REVIEW OF HIPPOPOTAMUS “HAZINA” DEATH AT THE CALGARY ZOO, OCTOBER 27, 2007

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REVIEW OF HIPPOPOTAMUS “HAZINA” DEATH AT CALGARY ZOO ON OCTOBER 27 2007

The Calgary Zoo provided Terms of Reference as a guideline for the investigation of the death of a river hippopotamus, *Hippopotamus amphibius*, from the Denver Zoo. It is essential to mention that my areas of expertise are limited to veterinary medicine (20 years in zoological medicine in zoos), biology (M.Sc. in animal behaviour) and animal transportation (veterinarian consultant for the International Air Transport Association). In the process of my investigation, other areas have been queried, but I believe it would be inappropriate for me to comment or reach conclusions on some issues based on either conflicting comments, speculation or unsubstantiated information provided by some parties.

I wish to thank all those individuals who have assisted me and cooperated in the investigation, in many cases providing substantive information and access to records.

Moving a big and heavy animal such as a hippopotamus is no simple task and it must be done with the help of many people working in unison to be successful. Lots of time, energy and money are involved and the move must be important to be justified.

Reasons for Move

One main objective of most zoos in America, and around the world, is that of animal and species conservation. Hippos are classified as vulnerable by the World Conservation Union (IUCN.) Their zoo population is overseen by the Association of Zoos and Aquariums (AZA) Population Management Plan (PMP,) The International Species Information System (ISIS) lists their population as 27 males and 46 females in the Americas, 109 males and 175 females around the world with only a few births. The captive animal population must be self-sufficient, and that is why so many people in dedicated and accredited zoos are involved in studbook keeping and reproduction planning. Inbreeding and the drawbacks associated with it must be reduced to minimum, thereby reducing the chance of genetic faults being expressed in the genotype. Genetic representation of individuals in the captive population must be closely monitored to ensure that even those animals with few offspring will be encouraged to breed, compared to animals whose genes are already well represented. When the captive population is small, this practice is even more important. Animals are not transferred for futile motives, but to keep the population’s genetic strength and vigour, thereby ensuring good genetic potential for the future.

Regarding the transport case we are looking at now, the number of hippopotamus in the North American zoo population is quite low. It is therefore mandatory to move designated animals, especially if their genes are poorly represented in that population or
are at risk of being lost should the animal not be moved. The female hippo Hazina lived at the Denver zoo with her brother and father. She produced offspring from an incestuous mating. She was put on a hormone treatment to reduce her fertility (MGA,) and it thus became mandatory to move her and to find the best mate for her. Calgary Zoo was found an ideal location for her to be transfer, ensuring the good quality of the potential offspring.

1) **Selection and appropriateness of the transportation container**

Measurements of the crate:
- 17.6 feet (5.4 meters) long
- 5 feet (1.5 meters) wide
- 7.3 feet (2.2 meters) tall

Measurements of Hazina:
- 6 feet (1.8 meters) long
- 4 feet (1.2 meters) wide (*)
- 3.5 feet (1.1 meters) at shoulder

(*)- Approximation made from the comment of Dale Leeds, curator of Large Mammals at Denver zoo, when he indicates that the clearance was 6 to 9 inches (15.2 to 21.7 cm) on each side of the hippo when inside the crate.

The International Air Transport association (IATA) has published the Live Animal Regulation (LAR) book where guidelines are to be followed by shippers if they wish to send animals by plane. Many shippers rely on these standards for land transportation.

In Container Requirement #71, to be followed to send elephant, rhinoceros and hippopotamus, it is written:

“For general transport purposes, animal will be carried only in a closed container…”
“The container must be suitable to keep the animal inside at all times and protect the animal from unauthorised access”
“The container must not cause the animal to damage itself”
“The animal must be able to stand naturally without being cramped but must not be able to move freely”
“Floor must be made of thick tongue and groove of at least 2.5 cm thickness…and have a non-slippery surface…”

The crate was long and high enough for the transportation of a hippo that size. The material, wood, was appropriate, and the entire construction was secure. We will focus on 2 points that are questionable: The floor and the actual width of the container.
Pictures of the floor show wood planks placed longitudinally. Floor does not show any special non-slip surface. One purpose of the non-slip surface (which can be grooved, covered with a non-slip surface, or close boarded) is to facilitate an animal when he wishes to stand up. Many people who saw the inside of the container in Denver, at the US-Canada border, and in Calgary, indicated that straw or grass hay inside the crate was covering part of the floor. Mr. Chris Danhauer from Planned Migration indicated that the straw would pile up near the walls of the container during the trip, leaving the wood floor almost bare.

The width of the container is another concern. Was this space sufficient to allow the animal to easily stand up? Nobody actually saw the animal getting up and standing normally for the entire trip, besides during the loading at Denver (but there are some contradictions about this fact between all the people interviewed). We know that the animal could stand up in this crate, as it entered and exited it with ease during crate training and during the actual loading in Denver on October 25 2007. Also, we know that hippos sometimes sleep bringing their 4 legs on one side, but it is uncertain if the space allowed this hippo to do that.

The use of slings:

Slings are used to support the weight of certain animals during transport (like for instance in the transport of Flamingos, where slings supporting the weight can be used to reduce the possibility of leg muscle myopathy, re: LAR from IATA, container requirement 17). Slings have been used for big and heavy animals like horses and are known to lead to ischemic myopathy of the abdominal muscles (Jubb, Kennedy and Palmer, 2007). Slings are therefore not considered as an option for hippos during transport.

2) **Training of the animal to enter the crate and other pre-transportation preparations**

Crate training is frequently used in zoos to minimize the stress associated with transport and to facilitate the loading of the animal when it departs.

According to Mr. Dale Leeds from Denver zoo, many efforts had been made to crate train the hippo Hazina. Training started during summer 2007 and went well. With positive reinforcement (the process by which an activity is learned through use of a pleasant stimulus or rewards such as apples in this case) she gradually became accustomed to enter and exit the same crate that would later be used to make the actual move. As one should expect, she was quite nervous at first, but by the end she was quite relaxed and would enter the crate without any apparent stress.

One must not overlook the social behaviour of Hazina as registered by the keepers. Mr. Gabe Kibe, zookeeper at the Denver Zoo notes in his report:
“..if training with other hippos in area, she feels very secure and more likely to focus on trainer. While separated, she is very skittish…”
“She (Hazina) is a calm hippo when with other hippos”
“Hazina is very trainable hippo but stubborn in her training sometimes”

Hippos are by nature very social animals, but some tolerate being alone better than others. Even though hippo Hazina looked and seemed quite relaxed at the end of the crate training, we must take into consideration the fact that being alone in a moving crate was certainly quite a different experience to her than being in a non-moving crate with other hippos known to her nearby. In this sense, it is my opinion that crate training in general might lead to a false security impression. It can be said that it is better than no training at all, but most certainly that it will not eradicate stressful transportation conditions altogether (noise, motion, etc.). Nevertheless, one thing we can be sure about is that crate training surely facilitate the loading of an animal, which otherwise could be a very long and traumatic event.

3) **Crating, loading, bedding, feeding and watering of the animal on and around the transportation dates of October 25, 2007 and October 26, 2007**

Judging by comments from different sources at the Denver Zoo and from pictures sent, crating and loading of the animal were uneventful. Information provided by the Calgary Zoo indicates that unloading Hazina from the crate was difficult. It took some time for the people involved in the process to realise the precarious health status of the hippo. When the crate door was opened Hazina did not get up and immediately exit the crate. This can be considered normal behaviour for animals in transit as it takes time for them to become accustomed and leave their shipping crates. It is common practice to leave the crate in the new enclosure with the door open and allow the animal to relax and settle. However, outdoor temperatures precluded this option so efforts were made to encourage Hazina to leave the crate. It was during this time that the staff noted her inability to stand. Other than lowering her internal temperature, we have no way of telling if those few hours (from 4 to 8 pm) trying to make her exit the crate really worsened her condition, though probably it did not. She was hypothermic (34.7 Celsius) at her first veterinarian exam and we know that the temperature was quite low when she was gradually moved inside the building.

We have no comments on feeding and watering before and after the trip as it seemed to have been done correctly. We will comment those topics during the actual move in section 7

4) **Route selection and timelines**

The route selection was well chosen and quite direct. Estimated at just over 1000 miles (1600 km) this would include 17 hours driving time, plus the time for regular stops to feed and water the animal.
The actual trip took more than 28 hours, the longest delay having occurred at the US-Canada border. The shipment came to the border early because the loading in Denver had gone so smoothly, and had to wait for the USDA veterinarian to arrive. Arrangements to meet with both Canadian and U.S. veterinarians were made properly by Calgary zoo and the time written of 8 a.m. was noted. It would have been impossible to get in touch with the veterinarians earlier that day, as a reasonable 12 hours notice time must be given.

Although it could be argued that this long stay at the border (from 4:30 to 10:00) was much too long, it may have been beneficial for the animal as she was in a quiet, non-moving place for a while. Mr. Danhauer from Planned Migration never witnessed the hippo standing up during this waiting time. He assumed that the hippo was resting and was acting like a “normal hippo”.

5) **Compliance with existing federal, state and provincial requirements and regulations regarding the transport of large animals**

General guidelines were followed by US and Canada to meet the criteria of the United States Department of Agriculture (USDA) and Canadian Food Inspection Agency (CFIA) as far as; protection from extreme weather, food and water, ventilation, bedding and other physical aspects are concerned. Export permits, import permits, CITES permits, and health certificates were also done properly.

As the law prohibits people from being physically in the box of a moving truck, no persons were in the box while in transit.

6) **Compliance with relevant guidelines issued by the Association of Zoos and Aquariums (AZA,) the Canadian Association of Zoos and Aquariums (CAZA) and any other lawfully constituted accreditation or regulatory body**

Specific guidelines for land transportation of hippopotamus are presently unavailable from AZA or CAZA.

At AZA, Mr. Denny Lewis, Vice-President Accreditation Programs, stipulated that the old husbandry guidelines for hippos did not mention anything about transportation. Mr. Carmi Penny, curator of mammals, San Diego Zoo and chair of the hippo’s Taxon Advisory Group (TAG,) mentioned that the new guidelines are currently in the process of being rewritten and expanded by Mr. Matthew Hohne, Curator of Mammals at Disney Animal Kingdom. This process is not yet completed.

Mr. Robert Hilsenroth, Executive Director at the American Association of Zoo Veterinarians (AAZV,) states that he is not aware of any guidelines referring to land transportation of hippos, and that most people refer to the Live Animal Regulation book (LAR) from the International Air Transport Association (IATA,) container requirement 71 for elephants, rhinoceros and hippopotamus. He also pointed out that species-specific transportation guidelines should be the norm today.
Regarding international regulations and guidelines about hippo transportation, very few exist. Meanwhile there is some information about other types of pachyderms.

The British and Irish Association of Zoos and Aquariums (BIAZA) have recently published (2006) a new version of the guidelines on management of captive elephants (see appendix 1). Although hippos differ greatly from other pachyderm in their behaviour (unloading and reloading are much more difficult with hippos than with elephant for example and in some cases impossible) they are similar in that they can also be affected by pressure myopathy due to their massive size. BIAZA guidelines recommend in section 3.14 (transportation of elephants) that:

“If the journey is likely to exceed 10 hours … in length, a suitable place to stop should be organised prior to the journey so that the driver and elephant can be rested. If possible, night stops should be planned at a zoo, for supplies of fresh food and water and for security reasons…” (*)

(*)- Of course, this can be done only if no borders are to be crossed (quarantine laws must be taken into consideration)

7) Care and attention provided to the animal while in transit between Denver and Calgary

Mr. Chris Danhauer of Planned Migration provided normal care for the animal during the trip. While Mr. Danhauer described Hazina as a hippopotamus similar to others, his experience with this species is limited. His experience is greater with elephants and rhinoceros, having participated in transportation of large animals 4 to 6 times a year for the past 9 years.

Mr. Danhauer made regular stops every 3 to 4 hours during the trip from Denver to Calgary. During those stops, he would visually inspect the animal, offering her food and water by means of a hose (as hippos are used to in captivity). From what he reported, Hazina was not interested in drinking. He did not see the hippo standing up, but that neither bothered nor seemed abnormal to him since the animal had a very nervous and skittish character. He assumed that Hazina was moving and could stand up because he was feeling the truck movement when he was driving. These movements where similar to those he experienced some weeks previous when transporting rhinoceros. According to him, there were no signs of distress from the hippo.

While Dr. Kelley of the Canadian Food Inspection Agency (CFIA) noted that the temperature inside the crate seemed to be warmer than the outside temperature at the border, there was no means of recording the actual temperature inside the crate. It would have been helpful to have an automatic registration system for monitoring the temperature.
Ventilation was sufficient, following the statements of the CFIA and USDA veterinarians. The transport truck was equipped with a ventilation system to evacuate air from the front towards the back of the truck.

8) **Processes followed and steps taken to obtain necessary approvals to cross U.S.-Canada border, including examination of the animal by U.S. and Canadian regulatory authorities**

Officials at the border were advised of all details of the shipment in advance. Appointments were made for veterinary inspections at 8 a.m. on October 26, 2007. The shipment arrived early due to the efficient loading in Denver and lack of delays during the drive, and waited for the pre-arranged appointment time.

Dr. Jim Becker, USDA veterinarian, reported his inspection of the animal was minimal as is normal to minimize stress as much as possible for the animal in transport. Dr. Becker entered the truck and briefly looked at her. He does not recall anything particular, other that he was able to see only part of one hind limb. His inspection was over after 10 to 15 minutes.

The truck then proceeded to the Canadian side, where Dr. Peter Kelley was on duty. Dr Kelley does not have experience with hippos but he made some subjective comments about the animal being stressed. His clinical impression, based on a visual exam, was that the animal looked healthy and could be admitted into Canada.

The truck left the border around 10 am on October 26.

9) **Medical treatment provided to the animal upon its arrival in Calgary**

The health and physical condition of Hazina remained unknown for a couple of hours after her arrival at Calgary zoo.

The fact that she did not stand up to exit the crate right away was because she was suspected to be stubborn. People clearly adopted behaviours supporting that assumption, trying to motivate the animal to leave the crate by using a variety of methods.

Dr. Doug Whiteside, veterinarian at Calgary Zoo, made the first medical exam and reacted promptly when he realized that the animal was in shock with pale hind legs. His symptomatic treatments with fluids and painkillers began around 8 p.m. on the 26 of October, as soon as he could do it. Putting the hippo in water in order to alleviate the pressure on her hind legs seemed beneficial at first, even though it was not done before 2 am on October 27, several hours after her arrival.

Necropsy showed massive acute and severe myopathy in her hind legs, but also her front legs and sternal muscles.
10) **Animal transfer knowledge and experience of any employees of the Calgary Zoo, Denver Zoo and Planned Migration involved in the shipment of the animal**

This transfer from Denver to Calgary was very well planned by both zoos. In Denver, great efforts had been made to crate train the animal well in advance by people accustomed to working with hippos. This particular animal was well known to her keeper and her behaviour was also known. Denver Zoo transported 14 hippos since 1966 without incident.

Calgary Zoo also put a lot of energy into this transfer, and everything was well planned.

Both zoos have had hippopotamus in their collection for a number of years, and they know how they react.

Mr. Chris Danhauer from Planned Migration also has a lot of experience with all kinds of animals (he had been a zoo keeper before becoming an animal carrier 9 years ago.) His experience is limited with hippos, and he knows more about elephants and rhinoceros.

**CLINICAL COMMENTS**

The necropsy report concluded that Hazina died of: **myopathy, ischemic, acute, severe.**

Skeletal muscle is a highly vascular tissue with abundant capillary bed that forms an extensive system of anastomoses. Example of ischemic muscle necrosis are often due to vascular occlusion secondary to pressure. Jubb, Kennedy and Palmer (Elsevier Saunders, 2007) explain that ischemic damage to muscle fibres and the capacity to repair will depend on the completeness and duration of oxygen and nutrient deprivation.

1- Least damaging is transient hypoxia of a few hours duration, which causes coagulation of muscle contractile proteins but does little harm to the cellular components….muscle are ordinarily restored to normal function in 16 to 20 days (after the effective removing of the pressure for example)

2- Next level of injury is induced by episodes of ischemia lasting 6 to 24 hours, which cause death of both myofiber and satellite cell nuclei and coagulative necrosis of long segment of myofibres. The capacity for regenerative muscle fibres is lost or greatly reduced…
The third level of ischemic injury is that lasting for more than 18 to 24 hours, which leads to death of all cells within an area of muscle…the end result, is a mass of scar tissue that can include adipose tissue, with a periphera narrow zone of distorted muscle fibres.

Authors also note that regardless of the duration and extent of ischemic change, muscle fibre plasma membrane become permeable to enzymes and myoglobin... myoglobin is released from damaged muscle and the amount released will vary directly with the severity and extent of damage. When a large mass of muscle is physically injured or when ischemic degenerative changes are extensive, large amounts of myoglobin are released into the bloodstream… myoglobin has a direct toxic effect on the kidney tubules leading to nephrosis… renal ischemia due to shock will contribute to the potential for severe renal damage and renal shutdown. Hyperkaliemia due to massive muscle fibre breakdown can result in acute heart failure.

Pressure created by the weight of body, torso or head on a limb tucked under the body for prolonged periods leads to muscle ischemia syndrome (Downer syndrome)….absolute size and body weight has some influence on the incidence of the disease. Muscles of limbs tucked under are particularly susceptible to ischemic pressure myopathy, as both venous and arterial pressure is affected.

Clinical presentation of Downer syndrome can be complicated by pressure induced peripheral nerve injury. Even 6 hours of inactivity can cause sciatic damage leading to peroneal nerve paralysis. Hazina seemed to have suffer from this in one of her hind legs (left one)

In cows and horses…extensive ischemic lesions can result from prostration in 6 hours. (Pathologic Basis of Veterinary Disease, 2007)

Nobody saw the hippopotamus Hazina stands up for almost 29 hours. If she sat sternal most of the time in dog sitting fashion (but nobody can be sure of that), it is easily understandable that the pressure was very significant on her hind legs all the time. Pressure was also present on her front legs and sternum, as shown in the pathology report, reinforcing the fact that the bedding was thin beneath her.

Hippos are not marine mammals. They are well adapted to spend lots of time on earth foraging and resting. The fact that they often move prevents them to be affected by myopathy…or killed by their own weight.

Necropsy also showed that she had a thick fat accumulation under the skin. She was 2400 pounds in 2006 (estimated) and 3200 pounds in October 2007. Her weight of 3200 pounds does not seem excessive but her weight gain might have been. We know that she was receiving hormones and we know that it could result in weight gain in a short period of time. Sudden extra weight on the legs would not be of any help in this case.
RECOMMENDATIONS:

After reviewing this case, it is clear to me that Hazina death was an accident that none could have reasonably foreseen. The following recommendations could help prevents similar cases to happen but certainly not eliminate all of them.

- Visual stops at regular intervals mandatory
- Container that allows the hippo to stand, lay on its side without being cramped or being able to turn around
- Crate with a non-slippery floor to facilitate the animal when it wants to get up
- Abundant bedding (wood shaving when allowed)
- Some means of looking at the animal while driving (closed circuit camera)
- Means of giving water to the animal during transport without being there physically (for trip lasting more than 24 hours, and if the animal was watered before dispatch, re LAR from IATA, container requirement 71)
- Be aware of the delays that might happen crossing borders
- When possible, follow BIAZA advice and stop at zoos on the way, if the carrier does not witness the animal standing up, keeping in mind that hippos do not behave like elephants (we recommend that a zoo employee travels with the animal). Those stops must be well planned before.