4-27-2020

Are Florida Manatees (Trichechus Manatus Latirostris) Wearing their Teeth Beyond Functionality? Interspecific and Intraspecific Mesowear in Manatees

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J. N. Andrews Honors Program
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HONS 497
Honors Thesis

Are Florida manatees (*Trichechus manatus latirostris*) wearing their teeth beyond functionality?
Interspecific and Intraspecific mesowear in manatees

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April 27, 2020

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ABSTRACT

Manatees (*Trichechus spp.*) are herbivorous aquatic mammals found in tropical and subtropical waters. At maturity, they possess only supernumerary molars (SM), with 5-8 in occlusion at each quadrant. Manatees exhibit a dental replacement system in which they shed old teeth anteriorly and erupt new teeth posteriorly. This adaptation is thought to have arisen to deal with abrasive foods. Mesowear (facet development on occlusal surfaces of teeth) increases from posterior (younger) to anterior (older) molars. Tooth functionality is linked to level of mesowear, with increased amounts resulting in decreased food-processing ability. Less functional teeth can result in an increase in feeding time, potentially decreasing fitness. Domning (1982) noted that Florida manatees (*T. manatus latirostris*) appeared to experience greater levels of mesowear compared to other manatee populations, however, he did not quantify the difference. To address this, we examined museum specimens from all manatee taxa: Florida (n=64), Antillean *T. m. manatus* (n=49), Amazonian *T. inunguis* (n=121) and African *T. senegalensis* (n=4) manatees. Photographs of the dental arcade (upper and lower) were taken and analyzed. Each SM in occlusion was numbered (posterior to anterior) per quadrant and classified into one of five discrete wear categories (level 5, extreme, being considered as non-functional). Total number of teeth (TNTQ) and total number of functional teeth (TNFTQ) per quadrant were counted including missing teeth (evidenced by dental alveoli). Florida manatees had significantly fewer mean TNTQ ($H=130.03$, $p<0.001$) than other taxa except Antillean manatees, and fewer mean TNFTQ ($H=362.21$, $p<0.001$) than all other manatee taxa. In addition, except for SM1, Florida manatees had greater mean levels of mesowear (SM2-SM6) compared to all other taxa. Florida is not only a marginal habitat for manatees because of seasonally cooler water, but also because of the additional dental burden: it appears they are wearing down their teeth faster than the replacement process.

ACKNOWLEDGEMENTS

Funding was provided by the Andrews University of Research and Creative Scholarship through an Undergraduate Research Scholarship and a Faculty Research Grant. Several museums and Brazilian colleagues have supported our research by providing us with access to specimens. In addition, I am grateful for Dr. Daniel Gonzalez-Socoloske's mentorship and guidance through each stage of the research process and the J.N. Andrews program for making this research a reality. I am thankful to Daryl Domning for his suggestions and tremendous support along the way. A special thanks to Ezra Panjaitan for helping jumpstart the project and Olivia Woodard for graphic design work.

INTRODUCTION

Manatees are herbivorous aquatic mammals, occupying the tropical and subtropical coastal waters of the Atlantic Ocean from the southeastern United States to Brazil, and the west coast of Africa (Gonzalez-Socoloske and Olivera-Gomez 2012; Deutsch, Self-Sullivan, and Mignucci-Giannoni 2008; Kieth-Diagne 2015). Their diet consists mainly of freshwater and marine plants, with the West Indian and West African manatee having broader diets than the Amazonian, due to the latter being confined to freshwater habitats. Manatees possess a unique dentition, in which they possess only supernumerary molars, with 5-8 molars on the occlusal plane, along each side of the maxilla and mandible (Domning and Hayek 1984). The possession of supernumerary teeth goes back to the Late Miocene Epoch and is explained as an adaptation necessary for the restrictions imposed by the manatee's isolated location (Domning 1982). Throughout the manatee's adult life, these teeth are continuously and horizontally replaced (1mm/month) from posterior to anterior in a conveyor-belt like fashion, shedding worn teeth anteriorly and erupting new teeth posteriorly (Figure 1) (Domning and Hayek 1984; Beatty *et al*. 2012). The replacement process begins when the manatee takes in solid food and the replacement rate may vary directly with food intake and growth (Domning 1976). This type of tooth replacement is rare, but this strategy can be seen in a few other mammals like the silky mole-rat (*Helioiphobius argenteoceinerus*), where the replacement process arose as an adaptation to tooth digging, creating high dental wear (Rodrigues *et al*. 2011). In contrast, it is hypothesized that this same adaptation in manatee's arose to deal with tooth wear due to abrasive foods and substrates (Domning 1982).

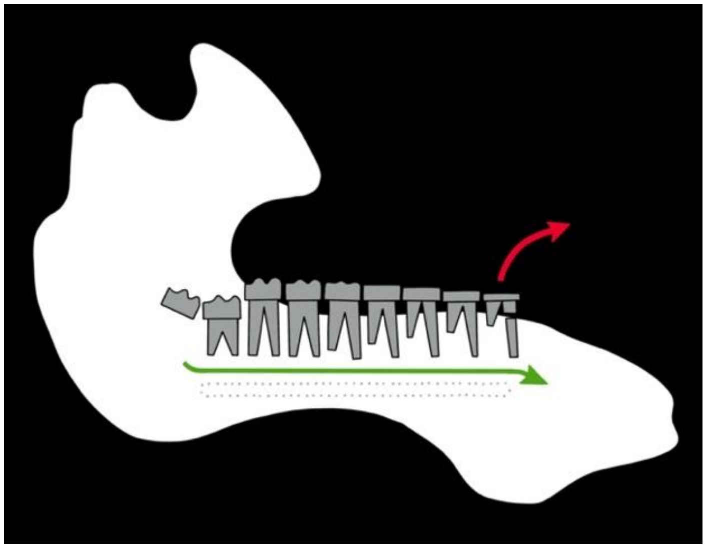

Figure 1. Conveyor-belt-like tooth replacement. Most known as marching molars. Green arrow indicating the direction of the dental drift; red arrow indicating the molar loss. Modified from Rodrigues *et al*., 2011.

Teeth play an essential role in the feeding process of animals. For herbivorous mammals, teeth break down the plant cell walls to release the nutrients within the food item (Bezzobs and Sanson 1997). Food can be fragmented by shearing, slicing, crushing or grinding (Ungar 2010). Both the tooth morphology and enamel structure are important for the function of a tooth, and wear can variably change the morphology and structure of the tooth (Ungar and M'Kirera 2003). Mesowear in manatees (facet development on the occlusal surfaces of the teeth) increases from posterior to anterior and may be caused by several processes. Attrition, wear by tooth-tooth contact, can be caused by mastication or grinding of the teeth, while abrasion can occur when teeth come into contact with other materials, such as phytoliths and exogenous grit (Kaiser and Fortelius 2003). The development of supernumerary molars, along with the replacement process, provides the manatee with the ability to deal with a certain degree of dental wear.

Herbivorous mammals often experience tooth wear when they are feeding on their natural diets and there tends to be a positive relationship between tooth wear and abrasive diets (Damuth and Janis 2014). The diet of the West Indian manatee (*T. manatus*) consists largely of freshwater plants, along with marine seagrasses. In contrast, the Amazonian manatee's (*T. inunguis*) diet consists mostly of true grasses, containing siliceous phytoliths, which contributes to heavy wear on the teeth of the manatee (Domning 1982). Excessive wear has been shown to create issues with functionality, with mammals struggling to properly ingest food to maintain energy (Clauss *et al*. 2007). Research has described a non-functional tooth as one that is experiencing a complete or near-complete loss of enamel from the occlusal surface of the tooth (Gipps and Sanson 1984). A mammal with a functional tooth is able to efficiently process food items, while a mammal with a tooth worn beyond function may not. For herbivorous mammals, this could mean that they are no longer able to release the cell contents from their food as the non-functional tooth may not be able to properly break the cell wall. Excessive tooth wear was found to be potentially detrimental for Koalas, where they are no longer able to efficiently break down their food to receive their required daily nutritional intake (Lanyon and Sanson 1986).

Daryl Domning (1982) noted that Florida manatees (*T. manatus latirostris*) appear to experience greater levels of mesowear compared to the other manatee populations, despite the fact that Amazonian manatees experience harsher diet. However, this difference has not yet been quantified. We sought to find data confirming whether or not Florida manatees do indeed have fewer functional teeth and greater levels of mesowear than other manatee populations. Any differences detected may indicate that Florida manatees are experiencing an incredibly difficult time eating, reducing their chewing efficiency and not receiving enough nutritional intake.

METHODS

A total of 238 manatee skulls, totally 5324 teeth, from the four manatee taxonomic groups were examined: Florida *T. manatus latirostris* (n=640, Antillean *T. m. manatus* (n=49), Amazonian *T. inunguis* (n=121), and African *T. senegalensis* (n=4) manatees. Photographs of the dental arcade were at our disposal for observation and were from the following institutions: Smithsonian (USNM), Mamirauá Institute (IDSMTi), Felipe Poey Natura History Museum (UHMM), Aquasis, Emílio Goeldi Museum, and Centro dos Mamíferos Aquáticos (Figure 2). Each photo was assigned its own specimen number relative to the skull. The data included genus, species, population, relative molar size, and standard skull length. To address the research question and hypothesis, the methodology of this study consisted of data extraction and statistical analysis.

Figure 2. A) Side view of *T. manatus* (MSW16028). Black arrow indicates direction of dental drift. Occlusal view of the B) maxilla and C) mandible of *T. inunguis* (USMN20916).

Data Extraction. A total number of teeth per quadrant (TNTQ) and a total number of functional teeth per quadrant (TNFTQ) were calculated, including missing teeth, for each manatee skull. Data were filtered to exclude juvenile manatees. Juveniles were categorized as skulls that had the initial deciduous molars present, likely not having been yet weaned or chewing solid food. Thus, wear indicative of solid food was not present on these molars, and they were not included in the TNTQ and TNFTQ count. The number of molars were determined by counting from the posterior to anterior end of the jaw, with the first tooth being closest to the posterior end and already on the occlusal plane (Figure 3).

Figure 3. Occlusal view of the maxilla (*T. manatus* MNW16001), indicating the numbering system used from posterior to anterior end of the jaw. Lingual (relating to the side toward the tongue) and buccal (relating to the cheek) surfaces noted.

To distinguish the levels of mesowear for each tooth, wear was divided into five discrete wear class categories: 1) Light, 2) Moderate, 3) Medium, 4) Heavy, and 5) Extreme. Teeth categorized as extreme (5) were considered to be non-functional and thus were excluded from the TNFTQ count. Basic tooth anatomy and definitions were important in establishing the criteria for mesowear categories (Figure 4):

1) Light – visible evidence of wear on enamel (hard, outer surface layer of tooth). No dentin (hard tissue forming majority of tooth beneath enamel) exposed on any of the cusps. Rounded cusps.

2) Moderate – exposed enamel on at least one of the cusps. Dentin is not connected throughout any of the lophs (ridge of enamel connecting cusps).

3) Medium – full loph of dentin exposed. The lophs are not connected yet.

4) Heavy – two lophs are connected with each other. The enamel ridge may still be present except for a small ring of enamel outside of the perimeter.

5) Extreme – non-functional. Begins when no enamel is present except for a small ring of enamel outside of the perimeter.

Figure 4. Upper left molars of *T. manatus* (MSW0836; MNW16001; MSW14078) representing each mesowear category.

The wear class category for missing teeth could be determined if the missing tooth was situated directly before a tooth with a wear class category of 1, or situated directly after a tooth with a wear class category of 5. Otherwise, the missing tooth was not assigned a wear class category. However, the missing tooth was still included in the TNFTQ count.

Statistical Analysis. To compare the mean TNTQ, TNFTQ, and mesowear between the manatee taxonomic groups, a Kruskal-Wallis one-way ANOVA was conducted. If significance was detected, post-hoc pairwise comparisons (Mann-Whitney U) were conducted to determine where these specific differences occurred. Comparisons were also made for every supernumerary molar between the taxa. Using the same test, the mean TNTQ, TNFTQ, and mesowear between the upper and lower jaw and the right and left side, were compared statistically.

RESULTS

Florida manatees had significantly fewer mean TNTQ ($H(3)=130.03$, $p<0.001$) than other taxa and fewer mean TNFTQ ($H(3)=362.21$, $p<0.001$) than all other manatee taxa (Table 1 and 2;

Figure 5). Across all manatee taxa, the lower jaw had fewer mean TNTQ (p=0.012) and fewer TNFTQ (p=0.004). No statistical difference was found in the TNTQ (p=0.911) and TNFTQ (p=0.656) between the right and left side of the jaw. Except for SM1, Florida manatees had greater mean levels of mesowear (SM2-SM6) compared to all other taxa (Table 3; Figure 6).

Table 1. Descriptive Statistics of TNTQ for the four manatee taxonomic groups

	N	**Mean ± SD**	**Min.**	**Max.**
Florida	252	5.65 ± 0.63	4	7
Antillean	186	5.57 ± 1.15	3	8
Amazonian	435	6.32 ± 0.89	4	9
African	16	7.00 ± 0.73	6	8

Table 2. Descriptive Statistics of TNFTQ for the four manatee taxonomic groups

	N	**Mean ± SD**	**Min.**	**Max.**
Florida	252	3.43 ± 1.577	1	7
Antillean	186	4.95 ± 1.37	1	7
Amazonian	435	6.18 ± 1.01	2	9
African	16	6.56 ± 1.15	4	8

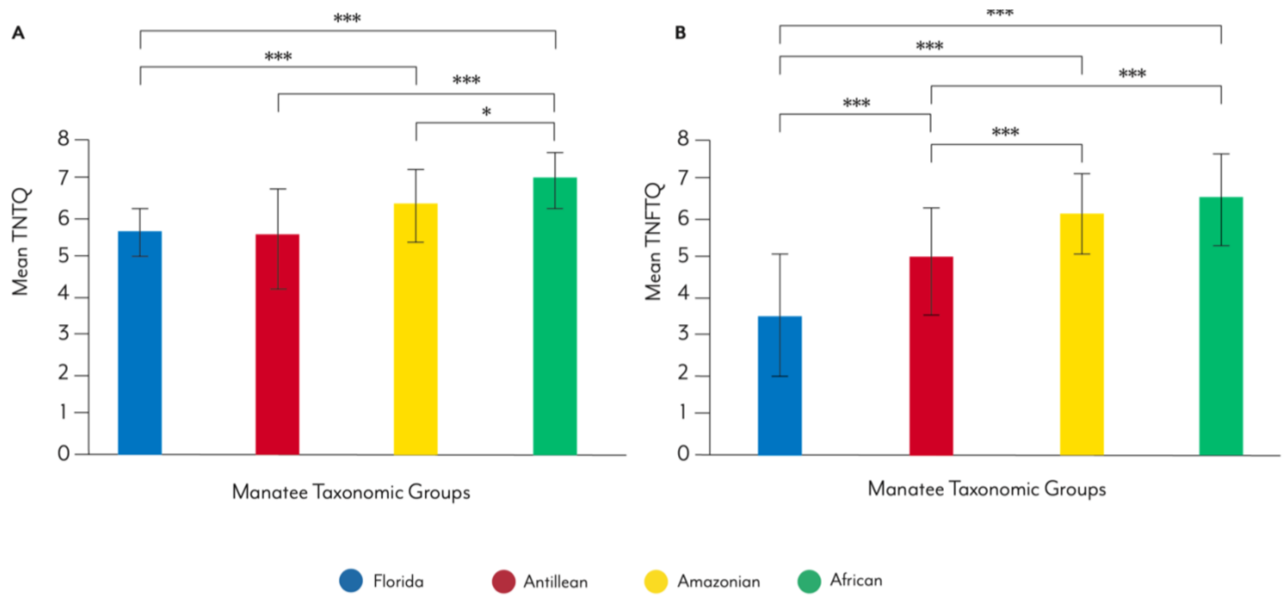

Figure 5. Mean A) TNTQ and B) TNFTQ were statistically difference between manatee taxa (H(3)=130.038, p<0.001, H(3)=362.218, p<0.001). Post hoc pair wise comparisons (Mann-Whitney U) indicated by the following symbols *p<0.05, **p<0.01, ***p<0.001.

Table 3. Descriptive Statistics mean mesowear for SM1-SM6 between manatee taxa (n=number of teeth)

	Mean ± SD							
	n	**Florida**	**n**	**Antillean**	**n**	**Amazonian**	**n**	**African**
SM1	254	1.46 ± 0.663	163	1.41 ± 0.528	399	1.05 ± 0.218	16	1.00 ± 0.000
SM2	254	2.89 ± 0.902	178	2.03 ± 0.563	432	1.59 ± 0.563	16	1.44 ± 0.512
SM3	253	3.81 ± 0.987	174	2.53 ± 0.600	431	2.26 ± 0.600	16	2.06 ± 0.443
SM4	240	4.33 ± 0.943	157	3.27 ± 0.597	420	2.70 ± 0.597	16	2.31 ± 0.602
SM5	198	4.56 ± 0.786	127	3.86 ± 0.627	338	3.04 ± 0.627	16	2.75 ± 0.931
SM6	191	4.66 ± 0.705	111	4.22 ± 0.768	160	3.28 ± 0.768	11	3.42 ± 1.240

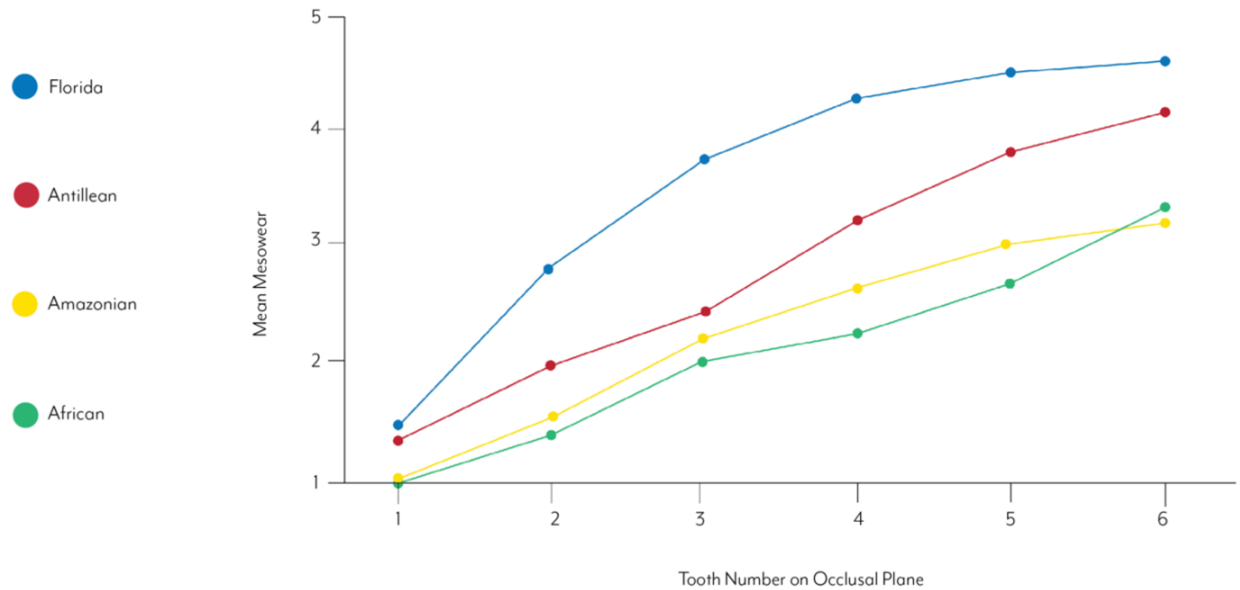

Figure 6. Mean mesowear for molars 1-6 were statistically different between manatee taxa (Kruskal-Wallis test p<0.001 for all 6 molars). Post-hoc pairwise comparisons (Mann-Whitney U) within each molar revealed that the Florida manatees had statistically higher mean mesowear than all other manatee populations, except for molar 1, in which the Florida manatees were not statistically different than the Antillean manatees.

DISCUSSION

This study was the first quantitative glimpse into the potential inter- and intraspecific differences between manatee dental wear. Florida manatees are experiencing greater levels of mesowear and have fewer functional teeth than the other manatee populations, resulting in a substantial dental burden as they wear down their teeth. This decreased function may lead to a decrease in food processing efficiency, which results in an increase in energetic cost (Kojola *et al.* 1998). This could also mean that they have to spend less time in other behaviors that could promote reproductive fitness (Lanyon and Sanson 1986). King *et al.* (2005) discovered that excessive tooth wear in a rainforest lemur reduced their chewing efficiency. This, along with seasonal environmental fluctuations, also affected the mother's ability to produce milk, resulting in the mortality of lemur infants. To compensate for decreased chewing effectiveness, some mammals may chew a food item for a longer period of time or modify the amount of food that they take in at any given moment (Pérez-Barbería and Gordon 1998). Longer chewing cycles could also then lead to enhanced levels of enamel degradation and tooth fracturing (Keown *et al*. 2012). Ultimately, with extreme dental wear and reduced tooth function, Florida manatees may experience deleterious effects. Captive giraffes with heavy dental wear had substantial issues with tooth function, resulting in deleterious long-term consequences (Clauss *et al*. 2007).

Environment may play a key role in the excessive dental wear in Florida manatees. Domning (1982) suggested that the quartz sand, which constitutes much of the substrates of the Florida and Gulf coasts, may be responsible for the wear. As Florida manatee's have a greater rostral deflection, another possibility is bottom-feeding among manatees in the United States (Domning 1982). Enamel structure, and perhaps even dentine structure, plays a key role in the tooth's resistance to wear (Kierdorf and Kierdorf 1992; Ungar 2015). Differences in enamel thickness and dentine across manatee taxa could affect the rate and level of wear on an individual's tooth. However, no significant differences in the enamel thickness between the taxa have been discovered. Dental topographic analyses have been conducted exploring toothwear gorillas to determine if there was a relationship between tooth function and tooth morphology (Ungar and Williamson 2000). Future studies could use similar tools to examine morphological characteristics, such as enamel thickness, in Florida manatees. If Florida manatees exhibit thinner enamel than the other taxa, this, along with their daily chewing cycles, could be contributing to the extreme wear and loss of function. However, as of yet it us unknown why the difference in dental wear exists.

It is important to note that much of what we know about the ecology of manatees has been extrapolated from studies of the Florida manatee, such as their food-handling ability, feeding-cycle length, digestive efficiency, and amount of food consumed (Marshall *et al*. 2000; Lomolino and Ewel 1984; Bengston 1983). Therefore, we must be careful in making assumptions about the other populations. Our results indicate that caution should be taken when assuming that the feeding rates for Florida manatees is what we should expect for the other manatee populations since their dental efficiency is different. It is clear that the dental burden is not significantly holding manatees back due to thriving populations in Florida. However, we need to be cautious when assuming behavior to the other species based on our results from the Florida manatee.

With such significantly worn teeth, the United States may be marginal manatee habitat, not only because of seasonally cooler waters, but also because of the additional dental burden: where they are wearing down their teeth faster than they are replacing them.

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Appendix: Museum Specimens used in this study

Specimen Code	Genus	Species	Subspecies
MNW16001	*Trichechus*	*manatus*	*latirostris*
MNW16004	*Trichechus*	*manatus*	*latirostris*
MSW0836	*Trichechus*	*manatus*	*latirostris*
MSW14078	*Trichechus*	*manatus*	*latirostris*
MSW16028	*Trichechus*	*manatus*	*latirostris*
USNM200395	*Trichechus*	*manatus*	*latirostris*
USNM217259	*Trichechus*	*manatus*	*latirostris*
USNM228479	*Trichechus*	*manatus*	*latirostris*
USNM228480	*Trichechus*	*manatus*	*latirostris*
USNM228481	*Trichechus*	*manatus*	*latirostris*
USNM228482	*Trichechus*	*manatus*	*latirostris*
USNM228483	*Trichechus*	*manatus*	*latirostris*
USNM228486	*Trichechus*	*manatus*	*latirostris*
USNM238018	*Trichechus*	*manatus*	*latirostris*
USNM257406	*Trichechus*	*manatus*	*latirostris*
USNM527900	*Trichechus*	*manatus*	*latirostris*
USNM527901	*Trichechus*	*manatus*	*latirostris*
USNM527903	*Trichechus*	*manatus*	*latirostris*
USNM527905	*Trichechus*	*manatus*	*latirostris*
USNM527906	*Trichechus*	*manatus*	*latirostris*
USNM527908	*Trichechus*	*manatus*	*latirostris*
USNM527909	*Trichechus*	*manatus*	*latirostris*
USNM527911	*Trichechus*	*manatus*	*latirostris*
USNM527912	*Trichechus*	*manatus*	*latirostris*
USNM527914	*Trichechus*	*manatus*	*latirostris*
USNM527915	*Trichechus*	*manatus*	*latirostris*
USNM527916	*Trichechus*	*manatus*	*latirostris*
USNM527920	*Trichechus*	*manatus*	*latirostris*
USNM527924	*Trichechus*	*manatus*	*latirostris*
USNM527926	*Trichechus*	*manatus*	*latirostris*
USNM527927	*Trichechus*	*manatus*	*latirostris*
USNM530292	*Trichechus*	*manatus*	*latirostris*
USNM530297	*Trichechus*	*manatus*	*latirostris*

USNM530299	*Trichechus*	*manatus*	*latirostris*
USNM530303	*Trichechus*	*manatus*	*latirostris*
USNM530305	*Trichechus*	*manatus*	*latirostris*
USNM530306	*Trichechus*	*manatus*	*latirostris*
USNM530310	*Trichechus*	*manatus*	*latirostris*
USNM530311	*Trichechus*	*manatus*	*latirostris*
USNM530312	*Trichechus*	*manatus*	*latirostris*
USNM530313	*Trichechus*	*manatus*	*latirostris*
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USNM530315	*Trichechus*	*manatus*	*latirostris*
USNM530316	*Trichechus*	*manatus*	*latirostris*
USNM530318	*Trichechus*	*manatus*	*latirostris*
USNM530320	*Trichechus*	*manatus*	*latirostris*
USNM530323	*Trichechus*	*manatus*	*latirostris*
USNM530324	*Trichechus*	*manatus*	*latirostris*
USNM530327	*Trichechus*	*manatus*	*latirostris*
USNM530328	*Trichechus*	*manatus*	*latirostris*
USNM550421	*Trichechus*	*manatus*	*latirostris*
USNM551656	*Trichechus*	*manatus*	*latirostris*
USNM551657	*Trichechus*	*manatus*	*latirostris*
USNM551660	*Trichechus*	*manatus*	*latirostris*
USNM551661	*Trichechus*	*manatus*	*latirostris*
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USNM554180	*Trichechus*	*manatus*	*latirostris*
USNM571668	*Trichechus*	*manatus*	*latirostris*
USNM571669	*Trichechus*	*manatus*	*latirostris*
USNM571671	*Trichechus*	*manatus*	*latirostris*
USNM571672	*Trichechus*	*manatus*	*latirostris*
USNM571675	*Trichechus*	*manatus*	*latirostris*
01S0110/295	*Trichechus*	*manatus*	*manatus*
01S0110/296	*Trichechus*	*manatus*	*manatus*
01S0110/44	*Trichechus*	*manatus*	*manatus*

01S0110/46	*Trichechus*	*manatus*	*manatus*
01S0110/57	*Trichechus*	*manatus*	*manatus*
01S0110/61	*Trichechus*	*manatus*	*manatus*
01S0110/62	*Trichechus*	*manatus*	*manatus*
01S0110/91	*Trichechus*	*manatus*	*manatus*
01S0111/201	*Trichechus*	*manatus*	*manatus*
01S0111/214	*Trichechus*	*manatus*	*manatus*
01S0112/273	*Trichechus*	*manatus*	*manatus*
01S0112/28	*Trichechus*	*manatus*	*manatus*
01S0112/99	*Trichechus*	*manatus*	*manatus*
01S0112/293	*Trichechus*	*manatus*	*manatus*
FMAS0110:196	*Trichechus*	*manatus*	*manatus*
FMAS0111:230	*Trichechus*	*manatus*	*manatus*
FMAS0111:331	*Trichechus*	*manatus*	*manatus*
FMAS0111:362	*Trichechus*	*manatus*	*manatus*
FMAS0111:377	*Trichechus*	*manatus*	*manatus*
FMAS0112:194	*Trichechus*	*manatus*	*manatus*
FMAS0112:198	*Trichechus*	*manatus*	*manatus*
FMAS0112:363	*Trichechus*	*manatus*	*manatus*
FMAS0112:376	*Trichechus*	*manatus*	*manatus*
FMAS195	*Trichechus*	*manatus*	*manatus*
0250110/02	*Trichechus*	*manatus*	*manatus*
0250110/10	*Trichechus*	*manatus*	*manatus*
0250110/25	*Trichechus*	*manatus*	*manatus*
0250110/43	*Trichechus*	*manatus*	*manatus*
0250110/60	*Trichechus*	*manatus*	*manatus*
0250110/73	*Trichechus*	*manatus*	*manatus*
0250110/77	*Trichechus*	*manatus*	*manatus*
429	*Trichechus*	*manatus*	*manatus*
8845	*Trichechus*	*manatus*	*manatus*
9138	*Trichechus*	*manatus*	*manatus*
11198	*Trichechus*	*manatus*	*manatus*
12755	*Trichechus*	*manatus*	*manatus*
22428	*Trichechus*	*manatus*	*manatus*

42043	*Trichechus*	*manatus*	*manatus*
42181	*Trichechus*	*manatus*	*manatus*
UHMM009	*Trichechus*	*manatus*	*manatus*
UHMM010	*Trichechus*	*manatus*	*manatus*
UHMM011	*Trichechus*	*manatus*	*manatus*
UMHM008	*Trichechus*	*manatus*	*manatus*
USNM257674	*Trichechus*	*manatus*	*manatus*
USNM257675	*Trichechus*	*manatus*	*manatus*
USNM258298	*Trichechus*	*manatus*	*manatus*
USNM550417	*Trichechus*	*manatus*	*manatus*
USNM550419	*Trichechus*	*manatus*	*manatus*
USNM550420	*Trichechus*	*manatus*	*manatus*
USNM470552	*Trichechus*	*senegalensis*	
USNM571420	*Trichechus*	*senegalensis*	
USNM571421	*Trichechus*	*senegalensis*	
USNM571422	*Trichechus*	*senegalensis*	
Bela	*Trichechus*	*inunguis*	
da Elisa	*Trichechus*	*inunguis*	
IDSMTi1994-01	*Trichechus*	*inunguis*	
IDSMTi1994-03	*Trichechus*	*inunguis*	
IDSMTi1994-04	*Trichechus*	*inunguis*	
IDSMTi1994-05	*Trichechus*	*inunguis*	
IDSMTi1994-06	*Trichechus*	*inunguis*	
IDSMTi1994-09	*Trichechus*	*inunguis*	
IDSMTi1995-03	*Trichechus*	*inunguis*	
IDSMTi1995-08	*Trichechus*	*inunguis*	
IDSMTi1995-10	*Trichechus*	*inunguis*	
IDSMTi1995-11	*Trichechus*	*inunguis*	
IDSMTi1995-13	*Trichechus*	*inunguis*	
IDSMTi1995-14	*Trichechus*	*inunguis*	
IDSMTi1995-21	*Trichechus*	*inunguis*	
IDSMTi1995-23	*Trichechus*	*inunguis*	
IDSMTi1995-xx	*Trichechus*	*inunguis*	
IDSMTi1996-02	*Trichechus*	*inunguis*	

IDSMTi1996-05	*Trichechus*	*inunguis*
IDSMTi1996-08	*Trichechus*	*inunguis*
IDSMTi1996-23	*Trichechus*	*inunguis*
IDSMTi1996-24	*Trichechus*	*inunguis*
IDSMTi1997-02	*Trichechus*	*inunguis*
IDSMTi1997-03	*Trichechus*	*inunguis*
IDSMTi1997-04	*Trichechus*	*inunguis*
IDSMTi1997-06/14	*Trichechus*	*inunguis*
IDSMTi1997-07	*Trichechus*	*inunguis*
IDSMTi1997-11	*Trichechus*	*inunguis*
IDSMTi1997-11	*Trichechus*	*inunguis*
IDSMTi1997-15	*Trichechus*	*inunguis*
IDSMTi1997-xx	*Trichechus*	*inunguis*
IDSMTi1998-03	*Trichechus*	*inunguis*
IDSMTi1998-09	*Trichechus*	*inunguis*
IDSMTi1998-10	*Trichechus*	*inunguis*
IDSMTi1998-11	*Trichechus*	*inunguis*
IDSMTi1998-12	*Trichechus*	*inunguis*
IDSMTi1999-04	*Trichechus*	*inunguis*
IDSMTi1999-04	*Trichechus*	*inunguis*
IDSMTi1999-05	*Trichechus*	*inunguis*
IDSMTi1999-08	*Trichechus*	*inunguis*
IDSMTi1999-10	*Trichechus*	*inunguis*
IDSMTi1999-10	*Trichechus*	*inunguis*
IDSMTi1999-11	*Trichechus*	*inunguis*
IDSMTi1999-12	*Trichechus*	*inunguis*
IDSMTi1999-16	*Trichechus*	*inunguis*
IDSMTi1999-17	*Trichechus*	*inunguis*
IDSMTi1999-23	*Trichechus*	*inunguis*
IDSMTi2000-04	*Trichechus*	*inunguis*
IDSMTi2000-06	*Trichechus*	*inunguis*
IDSMTi2000-10	*Trichechus*	*inunguis*
IDSMTi2000-14	*Trichechus*	*inunguis*
IDSMTi2001-01	*Trichechus*	*inunguis*

IDSMTi2001-05	*Trichechus*	*inunguis*
IDSMTi2001-08/09	*Trichechus*	*inunguis*
IDSMTi2001-08/09	*Trichechus*	*inunguis*
IDSMTi2001-16	*Trichechus*	*inunguis*
IDSMTi2001-17	*Trichechus*	*inunguis*
IDSMTi2001-18	*Trichechus*	*inunguis*
IDSMTi2001-21	*Trichechus*	*inunguis*
IDSMTi2001-35	*Trichechus*	*inunguis*
IDSMTi2001-35	*Trichechus*	*inunguis*
IDSMTi2001-36	*Trichechus*	*inunguis*
IDSMTi2001-39	*Trichechus*	*inunguis*
IDSMTi2001-42	*Trichechus*	*inunguis*
IDSMTi2001-43	*Trichechus*	*inunguis*
IDSMTi2001-65	*Trichechus*	*inunguis*
IDSMTi2001-xx	*Trichechus*	*inunguis*
IDSMTi2002-16	*Trichechus*	*inunguis*