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Rescue and handling of Antillean manatees *Trichechus manatus manatus* in Venezuela 1992–2014

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Given the importance of the rescue and rehabilitation of confiscated manatees from illegal traffic or accidental fishery entanglements, the handling and transport of two Antillean manatees *Trichechus manatus manatus* in the 'Llanos' of Apure state in Venezuela is described. In 1992, two ♀ calves were confiscated in the region of Arichuna in the Apure River and transported to a lagoon at the Fondo Nacional de Investigaciones Agropecuarias, Biruaca, for rehabilitation. Data about age, size, weight and haematological values were recorded. In 1994, one of the manatees was transferred to the Parque Zoologico y Botanico Bararida, Barquisimeto, in order to form a breeding pair and start a captive-breeding programme. Successful reproduction was achieved in 2007, 2011 and 2013. In 1995, the second ♀ Antillean manatee was released into a natural environment in Santa Luisa Cattle Ranch, Apure state. The confiscation, rescue, rehabilitation and transport (by land and air) of these two ♀ Antillean manatees were carried out satisfactorily.

Key-words: captive breeding; capture; confiscation; haematology; manatee; rehabilitation; transport.

INTRODUCTION

The Antillean manatee *Trichechus manatus manatus* is Red Listed as Endangered by the International Union for Conservation of Nature (IUCN, 2015), and in Venezuela, it is registered as a species under a 'hunting ban' and in 'danger of extinction', according to Ordinances 1485 and 1486 (Gaceta Official No. 36.059: Ejecutivo Nacional, 1996a,b). The Red Book of Venezuelan Wildlife catalogues the Antillean manatee as 'critically endangered' (Ojasti & Lacabana, 2008; Castelblanco-Martínez *et al.*, 2012). The wild population of the species is distributed in the tributaries of rivers in lower and middle Orinoco, also in rivers of the eastern Atlantic coast, the Orinoco Delta and to the west in the Maracaibo Lake (Mondolfi, 1974, 1995; Mondolfi & Müller, 1979; O'Shea *et al.*, 1988; Correa-Viana, 1995; Linares, 1998; Castelblanco-Martínez *et al.*, 2005; Manzanilla-Fuentes, 2007; Hoyt, 2011; Rivas Rodríguez *et al.*, 2012; Rodulfo, 2012).

The first live Antillean manatee to be rescued and handled in Venezuela was a calf caught in 1985 in the Portuguesa River and transported to Acuario de Valencia (Boede & Mujica, 1995; Martínez, 1995).

In February 1992, the National Guard and the Autonomous Service of Wild Fauna (Profauna) of the Ministerio del Ambiente y de los Recursos Naturales Renovables (MARNR: Ministry of Environment and Renewable Natural Resources) confiscated two ♀ Antillean manatee calves from local fishermen in the Arichuna region of the Apure River (Plate 1). These manatees were transported to Fondo Nacional de Investigaciones Agropecuarias (FONAIAP: National Fish and Agricultural Research Center), Biruaca, Apure state, for rehabilitation (Boede & Mujica, 1995; Bolaños & Boher-Benti, 1995; Correa-Viana, 1995;

Plate 1. Handling a rescued Antillean manatee *Trichechus manatus manatus*, **February 1992.** *E. O. Boede & E. Mujica-Jorquera.*

Boede *et al.*, 2013). In the past, the Arichuna region was an area of high population densities of this species, but the indiscriminate and careless historical hunting and exploitation of the Antillean manatee as a source of meat, fat and skin drastically decimated the population (Röhl, 1956; von Humboldt, 1959; Mondolfi & Müller, 1979; O'Shea *et al.*, 1988; Mondolfi, 1995; Royero, 1995; Linares, 1998; Ojasti & Lacabana, 2008).

In January 1994, Antillean manatee (A), a ♀ called 'Biruaca', was transferred to the Parque Zoologico y Botanico Bararida (PZBB), Barquisimeto, Lara state, Venezuela, in order to form a breeding pair with a ♂ that had been confiscated from Maracaibo Lake in September 1992. In 1995, the second ♀ Antillean manatee (B), called 'Arichuna', was transferred and released in the Arauca River Basin at Santa Luisa Cattle Ranch (Boede, 2012).

MATERIALS AND METHODS

Just after they were confiscated in 1992, both ♀ manatees (A and B) were measured, sexed and blood samples were taken (Tables 1 and 2). Female B's blood sample haemolysed so for 1992 there were no blood-chemistry data recorded for this manatee. No blood samples were collected in 1994 when morphometric measurements were taken for both ♀♀. In 1995, another blood sample was obtained from ♀ B and analysed (Table 2). These ♀♀ were kept at FONAIAP, in a 200 m^2 lagoon and fed *ad libitum* with the grass *Paspalum fasciculatum* and, occasionally, with Water hyacinth *Eichhornia crassipes.* According to the techniques described by White & Francis-Floyd (1990) and Stamper & Bonde (2012), blood sampling was carried out using a 5 ml syringe with a 37 mm-long 19 gauge needle, inserted into the medial side of the pectoral flipper reaching the brachial vascular plexus (Plate 2). Blood was kept in two test tubes, one with and one without ethylenedinitrilotetra acetic acid (EDTA) anticoagulant, refrigerated in ice and evaluated (Wallach & Boever, 1983; Bossart *et al.*, 2001; Vanoye Lara, 2002; Kahn, 2005; Menezes de Oliveira, 2008; Harvey *et al.*, 2009; Stamper & Bonde, 2012).

	1992		1994	
MEASUREMENTS	MANATEE A	MANATEE B	MANATEE A	MANATEE B
Total length (straight-line tip of the snout to posterior edge of the tail fluke) (cm)	170	187	178	200
Weight (kg)			80	119
Base circle of the tail fluke (cm)	67	74		
Genital opening to anus (cm)	6	8		
Genital opening to umbilicus (cm)	35	37	40	43
Approximate age (years)	1·5	1·5–2	3·5	4

Table 1. Morphometric measurements for two ♀ Antillean manatees *Trichechus manatus manatus*: Manatee A. 'Biruaca'; Manatee B. 'Arichuna'.

Given the basic conditions at FONAIAP, where there was no water-exchange system, limited food supply and a lack of suitable staff, Profauna-MARNR decided to transfer the manatees to better environments. Female A was transferred to PZBB after 2 years and ♀ B was released into a natural environment after 3 years.

In January 1994, when it was coolest at 0700 hours, the ♀ Antillean manatees were each captured with a fishing net. They were weighed using a stretcher on scales (200 kg) and various measurements were taken, including straight-line total length (TL), distance from the tip of the snout to the posterior edge of the tail fluke and distance from the genital opening to the umbilicus and to the anus (for sexing) (Table 1) (White & Francis-Floyd, 1990; Reynolds & Odell, 1991; Bossart, 2001; Vanoye Lara, 2002; Reisfeld *et al.*, 2010; Stamper & Bonde, 2012; Caribbean Stranding Network, undated).

Transfers

Female A was transported by pick-up truck to the San Fernando de Apure Airport, 8 km away, and later to the Barquisimeto Airport by a Super Puma helicopter belonging to the Venezuelan Air Force. The Antillean manatee was placed in a plywood transport box, measuring 190 cm × 90 cm × 60 cm wide, waterproofed on the inside with fibreglass. The animal was placed in a ventral–dorsal position, with the flippers close to its body, on a 20 cm-thick foam mattress, and its body was covered with a blanket exposing the face. The blanket and mattress were soaked with aqueduct potable fresh water and sprayed every 15 minutes, in order to prevent drying and overheating, using the same technique describe by Joseph *et al.* (1990) and Bossart (2001). To avoid low temperatures and hypothermia, the 319 km journey took 1 hour flying at a

VALUES	1992 MANATEE A	1995 MANATEE B
HAEMATOLOGY		
Haemoglobin	14 g dl^{-1}	9·9 g dl^{-1}
Haematocrit	37%	30%
MCHC	37·8 g dl^{-1}	33 g dl^{-1}
Leucocytes	18 800 mm^{-3}	6300 mm^{-3}
Neutrophils mm^3/%	5600/30%	3780/60%
Lymphocytes mm^3/%	10 716/57%	2205/35%
Eosinophils mm^3/%	2256/12%	0·315/5%
Monocytes mm^3/%	0·188/1%	0/0%
Basophils mm^3/%	0/0%	0/0%
BLOOD CHEMISTRY		
Glucose		57 mg dl^{-1}
Blood urea nitrogen		20 mg dl^{-1}
Creatinine		1·2 mg dl^{-1}
Uric acid		5·4 mg dl^{-1}
Total proteins		7·7 g dl^{-1}

Table 2. Haematology and blood-chemistry values for two ♀ Antillean manatees *Trichechus manatus manatus*: Manatee A. 'Biruaca'; Manatee B. 'Arichuna'; MCHC. mean cell haemoglobin concentration.

Plate 2. Blood collection (for analyses) on the medial side of the pectoral flipper of a rescued Antillean manatee *Trichechus manatus manatus* **calf.** *E. O. Boede & E. Mujica-Jorquera.*

low elevation of 800 m a.s.l. and an average temperature of 26°C. The manatee's respiratory rate (RR) was monitored constantly, and no antibiotics or corticosteroids were administered (Sandoval-Bavaresco, 2000; Antrim & McBain, 2001; Vanoye Lara, 2002; Reisfeld *et al.*, 2010; Wong *et al.*, 2012). From Barquisimeto Airport, the ♀ manatee was transferred in a covered pick-up truck to the PZBB *c.* 9·2 km away. Once at PZBB, which has no quarantine facilities for this species, the ♀ Antillean manatee was placed in the exhibition tank, next to the resident ♂ but separated by a grille. After a month of getting used to each other, the ♂ and ♀ were allowed to inhabit the tank together, without further separation. No problems or incidents were recorded when introducing these two manatees.

In February 1995, ♀ B was transferred to Santa Luisa Cattle Ranch, located 12·8 km south of FONAIAP, into a natural environment with a small river and calm waters. A provisional area was fenced off to comply with the quarantine regulations and to allow the manatee to adapt to its new location. Female B remained in the partitioned area for 1 month before she was released into the open river system. The techniques used for capture, blood sampling (Table 2) and transport were carried out following the same methodology as before. Once ♀ B was released, she was not monitored because there were no radiotelemetry facilities available at that time.

RESULTS AND DISCUSSION

The growth rates recorded at FONAIAP for ♀ A and ♀ B over 23 months were 8 cm and 13 cm, respectively (Table 1). In Mexico, Vanoye Lara (2002) reported a growth rate of 30 cm per year for a ♀ calf of the same subspecies in captivity. Data provided by C. Silva (unpubl. data) revealed that ♀ A grew in length by 52 cm after 14 months in the more favourable environment offered at PZBB, indicating a significant improvement in nutrition and recovery of health. In fact, after only 6 months, ♀ A had gained 40·7 kg, reaching a total weight of 120·7 kg (C. Silva, unpubl. data). Therefore, the decision to transfer the rescued Antillean manatees from FONAIAP to more suitable locations was the correct one.

Sexing was achieved by measuring the distance between the genital opening and the anus and umbilicus, respectively (Table 1). In ♀♀, the distance from the genital opening to the anus is very short, when compared with the distance to the umbilicus (White & Francis-Floyd, 1990; Reynolds & Odell, 1991; Menezes de Oliveira, 2008).

Haematology: Female A

The leucocyte values for ♀ A reflect slight leucocytosis (Tables 2 and 3), when compared with the white blood cell counts of an Antillean manatee kept in captivity, which had a reference range of 4200–14 800 mm^{-3} (C. Bonar, unpubl. data), manatee calves in captivity with values of 3000–14 600 mm^{-3} (Menezes de Oliveira, 2008), and reports from captive Florida manatees *Trichechus manatus latirostris* of up to 14 200 mm^{-3} and up to 13 500 mm^{-3} in Florida manatees in the wild (Harvey *et al.*, 2009). There have been other reports

on leucocyte levels that range from 8000 to 10 600 mm^{-3} for captive manatees (Wallach & Boever, 1983; Medway & Geraci, 1986), as well as leucocyte levels up to 13 970 mm^{-3} in a captive Antillean manatee calf (Vanoye Lara, 2002) and up to 11 000 mm^{-3} in an Amazonian manatee *Trichechus inunguis* undergoing a transport (Reisfeld *et al.*, 2010). Leukocytosis is considered severe in manatees when the values are around 25 000 mm^{-3}, and at those levels, it is very important to monitor changes in the count differential of leucocytes (Bossart *et al.*, 2001). The relative values of lymphocytes and eosinophils reported for ♀ A and ♀ B are about average for those reported for captive healthy adult manatees (Wallach & Boever, 1983; Medway & Geraci, 1986). The absolute values of lymphocytes for ♀ A (10 716/57%), just after confiscation in stressful conditions, are above the top range, when compared with the values reported by C. Bonart (unpubl. data: 900–10 200 mm^3), Bossart *et al.* (2001: 960–8 560 mm^3) and Reisfeld *et al.* (2010: 2200–5200 mm^3). The absolute values of eosinophils for ♀ A in 1992 show over the top range of 56–804 mm^3 reported by C. Bonart (unpublished data) and 300–600 mm^3 reported by Reisfeld *et al.* (2010). The manatees present a higher number of circulating lymphocytes when compared with cetaceans, but the eosinophils in the blood are not clearly differentiated from the neutrophils, when considering routine coloration (Bossart *et al.*, 2001). Harvey *et al.* (2009) report that young manatees have a tendency to show greater values of leucocytes, lymphocytes and monocytes than adults and that in some manatees, the values of basophils might be low. Adverse factors, such as capture and handling for transport, produce high levels of temporary stress, increasing the glucocorticoids and catecholamines, which cause a transitory leukocytosis with neutrophilia, monocytosis and lymphocytosis, affecting the number of circulating leucocytes, thereby increasing the values of these. In chronic stress conditions, the lymphocytes proliferate and become active (Fowler, 1986; Bossart *et al.*, 2001; St. Aubin & Dierauf, 2001; Vanoye Lara, 2002; Harvey *et al.*, 2009; Reisfeld *et al.*, 2010). Eosinophils generally increase when there is a parasitic infection, although the function of this is not fully understood in mammals (Bossart *et al.*, 2001). As recommended by Stamper & Bonde (2012), caution should be used when comparing values generated by different methods, and proper interpretation of the values should always be based on experience. No tests were carried out on the faeces of ♀ A.

Haematology: Female B

The haematological values show that the haemoglobin is slightly below the average of the values reported by Medway & Geraci (1986: 14·5 g dl^{-1}) and Wallach & Boever (1983: 14·5 g dl^{-1}) but within the range of 8·1–14·4 g dl^{-1} reported by Vanoye Lara (2002) and C. Bonar (unpubl. data), and of 7·3–18·2 g dl^{-1} reported by Menezes de Oliveira (2008) (Tables 2 and 3). Leucocytes values are within the normal range when compared with average values reported for captive manatees and those in the wild by Wallach & Boever (1983: 9300 mm^{-3}), Medway & Geraci (1986: 8800 mm^{-3}), Menezes de Oliveira (2008: 5980 mm^{-3}), Harvey *et al.* (2009: 6640 mm^{-3}) and C. Bonar (unpubl. data: 8592 mm^{-3}). The neutrophils, lymphocytes, eosinophils, basophils, monocytes and the values of blood chemistry are also within the normal range of absolute values according to Reisfeld *et al.* (2010) and C. Bonar (unpubl. data). Vanoye Lara (2002) reports that glucose values have a wide range and vary with each manatee, and broad ranges (from 20 to 179 mg dl^{-1}) have been reported, depending on age, sex, feeding and handling (Menezes de Oliveira, 2008; C. Bonar, unpubl. data). Uric acid values are unstable and present seasonal variations in manatees, with reports of ranges in young captive manatees of 0·5–2·2 mg dl^{-1} (Menezes de Oliveira, 2008;

REFERENCE VALUES	*n*	MALES (*n* = 3); FEMALES (*n* = 4)
HAEMATOLOGY		
Haemoglobin	96	11·39/7·30–18·20 g dl^{-1}
Haematocrit	97	41·17/23·40–86·60%
MCHC	96	28·77/13·10–37·69 g dl^{-1}
Leucocytes	97	6260/3000–14 600 mm^{-3}
BLOOD CHEMISTRY		
Glucose	69	57·49/30·00–133·00 mg dl^{-1}
Blood urea nitrogen	64	17·76/3·00–47·00 mg dl^{-1}
Creatinine	67	1·91/0·50–3·90 mg dl^{-1}
Uric acid	58	0·98/0·40–2·60 mg dl^{-1}
Total proteins	76	4·34/2·20–8·20 g dl^{-1}

Table 3. Haematology and blood-chemistry values for orphaned Antillean manatee *Trichechus manatus manatus* calves (Menezes de Oliveira, 2008): MCHC. mean cell haemoglobin concentration.

C. Bonar, unpubl. data). No tests were carried out on the faeces of the Antillean manatee ♀ B.

Physical assessment during transport

During land and air transport, ♀ A and ♀ B remained calm throughout. The transport of Sirenia is less complex than that of cetaceans and Pinnipedia because they are able to tolerate warmer temperatures. Manatees can be transported out of water, both by land and by air, with controlled temperatures ranging between 17 and 23°C (Joseph *et al.*, 1990; Sandoval-Bavaresco, 2000; Antrim & McBain, 2001; Vanoye Lara, 2002; Reisfeld *et al.*, 2010). The manatees must be kept moist and in the shade, with environmental temperatures ranging from 22 to 26°C. Spraying their bodies with fresh water avoids skin dryness and increasing body temperatures: in manatees, body temperature tends to be between 34 and 36°C (Sandoval-Bavaresco, 2000; Vanoye Lara, 2002; Stamper & Bonde, 2012; Wong *et al.*, 2012).

During transport, the out-of-water respiratory rates of ♀ A and ♀ B were monitored constantly and recorded at an average of around one breath every 2–4 minutes. The normal respiratory rate range for manatees being transported and handled averages one breath per 2–3 minutes (Reynolds & Odell, 1991). An out-of-water respiratory rate of one breath per 2–3 minutes has been recorded in two adult Antillean manatees transported by air from the Zoologico Metropolitano del Zulia, Maracaibo, Venezuela, to the Dallas World Aquarium, TX, USA (Sandoval-Bavaresco, 2000; Boede *et al.*, 2013). An out-of-water respiratory rate of one breath per 3–5 minutes has been recorded in 2 year-old Antillean manatee calves during capture and handling, and an average of 5·4 breaths per 5 minutes in adults (Vanoye Lara, 2002; Wong *et al.*, 2012). In the wild, manatees normally surface to breathe every 5 minutes, but in-water respiratory rates in adult Antillean manatees in the Orinoco River have been recorded as one breath per 10–21 minutes (Castelblanco-Martínez, 2004; Rivas Rodríguez *et al.*, 2012), although these may be resting animals. Active and/or smaller manatees breathe more frequently (Reynolds & Odell, 1991).

Breeding

Acclimatizing ♀ A to her new enclosure and with the resident ♂ at PZBB occurred without incident. Female A was housed in the same tank as the resident ♂ for a month, although separated by a grille, to allow the manatees to become accustomed to each other. Once the grille was removed the pair adapted well to the enclosure. Female A started to breed 13 years later, giving birth to a ♂ on 2 September 2007, a ♀ on 13 October 2011 and a ♂ on 3 December 2013, with interbirth intervals of 4·2 and 2·2 years, respectively (Boede, 2012; Ovalle & Silva, 2013) (Plate 3). Mean age of first reproduction in ♀♀ in Florida has been reported as 5 years, with an average age of sexual maturity of 3·2 years (Rathbun *et al.*, 1995; Reynolds, 1999). Interbirth intervals of 2·5–5 years have been recorded in other manatees (Rathbun *et al.*, 1995; Reynolds, 1999;

Plate 3. Breeding pair of Antillean manatees *Trichechus manatus manatus* **with calves at Parque Zoologico y Botanico Bararida, Barquisimeto, Venezuela, in October 2013. Note that the ♀ manatee on the right of photograph is pregnant, although visual diagnosis of late pregnancy is relatively difficult (Rathbun *et al.*, 1995).** *E. O. Boede.*

Weber-Rosas & Pimentel, 2001). The birth that occurred in 2007 represented the first Antillean manatee born at any zoological facility in the region of the Orinoco River basin and the Caribbean coast of South America. In 2011, an Antillean manatee was born at Barranquilla Zoo, Colombia; however, this neonate did not survive (D. Wehdeking, pers. comm.). In Brasil, at the Centro Mamíferos Aquáticos (CMA) of the Instituto Chico Mendes de Conservacão da Biodiversidade (ICMBio), Antillean manatees from the eastern Atlantic Coast are bred (Menezes de Oliveira, 2008).

Ex situ activities can improve the demographic and/or genetic viability of a wild population by ameliorating the impacts of primary threats on the population. Small populations that are vulnerable to primary threats and stochastic processes may require some form of intensive management of individuals and populations, to improve demographic and genetic viability and avoid extinction (IUCN/SSC, 2014). The 2005 *World Zoo and Aquarium Conservation Strategy* describes strategies for extending viability, including increasing breeding spaces, expanding from regional to global programmes, increasing the intensity of genetic management, improving care practices through research and importing founders from the wild or other regions (WAZA, 2005). Population management involves demographic management (e.g. age, sex, social structure and controlled population numbers), genetic management, veterinary care and husbandry. Genetic management involves verifying taxonomic identity and avoiding the deleterious effects of inbreeding and loss of genetic diversity.

At the time of writing, seven Antillean manatees are maintained at two Venezuelan zoos: an adult pair with their three offspring at PZBB and an adult ♂ and young ♀ at Zoologico Metropolitano del Zulia (Boede *et al.*, 2013).

CONCLUSIONS

Using the techniques and methods described by other authors, the confiscation, rescue, rehabilitation and transport (by land and air) of two ♀ Antillean manatees were all accomplished without serious complications. The haematological assessment from blood taken from the two ♀ Antillean manatees just after confiscation

and just before relocation provided important baseline data about these individuals during handling and while under stressful conditions. This made it possible to discount any physiological problems or illness during the process of capture, transport and rehabilitation. Monitoring respiratory rate of both manatees during transport, a time at which the manatees were out of water and on the move, revealed that they both took approximately one breath every 2–4 minutes.

Based on these two individuals and if appropriate conditions are provided, growth rates (length increase) for manatees in zoological institutions could be around 52 cm over a 14 month period, and body mass could increase by approximately 40 kg over 5 months. The management experiences with manatees at PZBB over 22 years resulted in successful reproduction 13 years after the arrival of a suitable ♀ to be paired with the resident ♂. Three births occurred between 2007 and 2013, with interbirth intervals of 4·2 and 2·2 years. Even with the recent birthing success, it is essential that the manatee exhibit at PZBB be improved, including the addition of a filtration system to maintain recirculation and improve water quality, as well as provide access to fresh water.

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