and is zoonotic (Van Bressem et al. 2009; Guzmán-Verri et al. 2012), although cetacean strains to date appear to have low infectivity and virulence in humans. Nevertheless, the true danger posed by cetacean strains of *Brucella* to humans remains unknown (Guzmán-Verri et al. 2012). Other pathogens, such as *Toxoplasma*, may also pose some degree of risk to people in close contact with infected cetaceans (Van Bressem et al. 2009). Tuberculosis in pinnipeds has been transmitted to caretakers (Kiers et al. 2008). Marine mammal handlers, who are frequently exposed to the animals, face unique health risks (Hunt et al. 2008).

3.6.2. Refuge and/or sanctuary areas

One study showed that "sanctuary"[66] use by dolphins in interactive programs increased significantly when swimmers were in the water (Kyngdon et al. 2003). The sanctuary area was actually smaller than the interactive area, but it was of a size and

[63] Disease-causing agents.
[64] Pathogens that can pass from animals to humans and vice versa.
[65] *Food Safety* (homepage), CENTERS FOR DISEASE CONTROL & PREVENTION, http://www.cdc.gov/foodsafety/diseases/clostridium-perfringens.html (last updated October 8, 2015).
[66] A location that animals can voluntarily retreat to that is free from human contact.

accessibility that enabled the animals to increase their use of it during interactive sessions.

The proposed minimum space requirements of a sanctuary area for animals involved in interactive programs is an area 7.3 m wide by 7.3 m long by 1.8 m deep.[67] There are not enough data to conclude that an enclosure of the size proposed would provide the dolphins with safe haven when they do not wish to interact with swimmers. Given the risks to swimmers should a dolphin (or sea lion) become aggressive or fail to respond to a trainer's commands, establishing performance-based standards (as the rule proposes)[68] for the interactive area's space requirements might ultimately not provide adequate space for swimmers to avoid aggressive animals and to exit the pool safely.

Therefore, the sanctuary area should meet the standards recommended for primary enclosures above, although it is understood that the interactive area can be smaller than the sanctuary area. A smaller interactive area may allow greater control over the animals, which may improve safety for humans interacting with the animals (Samuels and Spradlin 1995). Therefore, the interactive area should be no less than half the size of the sanctuary area in terms of MHD (i.e., 17.5 m). The current minimum surface area, volume, and depth requirements[69] should be retained for the interactive area.

3.6.3. Employees

Marine mammals have specific handling, care, and treatment requirements, given their evolutionary adaptations to an aquatic ecology. In all ways, employee background and experience should be specific to marine mammals. The proposed performance-based standards, using terms such as "adequate" and "demonstrable"[70] for employee qualifications, are insufficient to safeguard the welfare of captive marine mammals.

3.6.4. Handling

In addition to requiring the screening of interactive program marine mammals for good health,[71] for the sake of the health of the animals and human participants, all staff and participants in interactive programs should disclose any illness, particularly of an infectious nature, before entering a marine mammal enclosure. AMMPA (2013, 7) requests that "a guest certify that he/she is in good physical health with no illnesses, disabilities, injuries … [and that a program] preclude guests with any respiratory infection, opens sores, or other outward signs of contagious illness from interacting with dolphins." Similar language should be included in the final rule, but the disclosure should be mandatory.

[67] Animal Welfare; Marine Mammals, 81 Fed. Reg. 5629, 5651 (February 3, 2016).
[68] *Id.* at 5640.
[69] 9 C.F.R. § 3.111(a).
[70] Animal Welfare; Marine Mammals, 81 Fed. Reg. at 5656.
[71] *Id.* at 5657.

The proposed extension of the interactive time between marine mammals and the public from two hours to three is based on a suggestion from the zoo and aquarium community.[72] This is a conflict of interest and not science-based. Similarly, the proposals to replace the quantitative requirements for human participant-to-interactive marine mammal and human participant-to-attendant ratios of 3:1 with performance-based standards[73] are not supported by data. None of these changes should be included in the final rule.

3.6.5. Veterinary care

The proposed rule removes the enhanced requirements for veterinary care for interactive programs, particularly on-site monthly evaluations and biannual physical examinations.[74] These requirements are precautionary, as the marine mammals in interactive programs are exposed directly to the public and are at increased susceptibility to injury and disease as a result of these direct interactions. The enhanced requirements for veterinary care should be retained, at least until such time that scientific studies show that these requirements are not necessary.

3.6.6. Recordkeeping

The proposed rule removes the requirement to record statistical summaries of the number of minutes per day that each animal participates in an interactive session and the number of human participants per month in the interactive program.[75] It also reduces the time that other records are kept from three years to one year.[76] Given that the standards for recordkeeping have not been enforced for 17 years, and therefore detailed records have not been kept uniformly across all interactive programs in the United States and presumably have not been reviewed or evaluated by APHIS inspectors, decreasing the time these records must be kept before any facility has ever even had to keep them at all is premature, especially since record storage space is not an issue (records can be stored electronically). These requirements were presumably introduced to ensure that animals were not exposed to levels of interaction that might impair animal health, and the fact that these data are not being used for regular scientific evaluation is more a lack of oversight than a lack of usefulness of the data.

Importantly, feeding and petting programs should be required to report all aggressive or injurious incidents. This inclusion would be automatic if these programs were included in the definition of "interactive program," as recommended above.

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[72] *Id.* at 5641.
[73] "There must be a *sufficient number* of session attendants (includes trainer, handler, or attendants) to *effectively conduct* the session in a *safe manner*," and "[t]he number of public participants per marine mammal must not exceed *the number that the attendant can monitor safely*." *Id.* at 5657 (emphasis added).
[74] 9 C.F.R. § 3.111(g)(1), (3).
[75] 9 C.F.R. § 3.111(f)(5)(i), (ii).
[76] Animal Welfare; Marine Mammals, 81 Fed. Reg. at 5638–39.

4. Recommended additions to the regulations

4.1. Noise

Species-specific noise standards should be formulated for both indoor and outdoor facilities. Zoos and aquariums should eliminate loud, intermittent, impulsive sounds (see, e.g., Romano et al. 2004; Wright et al. 2007, on how these sounds are most likely to elicit stress responses) near marine mammal enclosures from sources such as fireworks and roller coasters, and limit received decibel levels of mechanical noise from facility equipment as measured along the pool walls, floors, structures, and acoustic nodes within a tank. There is now a considerable body of research on noise impacts on marine mammals (see, e.g., Miksis-Olds et al. 2007; Romano et al. 2004; Wright et al. 2007), including in captivity, which should be consulted when addressing this point.

Zoos and aquariums often claim that marine mammals are not bothered by in-air noise (see, e.g., Scheifele et al. 2012, which measured in-air sound levels at Georgia Aquarium but discussed the results only in terms of what was audible underwater).[77] This argument assumes that captive marine mammals spend most of their time below the water's surface. However, most captive marine mammals, including cetaceans, are at the surface much of the time, with their heads above water (see, e.g., Galhardo et al. 1996, on how captive bottlenose dolphins spend at least a quarter of their time with their heads out of water, alert for commands and food delivery from their trainers). Therefore, in-air noise levels are relevant to captive marine mammals.

4.2. Enrichment

Morgan and Tromborg (2007, 264) noted the following:

> Prior to the introduction of the concept of environmental enrichment … most artificial environments were structurally simple and unresponsive to behavior. Typically, these environments did not provide animals with opportunities to interact with their surroundings in ways which promoted the development of sensory and cognitive abilities, or that allowed display of species-typical behaviors.

This remains the case today for marine mammals across the board when they are held in concrete tanks. Most tanks are smooth-sided concrete and painted a light color, with few, if any, features below the waterline. There is no opportunity for marine mammals to interact with their surroundings and little opportunity to display species-typical behaviors. Many of the stereotypies associated with captive marine mammals therefore appear to arise from a lack of enrichment in their

[77] However, even Scheifele et al. (2012, EL92) noted that "care should still be taken not to locate public address speakers (those used for the demonstrations and shows in aquariums) over the water, since the coupling of sound pressure is significant in the vertical plane." Note, however, that they do not address the in-air component of the sound emitting from such public address speakers and its potential impact on cetaceans stationed by trainers or otherwise with their ears above water.

enclosures (see, e.g., Canino and Powell 2010; Franks et al. 2010; Kuczaj et al. 2002; Morgan and Tromborg 2007).

Many marine mammal species, including virtually all of the cetaceans, are not strictly on a diurnal cycle (Hastie et al. 2003; Kingsley et al. 2001; O'Corry-Crowe et al. 2009; Sekiguchi and Kohshima 2003; but see Baird et al. 2005 and Suzuki et al. 2003). Most marine mammal activity cycles are tied to prey movements, which in the marine environment may mean greater activity at night. For cetaceans, their echolocation abilities and deep diving make daylight somewhat immaterial to guiding activity cycles. Therefore, leaving marine mammals alone all night in concrete enclosures, with no human interaction, can create behavioral and psychological problems, including boredom.

The current AWA regulations contain no reference to environmental enrichment.[78] As an example of regulatory language referring to enrichment, the European Zoo Directive[79] states:

> Member States shall take measures under Article 4, 5, 6 and 7 to ensure all zoos implement the following conservation measures (including): Accommodating their animals under conditions which aim to satisfy the biological and conservation requirements of the individual species, inter alia, by providing *species specific enrichment of the enclosures* ….

In addition, Couquiaud (2005) notes that topography is one primary element that is neglected in captive environments, where irregular shapes, interesting bottomscapes, and other design features can diversify and enrich an artificial environment and increase the welfare of cetaceans in them. Lack of space in an enclosure might be compensated for to at least some degree when the animals are able to do more within that enclosure (McPhee and Carlstead 2010). The following papers address enrichment in marine mammals, but others may exist: Cox et al. (1996), Hawke et al. (2000), Kuczaj et al. (2002), Kastelein et al. (2007); Canino and Powell (2010), Clark (2013), Anzolin et al. (2014), and Hocking et al. (2015). Some form of enrichment should be required in marine mammal enclosures, and there should be a periodic review of the animals' interaction with these enrichment features to assess habituation or waning interest.

4.3. Retreat space

Virtually all cetaceans, sea otters, manatees, and most pinnipeds have no freely accessible retreat space in their exhibits (NAR personal observation). Unlike many other animals kept at zoos, they cannot go "off display" or escape from conspecifics voluntarily, but only when handlers open gates or doors to allow them access. This absence of retreat space has led to serious aggressive interactions between animals,

[78] *See* 9 C.F.R. §§ 3.102–3.103.
[79] Council Directive 1999/22/EC, art. 3, 1999 O.J. (L 094) (EU) (emphasis added) (related to the keeping of wild animals in zoos), http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31999L0022.

in at least some cases leading to serious injury and even death (Parsons 2012; Ventre and Jett 2015; in 1989, the killer whale Kandu attacked Corky at SeaWorld San Diego, broke her own jaw, and died).

All primary enclosures for every species of marine mammal should have "off display" retreat or refuge space. As with "sanctuary" areas in interactive programs (which are, however, rarely sheltered from public viewing), this retreat space should be inviting and freely accessible to all animals at all times. Shyan et al. (2002) is an example of a situation where bottlenose dolphins, when freely given a choice, appeared to prefer a smaller space over the main enclosure, possibly because the smaller space lacked an underwater viewing window and was more removed from the public. In addition, most marine mammal social groupings in captivity are wholly artificial in composition (see, e.g., Wells 2009), meaning social stress can be significant (see, e.g., Waples and Gales 2002). Retreat space should therefore also serve to allow animals to escape from conspecifics during aggressive altercations.

5. Conclusion

The vast majority of the proposed rule's regulatory amendments, as well as the provisions with no proposed changes, will mean that the negative impacts that marine mammals have suffered from the outset of their maintenance in captivity will continue unabated, unless the proposed rule is revised substantially prior to being finalized. Indeed, the proposed rule maintains the AWA standards as among the weakest in the world for marine mammals. The proposed rule should be revised per the recommendations presented above. The proposed rule in its current form does not accomplish APHIS's stated goal of basing its proposal on "current industry and scientific knowledge and experience,"[80] nor does it meet the standard of the AWA to "insure that animals intended … for exhibition purposes … are provided humane care and treatment."[81]

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[80] Animal Welfare; Marine Mammals, 81 Fed. Reg. 5629, 5629 (February 3, 2016).
[81] 7 U.S.C. § 2131(1).

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