

**Captive Management of Sumatran
rhinoceros (*Dicerorhinus sumatrensis*)
Tabin Wildlife Reserve**

September 2018

Paddock Staff

1. Wilson Kuntil (Head Keeper)
2. Justine Segunting (Rhino Keeper - RIF)
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* RQF: Rhino Quarantine Facility
 RIF : Rhino Interim Facility
 RFP : Rhino Food Plantation
 BRS : Borneo Rhino Sanctuary

Sumatran Rhinoceros

No.	Animal ID	Sex	Accession No
1.	Kretam	Male	SWD 002
2.	Iman	Female	SWD 004

1. Husbandry

1.1 Animal Management

The weather in September 2018 is very erratic with most rain occurring in the first three weeks, followed by a dry spell in the fourth week. The total rainfall is 115 mm, ranging from 5 – 31 mm. There are nine total rain – days, with more than half occurring in the afternoon.

All preparations were made to move the two rhinos within the same morning to the new Borneo Rhino Sanctuary (BRS) enclosure. Due to her condition and sensitivity to surrounding stress (people, noise and crating), Iman was moved first, followed by Kretam. She was crated, secured and crane lifted onto the lorry. She arrived at BRS at 0730H and moved into the night stall, via the runway and connecting night – stalls. She was fed and given water by the keeper (Plate 1 and 2).



Plate 1. Iman was crated before being loaded onto a lorry and moved to BRS



Plate 2. Iman being coaxed to feed on *Artocarpus* leaves by her two keepers

Iman was placed in night – stall No. 4 and 5, situated at the end of the facility, which connects to an outside Paddock 3.

Kretam was subsequently crated and loaded onto the lorry. It was quite easy to load Kretam into the crate. He arrived at the BRS

at 0930 am and was coaxed gently into night – stall No. 1 and 2 (Plate 3).



Plate 3. Kretam being released from the crate into the runway and his night - stall

Kretam was released into “breeding” enclosure (concrete fence), on the 7th September 2018, after he acclimatized to the night – stall. Two mud wallows were prepared for him but only one was used briefly by him. He showed a lot of normal behavioural activities, mostly marking of new territory, including debarking, defecating and urine spraying (Plate 4)



Plate 4. Kretam spraying urine in his new enclosure

Kretam was conditioned inside the concrete fence before releasing him into the large electric – fenced paddock (Paddock 1) on the 19th September 2018.

The movement of keepers to the new quarters took about two weeks thereof, with recurring repairs to the electric circuits and water pump for the house.

Leakages of the roof inside the night stall has not been resolved and caused short circuit in the food store. Temporary lighting was provided in order for the keepers to stack the daily rhino forage harvested for hand – feeding.

Both the rhinos were kept inside the night – stall for more than a week due to the constant finding of rusty nails, metal pieces, bricks, tin cans and plastics inside the paddocks. **To note, that, even to date, we still uncover rusty metal parts, mostly nails and iron rods, from the paddocks.** It is almost impossible to go through the entire paddock because of the undergrowth (Plate 5).



Plate 5. BORA staff digging out more rusty metal rods from the paddocks. A metal detector was used during the operation

However, the task of going through the trails made by the rhinos were carried out daily to locate remnants of building

materials left by the irresponsible contractors.

The voltage on the electric fence is between 6.9 - 7.9 kV. This was checked daily by the keepers.

The food source for the rhinos are adequate from the surrounding Tabin Wildlife Reserve and substantial amount were also collected from the RFP and the RQF.

Kretam is in good condition and spends a lot of time, browsing in his new paddock. On several occasion, he only comes back once a day, for his hand – feeding. His body weight dropped significantly in September 2018, with him not coming back on several occassions. However, he is very active inside the new paddock, marking his territory and browsing on the available vegetation, including *Macaranga triloba*.

However, Iman’s body weight dropped significantly in August 2018 and continued to drop in September 2018, with a slight increase at the end of the month. She was suspected to have malabsorption syndrome and fecal samples were being tested at the university. The other tentative diagnosis included her massive leiomyoma having a direct (obstruction on the gastro intestinal tract or organs) or indirect (toxaemia) impact on her weight loss.

Despite the clinical problem, her other parameters (appetite, vocalization and ethogram) remained normal. The vaginal discharge was still observed a few times daily. She was ultrasound to visualize the leiomyoma and ovaries

Mud wallows were constructed for each rhino inside the new paddock. Iman made full use of it from the first day and never built one on her own. Kretam, on the other hand, did not used the wallow built for him and defecated inside it. He constructed one in the swampy part of the enclosure.

The problem with hoof cracks had temporarily resolved in both rhinos.

However, Kretam was observed to have a 3.5 – cm laceration on the lateral aspect of his left hind limb, at the region of the metatarsals. This is very likely due to the sharp metal pieces, yet to be uncovered in his paddock.

However, the open pyometra in Iman still persist and is monitored daily. The discharge was seen in her wallow and occasionally in her night – stall, after defecation. No blood was observed in her discharge. She was ultrasound on the 26th September 2018.

1.2 Body Weight

The body weights were taken using TruTest® electronic weighing scale. Kretam was weighed, twice a month (15th and 30th of September 2018). Iman was weighed once a week to allow close monitoring of her body condition and weight loss. The decrease in body weight was observed on the 20th August 2018. She lost 20 kilograms in a week and her weight was further reduced to 489 kilograms, a week later. However, her body weight increased by 5 kilograms on the 3rd September 2018. The two subsequent weighing showed a decrease, followed by a small increase (Figure 1).

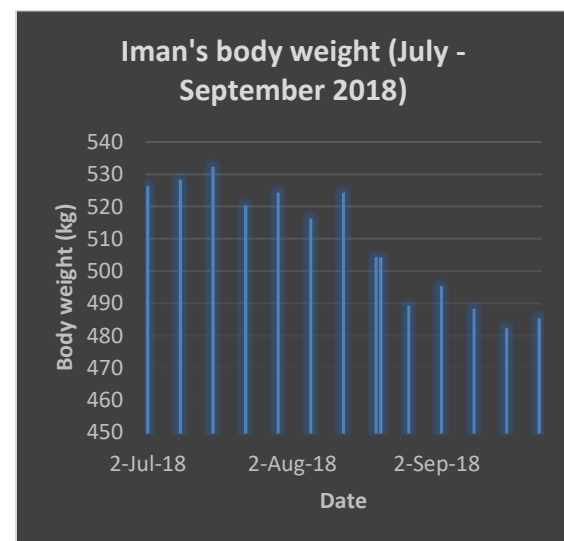


Figure 1. Iman’s body weight showing the drop in mid-August 2018 to September 2018

It was anticipated that, Kretam's body weight would decrease when he is moved to the Borneo Rhino Sanctuary (BRS) on the 4th September 2018. This is mainly associated with more physical activities and establishing of a new home range. Although he does foraged inside the new enclosure (Paddock 1), the amount and variety is limited. In addition, he didn't get his intake of horse pellets (500 grams) and 6 – 10 kilograms of fruits.

Kretam's average bodyweight in 2018 is 668 kilograms, with the highest of 677 kilograms attained in July 2018. Subsequently, it dropped to 662 kilograms in August 2018 and 640 kilograms in September 2018 (Figure 2).

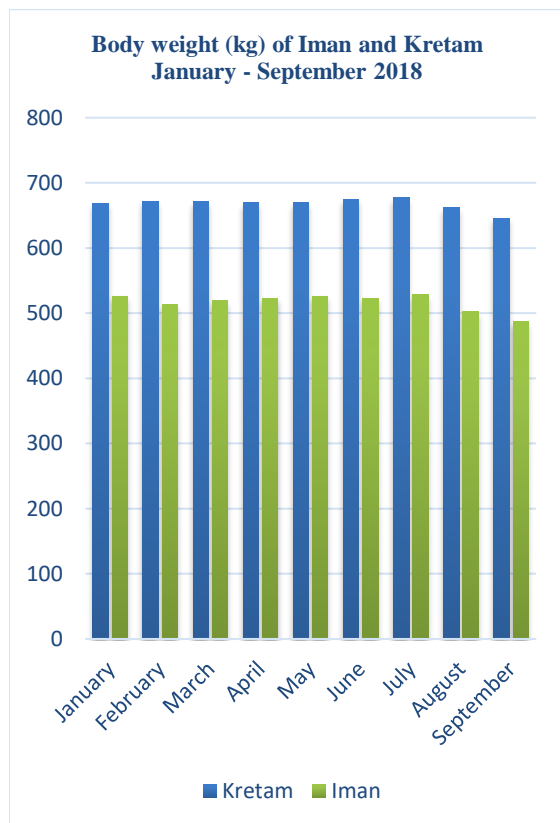


Figure 2. The average bodyweights of Kretam and Iman in 2018

2. Animal Health

The body scores of Kretam was maintained at around 2.5 and Iman at 2.0 (modified from Body Condition Scoring for Horses, Henneke et al., 1981).

The main reason for the rapid drop in Kretam's body weight was due to his refusal to come back for hand – feeding on ten occasions.

Iman has an issue of weight loss, more seriously in September 2018. Tentative diagnosis included the large and growing reproductive tumours, septicaemia, toxemia, malabsorption syndromes and organ failure. These structural or functional disorders affects the absorption of fat, carbohydrates, proteins, vitamins and minerals.

The vaginal discharge is still observed every day but almost all, without blood. The open pyometra still persisted in her. Her behavior (vocalization and other activities), gait, feces, urine and appetite were normal.

The amount of forage eaten by each rhino dropped significantly, partly related to the new and large paddocks. This period of establishing a new home range were done cautiously by the rhinos.

Both the rhinos were fed with a minimum amount of browse, daily. Iman consumed 9 – 11 kg of foliage that's fed to her twice a day. Both the rhinos hardly ate the browse that were hung inside the paddock. Kretam was offered a total of 36 kg, divided into two helpings.

External wounds included lacerations observed on the legs. These were caused by some of the metal pieces and sharp concrete, scattered in the paddocks which surfaced after heavy rain.

Kretam was observed to mount a small earth outcrop inside the paddock on four occasions. This is usually a response to the placement of feces from Iman, each morning.

The routine monthly sampling for health and environmental checks for pathogens, were carried out for both rhinos and their surroundings. The samples were collected on the 11th September 2018 (Tuesday) and

submitted to the Veterinary Diagnostic Laboratory, JPHPT and Public Health Laboratory in Kepayan, Kota Kinabalu on the 12th September 2018, before noon.

The samples included soil from around the night - talls, mud from wallows, water from the tanks, floor swabs, horse pellets, feces, urine and blood. All these samples except blood, were analyzed for bacterial contamination, particularly *E.coli*, *Salmonella sp* and *Bukholderia psedomalleie*.

2.1 *Kretam*

a. Lacerations

The 3.5 cm laceration was observed on the right hind feet. The cut would have been caused by a sharp piece of metal or concrete block inside the paddock. A smaller laceration was seen on the left fore feet (Plate 5).



Plate 5. The laceration on the right hind feet, extended to the sole

The lacerations were clean with flowing water and povidone applied into the cuts.

2.2 *Iman*

a. Reproductive tract pathologies

The growth of the leiomyoma had also altered the feeding behavior as well as the general health of Iman. Iman defecated more frequently in small quantities, sometimes within the chute, during feeding. This behavior was not seen in 2014 until mid – 2017. This relates to the leiomyoma's rapid growth and putting pressure on the caecum, colon and other adjacent organs.

Rectal examination indicated a large firm mass of the leiomyoma inside the uterus that occupies the right side of the pelvis. Ultrasonography of the cervix showed a loosely fit annular fold, sometimes with hypoechoic fluids (Plate 6).

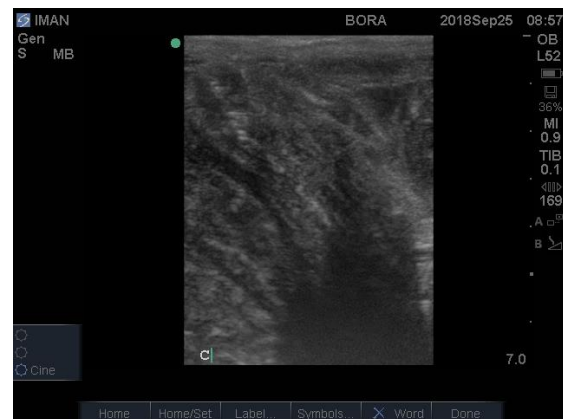


Plate 6. Cervix is edematous with fluids (hypoechoic and anechoic) in between the annular folds (hyperechoic)

The entire uterus is filled with numerous pathologies, ranging from fluids, cysts, masses and leiomyoma. The endometrial cysts ranged from a few mm to several cm, unilocular and multilocular. The leiomyoma ranged from a few centimeters to almost 8 cm and of various shapes. These tumours were observed in the uterine body and horns of the uterus.

Several anechoic fluid filled structures (cavernous) are seen in the middle of the leiomyoma. Echoic masses are often seen as part of the endometrial pathology in Iman (Plate 7 – 9).



Plate 7. Hypoechoic leiomyoma in the uterine body, with anechoic fluid filled center



Plate 8. A leiomyoma in the uterine body with anechoic fluid filled cyst. Note the echogenic structure (arrow) ventral to the fluids.



Plate 9. A large leiomyoma with anechoic cysts (C) in the uterine horn. Noticed the hypoechoic left ovary (O) located adjacent to it.

Her ovaries are inactive (follicular atresia), flat and small, with some echoic fibrous tissues and old corpus luteum (Plate 10).



Plate 10. Left ovary (O) of Iman

In early September 2018, the mucous vaginal discharge ranged from clear to milky or pinkish coloration, sometimes with frank blood. The volume ranged from 20 to 50 milliliters. This was seen a few times every day, particularly after or during defecation or urination. Occasionally the discharge was observed floating in the mud wallow (Plate 11).



Plate 11. The clear – pinkish vaginal discharge observed in the night – stall after defecation.

However, after the third week of September 2018, the discharge consisted only of clear to whitish mucous, both seen in the wallow and on the floor inside the night – stall (Plate 12).



Plate 12. The clear – white discharge voided after defecation inside the night stall

a. Malabsorption - malnutrition

Since 20th August 2018, her condition deteriorates with significant loss in body condition and body weight (504 kg). She weighs 485 kilograms on the 24th September 2018, a drop by 19 kilograms within a month, indication of a “wasting disease” (Plate 13).



Plate 13. Iman in her chute during feeding. Noticed the protruding pelvis and vertebral column.

Her appetite and behavior remain normal, with her coming back for food in the morning and evening meals (Plate 14 – 15).



Plate 14. Iman coming out from her mud wallow



Plat 15. Iman eating her forage inside her chute

The blood parameters, particularly the low mean corpuscular hemoglobin (MCH) is a reflective of poor nutritional intake (malnutrition), another likely reason in malabsorption syndrome. Normal MCH for Sumatran rhinos are between 27.3 – 30 pg. Similarly, the mean corpuscular volume (MCV) is below normal average of 78.5 fL.

She consumes at least 20 kilograms of browse daily, via hand feeding. She also consumes 5 kilograms of banana, 1 kilogram of mango, 1 kilogram of papaya

and 0.5 kilogram of jackfruit. Despite feeding her with more concentrates (600 – 800 gm/day) and increasing her diet, her weight loss is still significant. This “malabsorption syndrome” can be associated to the uterine tumors, toxemia, and the underlying hormonal imbalances.

3. Feed and feeding

The common source of rhino food plants was from the surrounding Tabin road, up to the 6th kilometer road towards the core area, KL – Kepong (Sabah) plantation and the forest fringes and to a lesser extent, Ladang Permai. Currently, about 20 % of the forage, used for hand – feeding comes directly from the RFP and RQF.

Nangka air pasir, Nangka air paya, Nangka air bukit (*F. fistulosa*) Ara manga (*F. annulata*), Mas cotek (*F. deltoidei*), Ara Kapal (*Ficus montana*), Ara Gatal berbulu (*F. francisci*), Putih sebelah (*Leucosyke capitellata*) and nangka (*Artocarpus hetrophyllus*) were recently collected from the Rhino Quarantine Facility. *Ficus calosa* (Pau) were collected from within the BRS paddock or along the road towards the core area. Ranking in terms of preference differ from both rhinos. The forage that were hung out for supper included mostly nangka (*Artocarpus hetrophyllus*), Maitap (*Neonauclea spp*) and Putih Sebelah (*Leucosyke capitellata*) and some ficus species. These were secured onto trees in Kretam’s paddock and near the railings outside of Iman’s night stall.

The common fruits fed to Kretam and Iman included banana, papaya, jack fruit, mango and pumpkin.

As with new paddocks, the rhinos, especially Kretam spends a lot of his time browsing and exploring, hence missed several of his hand feeding and supplements. This is also similar with Iman but on a smaller scale.

3.1 Forages

The total amount collected for the two rhinos in August 2018 is 3089 kilograms. Of this 47.3% (1460 kg), was eaten by the two rhinos. Of this, Kretam consumed 47.4% and the balance was eaten by Iman. Iman’s forage intake was limited to about 22 kilograms each day.

Thirty seven percent of the total forage collected was hung out for the rhinos. 53% was allocated for Kretam and 47% for Iman. Of this, the total consumed by both rhinos is only 15% (Figure 2).

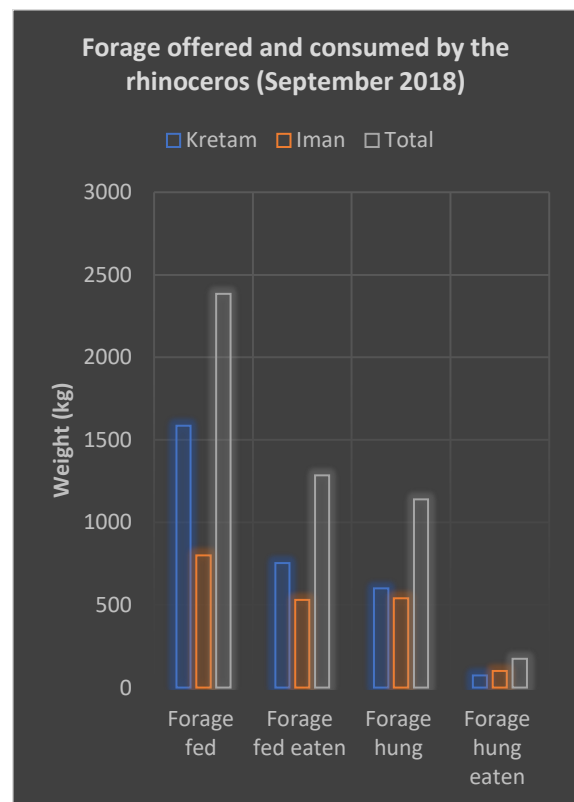


Figure 2. The total amount of forage offered and consumed by the two rhinoceros in Tabin

The total amount of forage offered and consumed by the rhinos varies each month but is within the normal range. However, in September 2018, the amount consumed is much lower (Figure 3).

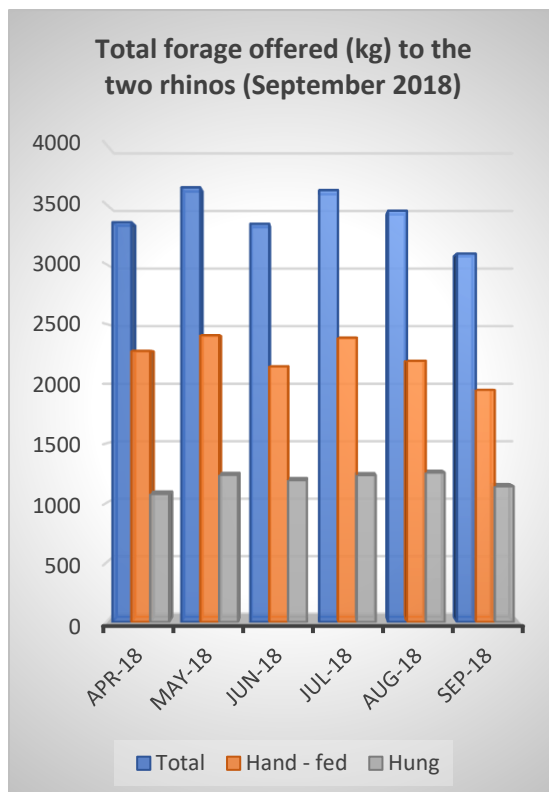


Figure 3. The foliage offered to Kretam and Iman for the months April – September 2018

3.2 Voluntary Feed Intake (VFI)

In September 2018, Iman came back for all her feedings except one day, while Kretam only came back for 24 morning and 26 evening feed. The feed intake for Kretam in September 2018 (total consumed 828 kg) is the lowest for 2018. The daily consumption from hand – feeding ranged between 11 – 22 kg and 13 – 39 kg for Iman and Kretam respectively.

Iman was fed 9 – 11 kilograms of foliage per feeding consisting of 16 species of plants, mostly figs. Her appetite remains good and feed intake, consistent. Iman consumed only 15.5% (174.5 kg) of the foliage hung out for her in September 2018. Her total feed intake is 632 kg, 142 kg less than in August 2018. It was observed that Iman did not feed on the browse hung out for her outside the night stall for almost two weeks.

In September 2018, Kretam consumed 828 kg (47% of the total forage offered) as compared to 1343 kg in August 2018.

Fruits constitute 18 % (330 kg) of the total diet of the two rhinos. Most fruits are available throughout the year (*Musa acuminata*, *Carica papaya*, *Mangifera indica* and *Artocarpus heterophyllus*) and a few including *Artocarpus integer* and *Mangifera foetida* are seasonal.

Half of the fruits were fed in the morning and the remaining in the afternoon or evening.

Horse pellets (Gold Coin ®) were given as supplements. Kretam receives 500 grams each day. Iman gets 400 grams daily boost her body weight. These were mixed with water and soften before feeding the rhinos.

In addition, the mineral and vitamin supplements (Stress Pack®) were added to the drinking water (5 grams to 8 liters water) and to the water to rinse some foliage prior to feeding the rhinos.

Clean drinking water was provided inside a container and given, intermittently during hand feeding. The water was also made available inside Iman’s paddock. Kretam has a flowing stream and swamp inside his paddock to drink from.

4. Biosecurity/health monitoring

Similar biosecurity measures were also undertaken in BRS with much less samples (from water tanks) for pathogens. Currently, there are only three water tanks at BRS. These were tested for total coliform counts and presence of *E.coli*. Blood sample was taken from Kretam for a complete blood count (CBC). Blood was also taken from Iman for CBC and serum chemistry. Samples from the vaginal discharge was taken for bacterial isolation and sensitivity tests.

4.1 Hematology

Blood was collected Kretam into EDTA tube from the digital plexus, for a complete blood count (CBC). The coccygeal vein was used for Iman due to her flighty nature. The CBC and serum chemistry was compared with his previous results (Table 1).

Table 1. The complete blood count for Kretam in August and September 2018.

Parameters	(Kretam)		(Iman)
	14 Aug	24 Sep	26 Sep
Hemoparasites	Nil	Nil	Nil
RBC (X10 ¹² /L)	5.8	5.24	9.08
WBC (1000/UL)	10.1	10.8	6.9
Hb (G/DL)	13.6	12.5	22.1
PCV (%)	45	44	67
Seg. Neutrophils (%)	67	51	NA
Eosinophils (%)	20	32	NA
Lymphocytes (%)	11	17	NA
Monocytes (%)	2	0	NA
Basophils (%)	0	0	NA
MCV (FL)	NA		73.8
Platelets (G/L)	NA		84
MPV (FL)	NA		7.8
MCH (PG)	NA		24.4
MCHC (G/L)	NA		330

Comparisons were also made with previous blood pictures from other Sumatran rhinoceros. The CBC showed variables are within normal limits for Kretam.

In Iman, the low mean corpuscular haemoglobin (MCH) is also reflective of poor nutritional intake (malnutrition), another likely reason in malabsorption syndrome. Normal MCV for Sumatran rhinos are between 27.3 – 30 pg. Similarly, the mean corpuscular volume (MCV) is below normal average of 78.5 fL.

However, the marked increase in packed cell volume (PCV or HCT), haemoglobin and red blood cells are suggestive of **polycythemia**. One of the causes of this

secondary polycythemia is uterine tumours (possibly renal cell or hepatocellular carcinoma), which releases high amounts of erythropoietin enzymes into the system.

The serum chemistry for Iman showed an elevated creatinine level of 87.9 µmol/l (normal = 42.5 µmol/l). This could indicate impairment of the kidney function.

4.2 Bacteriology

The 20 floor swabs were positive for *Staphylococcus sp* and *Bacillus sp*.

The 17 soil samples taken from various locations surrounding and inside the rhino enclosures were negative for *Bukholderia pseudomallei*. The two samples from the mud wallows were also negative for *Bukholderia pseudomallei*.

Water from the sump was positive for *Klebseilla pneumoniae*.

The water samples taken from 5 tanks at BRS had a total bacterial count ranging from 150 – 785 cfu/ml. The total coliform count ranged from 10 – 80 cfu/ml. Only one water tank had an *E.coli* count of 20 cfu/ml (Table 2).

Table 2. The total bacterial, coliform and *E.coli* counts in 5 water tanks (cfu/ml) for the month of September 2018.

Tank	Total bacteria	Total coliform	<i>E.coli</i>
1	785	30	0
2	150	10	0
3	200	70	20
4	170	70	0
5	100	80	0

There were no *Salmonella sp* isolated from the water samples.

Sample from the vaginal discharge was positive for *Streptococcus dysgalactiae*. The drug of choice was Amoxicillin, Gentamycin, Vancomycin, Erythromycin and Penicillin G (Table 3).

Table 3. The antibiotic sensitivity test for *Streptococcus dysgalactiae* from the vaginal discharge

No.	Antibiotic	Sensitivity
1.	Amoxycillin 25mcg	Sensitive
2.	Gentamycin 30mcg	Sensitive
3.	Norfloxacin 10 mcg	Intermediate
4.	Sulphonamide 300mcg	Resistant
5.	Erythromycin 15mcg	Sensitive
6.	Neomycin 30mcg	Resistant
7.	Penicillin G 10iu	Sensitive
8.	Vancomycin 30ug	Sensitive

stimulate Kretam's libido. He was observed to mount a small earth outcrop on four occasions in September 2018.

There were no pathogens isolated from the urine and feces of both rhinos.

The total coliform counts from the horse pellets (Gold Coin®) was 50 cfu/gm, but negative for E. coli.

4.3 Parasitology

The fecal samples from both rhinos were negative for endoparasites and parasitic egg count.

4.4 Routine prophylaxis

Routine liming (application of calcium/magnesium – rich materials) was carried out mostly around the rhino dung piles (composting area) located within the walled passage near paddock 3. Liming were also carried in the sumps. The tyre baths were monitored and maintained with proper disinfectants and concentration

5. Reproductive assessments

Iman was scanned on the 24th September 2018. Apart from the obvious uterine pathology, her left ovary was inactive.

The routine placement of Iman's feces in the concrete passage was done daily to