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# New strandings of True's beaked whale, *Mesoplodon mirus*, in Mozambique and their destiny as marine bushmeat

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## Abstract

True's beaked whales have a uniquely fragmented distribution of sightings recorded, mostly from stranding reports. The species is assumed to be associated with deep oceanic waters, occurring in both the northern and southern hemispheres. A hotspot for strandings in the southern hemisphere is South Africa. The third and fourth reported stranding of True's beaked whales for Mozambique is presented, and the first for Tofo Beach, Inhambane Province. This stranding event resulted in the carcasses being butchered and the bushmeat taken for human consumption. This report develops and discusses strategies for mitigation of future risk to public health from aquatic bushmeat consumption in Mozambique.

**Keywords:** *Mesoplodon mirus*, Mozambique, beaked whale, stranding, bushmeat, IMMA

## Introduction

The beaked whales (family: Ziphiidae) are among the least known mammalian groups (Dalebout, 1998). There are 22 described species in the group (Aguilar de Soto *et al.*, 2017), and most are rarely seen at sea due to their affinity to deep oceanic waters and possible low abundance (Mead, 1989). All species of beaked whale are incompletely described, missing information such as basic life-history, behaviour and distribution, and variations in morphology. At least 14 species of beaked whale are known to occur in the southern hemisphere, although misidentification is common, especially within the genus *Mesoplodon*, even with the whole animal available for examination, as they are very similar in overall appearance (Kitchener and Herman, 1995). The True's beaked whale *Mesoplodon mirus* was originally thought to be a solely northern hemisphere species until a stranding in South Africa greatly expanded the known range (Talbot, 1960). Other countries which have reported strandings of True's beaked whales in the southern hemisphere include

New Zealand (Constantine *et al.*, 2014), Brazil (Souza *et al.*, 2005), and Tristan da Cunha (Best *et al.*, 2009). True's, like other beaked whales, are thought to feed mainly on squid which they hunt off the continental shelf, making sightings and strandings relatively rare (Kitchener *et al.*, 2020). Only two beaked whale species have previously been recorded in Mozambique; one Cuvier's beaked whale *Ziphius cavirostris* (Bachara and Deffontaines, 2016), one True's beaked whale in Ponta do Ouro and another in Pomene (Bachara and Gullan, 2016) (see Fig. 1).

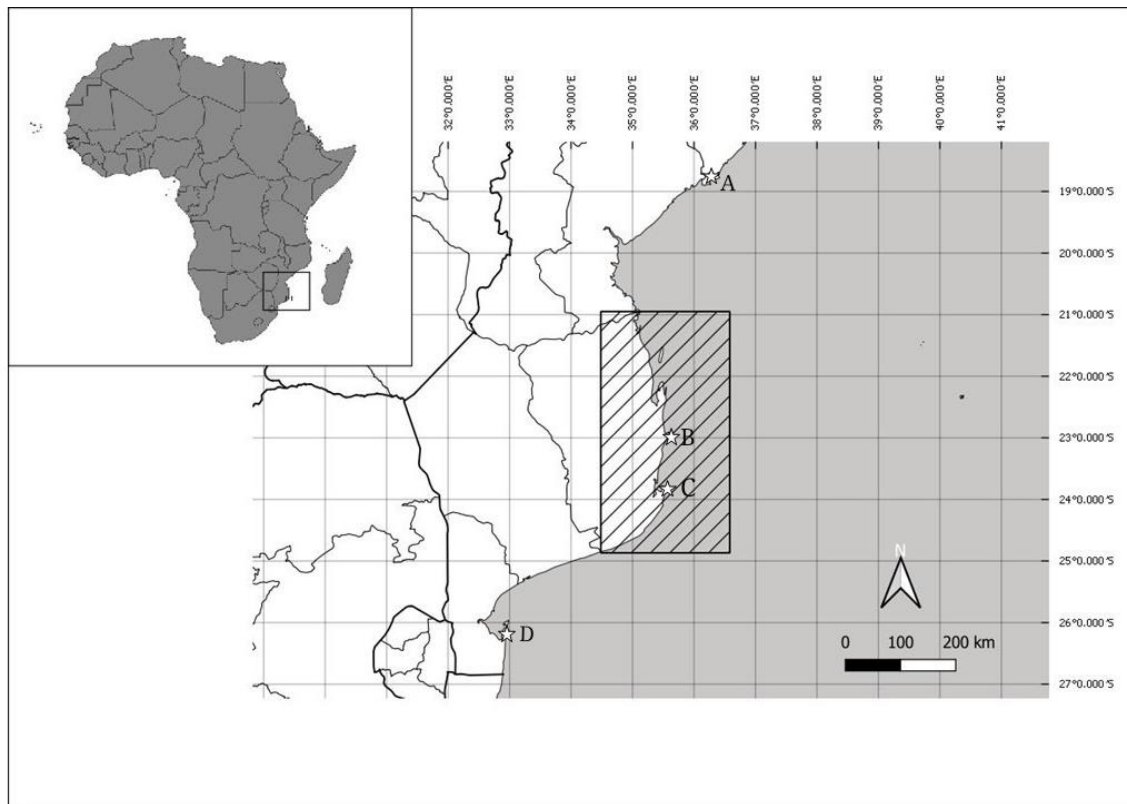
The first known stranding record of True's beaked whales on Tofo Beach in Inhambane Province, a national hotspot for tourism, and the third and fourth recorded strandings of True's beaked whales in Mozambique is reported here. While this is a rare stranding event, it demonstrates that the area is not only within their range but that the species may be more common to the waters of Mozambique than previously recorded, with the potential for further

unreported stranding events resulting in rapid disposal of the carcass by consumption as bushmeat.

Several Mozambican laws refer or apply to marine (or aquatic) bushmeat. Under Mozambican law, beached or stranded live wild marine mammals may not be killed or inflicted any injury (General Regulation of Maritime Fisheries – Decree no. 43/2003). The Regulation of Law of Forestry and Wildlife also covers some aspects regarding their destiny once deceased and while trophies are state property, bushmeat can be freely distributed for consumption to communi-

## Materials and Methods

Two True's beaked whales stranded at approximately 2 am on 8<sup>th</sup> April 2019 on Tofo Beach, Mozambique (S23°51' E35°32') (Fig. 1). Upon discovery within the breaking shore waves, the animals were confirmed dead at 2:10 am and remained under constant supervision by the local police from that point onwards. The only evident injury at this time was a 10 cm cut under the mandible of one animal from which fresh blood was emanating. It cannot be ruled out that this injury may have been inflicted during the beaching incident. A tractor was used to pull them fully out of the surf-



**Figure 1.** Oceanic region of the cross-hatch region indicates the designated Important Marine Mammal Area (IMMA). Stars indicate all reported stranding sites of beaked whales in Mozambique. (C) indicates stranding site (35°5.33 E, -23°8.57 S) of the two True's beaked whales (*Mesoplodon mirus*) in this report. (A) indicates the stranding site of a Cuvier's beaked whale on Mafamede Island, (B & D) indicates the stranding sites of True's beaked whales at Pomene and Ponta do Ouro, respectively.

ties if safe to human health as certified by a Veterinary authority (Regulation of Law of forestry and wildlife – Decree no. 12/2002). The regulation of animal sanitation also deals with health and consumption of livestock and animals generally, which includes bushmeat. It declares that consumption can be allowed if certified by a Veterinary authority as harmless and not posing a threat of dissemination of diseases to humans or domestic animals. Otherwise, by law bushmeat must be confiscated to be incinerated or buried (Diploma Ministerial – Decree no. 219/2002).

zone at 5:30 am. At 5:35 am the animals were assigned field numbers and photographs, measurements and other observations as per the stranding data sheet from the Center of Dolphin Studies in South Africa, by staff from All Out Africa (<https://www.alloutafrica.org/marine.html>). Further minor injuries to both carcasses were evident, largely bruising and skin abrasions. As these injuries were not present three hours earlier, they were likely a result of abrasions from sand during the prolonged post-mortem beaching, and removal from the surf and boat launch zone by a

tractor, pulled along the sand using rope tied around the tailstock of each carcass.

Local government officials and maritime authorities were contacted and attended the scene. Twelve hours after the beaching event, the skulls and several vertebrae were collected, and samples of blubber were taken and labelled for donation to the Natural History Museum in Maputo. Both carcasses were butchered and eaten by the local community.

## Results

The two beaked whales were sexed and measured (Table 1); the male to 471 cm (Fig. 2a), and the female to 491 cm in length (Fig. 2b; further measurements and the skulls are available from Museu de Historia Natural, Maputo, from A. Guissamulo). Both animals displayed a dark grey dorsal surface, with darker circular patches surrounding the eyes and a paler grey ventral surface from the lower jaw extending posteriorly towards the pectoral fins and the belly. The ventral surface then darkened slightly before again lightening at the ano-genital region (Fig. 2c). Based on the relative location of ano-genital openings, Whale 1 was identified as male (Fig. 2d) and Whale 2 as female (Fig. 2e). A large white elliptical from the anal to genital slit was present, which was larger and whiter on the male

(Fig. 2d) than the female (Fig. 2e). Light grey colouration was also noted around the base of the dorsal fins on both whales, which also appeared lighter and more pronounced in the male in contrast to the female. This colouration is thought to be typical of the Southern Hemisphere True's beaked whale (Baker, 1983; Jefferson *et al.*, 2015). However, a lighter colouration on the body, matching the pectoral fin contour, was not obvious, as was observed in Brazil (Souza *et al.*, 2005). Several scars and wounds were seen on the flanks of both specimens, similar to those caused by the cookie-cutter shark *Isistius* spp. (Fig. 2d).

Teeth were not evident in the lower mandibles, which is indicative of either juvenile male or female True's beaked whales (Mead, 1989) (Fig. 2f). There was no opportunity to investigate whether teeth were concealed under the skin prior to the burial of the heads in a soft sand and loose soil pit. After excavation there was sign in the skulls of vestigial teeth cavities or tooth alveoli (Fig. 2g). However, in both whales the tooth cavities were very small, suggesting both whales were potentially immature (Best, 2007). The skulls of both whales are now held at the Natural History Museum in Maputo (catalogue numbers: MHN.MAM.2019.0002 and MHN.MAM.2019.0003).

Table 1. Measured lengths of fresh carcasses in centimetres (cm).

	Whale 1 (male)	Whale 2 (female)
Tip upper jaw to deepest part of notch on flukes	471	491
Tip upper jaw to apex of melon	19	21
Tip upper jaw to angle of gape	30	30
Tip upper jaw to centre of eye	50	62
Centre of eye to angle of gape	29	29
Length of eye	4	3
Projection of lower jaw beyond upper jaw	2	2
Length of mammary slit (Left, Right)	8, 6	10.5, 9
Length of genital slit	11	21
Length of anal opening	1	2
Width of blowhole	11	12
Height of dorsal fin	14.5	26
Pectoral fin anterior length (length of fin base)	44	49
Fluke width tip to tip	120	153



**Figure 2.** a) Whale 1 – Male, 4.71 m total length. b) Whale 2 – Female, 4.91 m total length, with absence of erupted teeth shown. c) Dark eye patch. Darker grey dorsal and light grey ventral colouration. Abrasions to the face suspected from movement of dragging by tractor along the beach (Whale 2). d) White elliptical around the genitalia, scars and lesions consistent with cookie cutter (*Isistius* spp.) bites. Relative location of ano-genital openings further apart identified this whale, Whale 1, as male. e) Relative location of ano-genital openings and mammary slits close together were used to identify this whale, Whale 2, as female. f) No teeth were evident protruding from the mandibles of the fresh carcasses (Left - Whale 1 Male, Right - Whale 2 Female). g) Skulls and mandibles of both whales. Mandibles of both showing small tooth cavities visible (unfortunately burial was performed without record of relation to field identification). h) Presence of the police from 2:30 am and keen interest of the local community from 5.30 am through to the butchering of the carcasses at 4:30 pm (Whale 1).

## Discussion

With the True's beaked whale listed as Data Deficient by the IUCN red list (Taylor *et al.*, 2008), all new information gathered on this species adds to the understanding of its life history and conservation status. Indeed, so little is known about them that new information can still serve to improve knowledge of the Ziphiidae family as a whole.

Africa is recognised as a global hotspot for cetacean diversity (Pompa *et al.*, 2011). Cetacean stranding records, however, are extremely scarce in Mozambique. Dedicated offshore surveys are required to determine the distribution and abundance of cetacean species in Mozambique and along the southern Africa coastline. With increasing demands on the coastal waters of Mozambique from commercial fishing and tourism as well as resource exploration and exploitation, it is critical to gather further data and increase scientific understanding of the area to advise sustainable management and conservation. Megafauna species, such as beaked whales and other cetaceans, dugongs and turtles, are impacted by increased ocean traffic and elevated noise that accompanies coastal resource prospecting and extraction (Weilgart, 2007; Nelms *et al.*, 2016). The identification of the Inhambane coastline, where Tofo Beach is found, as an Important Marine Mammal Area (IMMA) recognises the unique, well preserved habitat this area has to offer and its value to the endangered species found there (IUCN-MMPATF, 2020) (Fig. 1). As this, the first report of True's beaked whales from Tofo Beach, Inhambane, shows, there is still much to learn about the region's wildlife, with data collection and reporting essential. The fact that there have now been three separate True's beaked whale stranding incidents recorded along the Mozambican coastline suggests that this species is likely using these waters more commonly than had previously been recognised.

This report highlights the demand for marine mammal meat, or aquatic bushmeat as it is known, within Mozambique. While use of landed and stranded cetaceans as marine bushmeat has been previously documented in coastal regions of many other African countries, including North and West Africa (Clapham and Van Waerebeek, 2007; Segniagbeto *et al.*, 2019), a scarcity of literature exists regarding both marine strandings and bushmeat consumption in Mozambique (Guissamulo, 2008). In this case, harvest occurred despite the unknown cause of death, undefined public health status of the carcasses and police presence (Fig. 2h).

A key management issue, also highlighted by this report, is the lack of clear protocol regarding stranding events, covering the correct handling and disposal of such remains. Preservatives, freezer space and autopsy equipment are limited and there is no clear delegation of responsibility, which results in confusion and delay or inaction by authorities. It is suggested that the better dissemination of procedural information, sampling and necropsy equipment and expertise is essential in order to support the upholding of legislation and avoid spread of illness derived from unsafe carcasses. This improved management approach could serve to reduce related negative outcomes, such as the recent tragic deaths of several citizens of the Memba district of Nampula after consuming contaminated sea turtle meat (as reported by the media: 'Rádio Moçambique' from 12 July 2020 and 'Jornal Notícias' from 27 July 2020).

Several stranded beaked whale carcasses have been shown to be infected with diseases, ranging from herpesvirus (Arbelo *et al.*, 2012; Saliki *et al.* 2006) and a novel beaked whale circovirus (Landrau-Giovannetti *et al.*, 2019) to mortality and stranding-related dolphin morbillivirus (Centelleghé *et al.*, 2017) all of which could pose threats to the survival and health of these marine mammals. With the diseases of beaked whales still poorly studied, more commonly studied cetacean species can give an indication of future directions for beaked whale research in their findings. Recently, three novel coronaviruses of marine mammals have been identified. BdCoV HKU22 was identified in Indo-Pacific bottlenose dolphins *Tursiops aduncus*, and US BdCoV in Atlantic bottlenose dolphins *T. truncatus*, in addition to BWCoV SW1 already identified in Beluga whales *Delphinapterus leucas* (Woo *et al.*, 2014; Wang *et al.*, 2020). Infectious diseases, such as brucellosis and toxoplasmosis, have been isolated from marine mammals which may pose a transmission threat to humans via contact or ingestion (Van Bresseem *et al.*, 2009; Waltzek *et al.*, 2012). These zoonoses range in severity from localised skin infections to life-threatening diseases of public health risk. Reports from more widely studied coastal areas indicate a risk of zoonotic disease development and transmission at the aquatic animal-human interface (Bogomolni *et al.*, 2008). Anthropogenic alteration of these environments, particularly through introduction of pollutants or release of ship ballast water, could potentially drive the spread and development of disease in marine wildlife populations (Van Bresseem *et al.*, 2009). Aquatic reservoirs of zoonotic diseases are understudied in Mozambique.

The primary issue with marine mammal bushmeat in Mozambique, evident in the specific case of these True's beaked whale carcasses, is that consumption takes place before any assessment and certification of risk has been carried out. Defining the process, with accompanying education and training, should serve to improve reporting, sampling and testing of stranded marine mammals in Mozambique. This will increase understanding to advise conservation management and mitigate risks to public health from stranded aquatic bushmeat consumption.

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## References

- Aguilar de Soto N, Martin V, Silva M, Edler R, Reyes C, Carrillo M, Schiavi A, Morales T, Garcia-Ovide B, Sanchez-Mora A, Garcia-Tavero N, Steiner L, Scheer M, Gockel R, Walker D, Villa E, Szlama P, Eriksson IK, Tejedor M, Perez-Gil M, Quaresma J, Bachara W, Carroll E (2017) True's beaked whale (*Mesoplodon mirus*) in Macaronesia. *Peer J* 5: e3059
- Arbelo M, Belliere EN, Sierra E, Sacchinni S, Esperon F, Andrada M, Rivero M, Diaz-Delgado J, Fernandez A (2012) Herpes virus infection associated with interstitial nephritis in a beaked whale (*Mesoplodon densirostris*). *BMC Veterinary Research* 8: 243
- Bachara W, Deffontaines JB (in review) First stranding record of a Cuvier's beaked whale in Mozambique - a short note. *Journal of Cetacean Research and Management*
- Bachara W, Gullan A (2016) First stranding record of a True's beaked whale (*Mesoplodon mirus*) in Mozambique. Unpublished report to Cetal Fauna. Report WB2016/1. 4 pp
- Baker AN (1983) Whales & dolphins of New Zealand and Australia – an identification guide. Victoria University Press, New Zealand. 135 pp
- Best PB (2007) Whales and dolphins of the Southern African Sub-region. Cambridge University Press, Cambridge, United Kingdom and Cape Town, South Africa. 123 pp
- Best PB, Glass J, Ryan PG, Dalebout ML (2009) Cetacean records from Tristan da Cunha, South Atlantic. *Journal of the Marine Biological Association of the United Kingdom* 89 (5): 1023-1032
- Bogomolni AL, Gast RJ, Ellis JC, Dennett M, Pugliares KR, Lentell BJ, Moore MJ (2008) Victims or vectors: a survey of marine vertebrate zoonoses from coastal waters of the Northwest Atlantic. *Diseases of Aquatic Organisms* 81: 13-38
- Centelleghes C, Beffagna G, Palmisano G, Franzo G, Casalone C, Pautasso A, Giorda F, Di Nocera F, Lancarino D, Santoro M, Di Guardo G, Mazzariol S (2017) Dolphin Morbillivirus in a Cuvier's Beaked Whale (*Ziphius cavirostris*), Italy. *Frontiers in Microbiology* 8: 111
- Clapham P, Van Waerebeek K (2007) Bushmeat and bycatch, The sum of the parts. *Molecular Ecology* 16: 2607-2609 [doi: 10.1111/j.1365-294X.2007.03378.x]
- Constantine R, Carroll E, Stewart R, Neale D, Van Helden A (2014) First record of True's beaked whale *Mesoplodon mirus* in New Zealand. *Marine Biodiversity Records* 7: 1-3 [doi:10.1017/S1755267213001140]
- Dalebout ML, Van Helden A, Van Waerebeek K, Baker CS (1998) Molecular genetic identification of southern hemisphere beaked whales (Cetacea: Ziphiidae). *Molecular ecology* 7: 687-694
- Diploma Ministerial (2002) Decree No. 219/2002 on animal health Regulation. Mozambican Government, Maputo
- Forest and Wildlife Regulation (2002) Decree No. 12/2002 of the 2002 Forest and Wildlife Regulation. Mozambican Government, Maputo
- General Regulation of Maritime Fisheries (2003) Decree No. 43/2003 on Marine Fisheries' Regulation (REPMAR). Mozambican Government, Maputo
- Guissamulo AT (2008) Ecological studies of bottlenose and humpback dolphins in Maputo Bay, Southern Mozambique. PhD Thesis. University of KwaZulu Natal. 290 pp
- IUCN-MMPATF (2020) Bazaruto Archipelago and Inhambane Bay IMMA FactSheet
- Jefferson T, Webber M, Pitman R (2015) Marine mammals of the world, 2<sup>nd</sup> edition. Elsevier. pp 155-157
- Kitchener AC, Herman JS (1995) Re-identification of the supposed True's beaked whale, *Mesoplodon mirus*, from Scotland. *Journal of Zoology* 236: 353-357
- Kitchener AC, Hantke G, Herman JS, ten Doeschate M, Brownlow AC (2020) First record of True's beaked whale, *Mesoplodon mirus*, in Britain. *Mammal Communications* 6: 29-33
- Laudrau-Giovannetti N, Subramaniam K, Brown MA, Ng TFF, Rotstein DS, West K, Frasca Jr S, Waltzek TB (2019) Genomic characterisation of a novel circovirus from a stranded Longman's beaked whale (*Indopacetus pacificus*). *Virus Research* 277: 197826



- Mead GJ (1989) Beaked whales of the genus *Mesoplodon*. In: Ridgway SH, Harrison RJ (eds) Handbook of marine mammals, Vol 4, River dolphins and the large toothed whales. Academic Press, London. pp 349-430
- Nelms SE, Piniak WED, Weir CR, Godley BJ (2016) Seismic surveys and marine turtles: An underestimated global threat? *Biological Conservation* 193: 49-65
- Pompa S, Ehrlich P, Ceballos G (2011) Global distribution and conservation of marine mammals. *Proceedings of the National Academy of Sciences of the United States of America*. 108: 13600-13605
- Saliki JT, Cooper EJ, Rotstein DS, Caseltine SL, Pabst DA, McLellan WA, Lovett P, Harms C, Smolarek KA, Romero CH (2006) A Novel Gammaherpesvirus associated with genital lesions in a Blainville's Beaked Whale (*Mesoplodon densirostris*). *Journal of Wildlife Diseases* 42 (1): 142-148
- Segniagbeto GH, Ayssi I, Bamy IL, Debrah J, Djiba A, Dossou-Bodjrenou J, Ofori-Danson PK, Samba Ould Bilal A, Sohoun Z, Tchibozo S, Uwagbae M, Van Waerebeek K (2019) On the utilisation of by-caught, hunted and stranded cetaceans in West Africa. Document SC/May19/AAWW/04, IWC Scientific Committee Meeting, Nairobi, May 2019. 14 pp [<http://www.researchgate.net/publication/334249267>]
- Souza SP, Siciliano S, Cuenca S, de Sanctis B (2005) A True's beaked whale (*Mesoplodon mirus*) on the coast of Brazil: adding to a new beaked whale species to the western tropical Atlantic and South America. *Latin American Journal of Aquatic Mammals* 4 (2): 129-136
- Talbot FH (1960) True's beaked whale from the south-east coast of South Africa. *Nature* 186 (4711): 406
- Taylor BL, Baird R, Barlow J, Dawson SM, Ford J, Mead JG, Notarbartolo di Sciara G, Wade P, Pitman RL (2008) *Mesoplodon mirus*. The IUCN Red List of Threatened Species 2008: e.T13250A3430702 [<http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T13250A3430702.en>]
- Van Bresselem M-F, Raga JA, Di Guardo G, Jepson PD, Duignan P, Siebert U, Barrett T, de Oliveira Santos MC, Moreno IB, Siciliano S, Aguilar A, Van Waerebeek K (2009) Emerging infectious diseases in cetaceans worldwide and the possible role of environmental stressors. *Diseases of Aquatic Organisms* 86: 143-157
- Waltzek TB, Cortes-Hinojosa G, Wellenhan Jr JFX, Gray GC (2012) Marine mammal zoonoses: A review of disease manifestations. *Zoonoses Public Health* 59 (8): 521-35
- Wang L, Maddox C, Terio K, Lanka S, Fredrickson R, Novick B, Parry C, McClain A, Ross K (2020) Detection and characterization of new coronavirus in bottlenose dolphin, United States, 2019. *Emerging Infectious Diseases* 26: 1610-1612
- Weilgart LS (2007) The impacts of anthropogenic ocean noise on cetaceans and implications for management. *Canadian Journal of Zoology* 85 (11): 1091-1116
- Woo PCY, Lau SKP, Lam CSF, Tsang AKL, Hui S, Fan RYY, Martelli P, Yuen K (2014) Discovery of a novel bottlenose dolphin coronavirus reveal a distinct species of marine mammal coronavirus in Gammacoronavirus. *Journal of Virology* 88 (2): 1318-1331