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Introduction

Elephant population management is one of the most critical conservation issues facing many areas in Africa. Wildlife managers are struggling with growing elephant populations and limited management options. Since 2001 our team has been working with conservationists and wildlife officials with the goal of providing an elephant management tool that can be used to maintain biological diversity and reduce the need for culling. Surgical sterilization is a permanent contraceptive technique that is used around the world and is one of the most common methods of birth control in both animals and humans. A vasectomy is one method of surgical sterilization that has the advantage of maintaining normal hormone levels and thus breeding and social behaviors remain unchanged. Elephants that have been vasectomized will continue to go into musth, breed (although sterile) and maintain their social status within the population.

There are several advantages for using vasectomy as a population management tool over the limited number of other methods of population control. The first is that while anesthesia and surgery are relatively invasive, vasectomy is a one-time procedure that does not require further manipulation of the individual animal. This is also a very flexible tool and application on pre-selected bulls can allow wildlife biologists the ability to determine what level of birthrates best fit their unique situation. In some cases, 0% birthrate may be optimal, while in other parks some degree of calving (e.g., 1-6%) may still be desired. The reduction in birthrate is directly proportional to the percentage of dominant breeding bulls that have been vasectomized.

Elephant Anesthesia and Positioning

Maintaining the health of our elephant patients during and after the surgical procedure is our highest priority with several new and innovative techniques being instituted to assure patient safety. Bull elephants are identified by local wildlife biologists, pursued by helicopter and then darted with the potent anesthetic agent, etorphine. An experienced wildlife capture team, Catchco Africa, is used for this specialized procedure to ensure the safety of the elephant patient and project personnel. Once anesthetized, the elephant is suspended by a crane truck using heavy straps that support the head and body. Wooden braces are then fastened to the front legs to maintain all limbs in a modified standing position to distribute the weight evenly from the sling and to reduce the pressure on the axillary region.

With the elephant in this modified standing position, both sides of the patient are simultaneously accessible for surgery, thereby minimizing total procedure time. Due to their great size, unique elephant equipment has been developed to safely anesthetize, maintain and monitor these animals during surgery. An endotracheal tube is placed in the elephant's trachea



and the animal's respirations are assisted using a portable ventilator system. While anesthetized, a wide variety of important physiologic parameters are measured to monitor the patient's health including blood pressure, oxygen saturation, end tidal carbon dioxide, body temperature, heart rate, respiratory rate and blood gas analysis. The equipment that has been developed and the information gained from these procedures will greatly contribute to future surgical



and anesthetic management of both free ranging and captive elephants. After surgery is complete, the elephant is lowered from its suspended position and the anesthetic reversal agent is given. The patient typically wakes up and walks away in less than 5 minutes.

Elephant Anatomy and Specialized Surgical Equipment

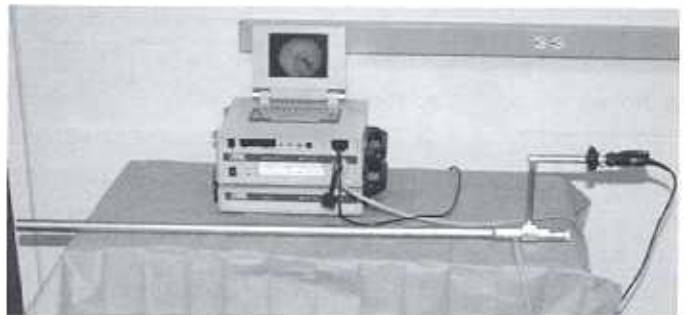
Unlike most mammal species, elephant testes are internal and can be found adjacent to the kidneys. Recent

advances in medical technology allow surgical access to the 3 elephant's reproductive organs using minimally invasive laparoscopic instrumentation and protocols. With the use of this technique, a rigid laparoscope, with camera attachment, is introduced into the elephant's abdomen to allow the surgeon to manipulate the internal organs while viewing on a television monitor. Since only a small incision is necessary, there is less chance for infection, the surgery time is much faster and there is less post-surgical discomfort and complications.

Inspired by the needs of this project, the Karl Storz Company has developed several unique laparoscopes for use in elephants and other large animals. These operating



laparoscopes have working channels that allow a variety of specially designed instruments to perform a range of surgical procedures including vasectomy. The pioneering introduction of this instrumentation has made an extremely important contribution to the veterinary care of our megavertebrate patients.



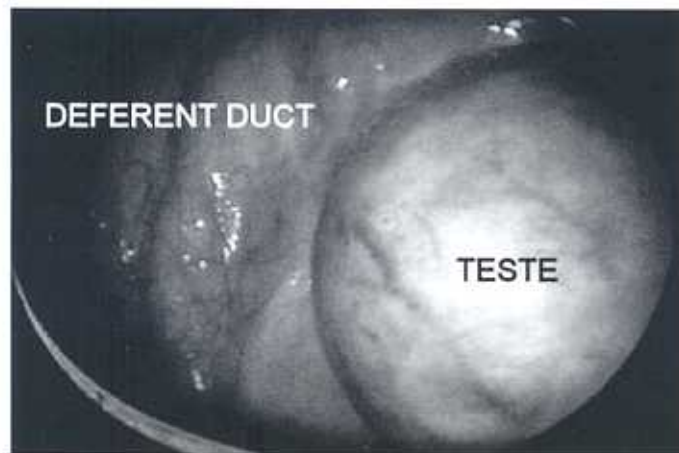
Laparoscopic Vasectomy Surgery

Once in position, the elephant is prepared for surgery with a disinfectant scrub of the elephant's skin and the area is then covered with sterile drapes. The primary incision is approximately 12 cm long and made just in front of the elephant's tuber coxae, or point of the hip. The laparoscope



is placed through the elephant's body wall and pressurized air is delivered into the abdomen to increase the size of this space for better viewing of the internal organs. To minimize surgical time, two teams work simultaneously on each side of the elephant. The testes, epididymis and the deferent ducts can be found suspended just next to the spine and close to the kidney.

The deferent ducts are clamped and a laparoscopic scissor is used to cut and remove a 4-6 cm portion of the sperm carrying ducts. Once the deferent duct has been



removed on one side, the elephant is lifted and rotated 180 degrees so that the laparoscopic team can complete the vasectomy on the second side while the second surgical team closes the incision on the previously completed side. Surgical times are relatively short, with most procedures lasting about 1.5 hours. The incision is closed in three layers using large diameter equine suture material (Syneture™, Covidien Healthcare).

Post-Operative Monitoring and Long Term Follow-Up

All vasectomized bulls are fitted with telemetry collars to locate and closely monitor the animals following surgery. Our goal is to document and ensure that there are no postoperative complications, and to have on-site staff and

researchers routinely observe these animals for any potential negative social changes. Our work with freeranging elephants has demonstrated that these animals recover quickly from this minimally invasive surgery and rapidly return to normal



behaviors. Generally, the elephant's incision heals in less than a month and it is often difficult to see a scar at six months.

Recent Population Management Programs

In July 2006, four bull elephants at the Welgevonden Game Reserve had complete laparoscopic vasectomies performed as part of a pilot study into the feasibility of this technique as a population control tool in elephants. The local ranger staff and research biologist have been monitoring this elephant population since the program was initiated in 2006. All the bulls have healed well and have shown no negative behavioral or social effects from the procedure. The research study at Welgevonden helped document that vasectomized bulls continue to go into musth, chase away subdominant



bulls, and continue to breed with elephant cows as they did prior to surgery.

In July 2007, an elephant population control program using laparoscopic vasectomy was initiated by the Mpumalanga Parks Board at the Songimvelo Game Reserve in South Africa. To date, five bulls have had successful surgery with additional bulls scheduled for vasectomy in 2008. The entire elephant population at Songimvelo is part of a long-term research project that will document elephant population dynamics and be part of behavioral observation studies until 2010. Furthermore, genetic profiles of vasectomized bulls and any subsequent calves produced from associated herds are obtained so parentage and social reproductive issues can be monitored. This work will provide specific data concerning the expected decrease in birth rates after the vasectomy program has been initiated while monitoring for any change in social behaviors. In addition to performing a contraceptive service to the Parks Board, the project team has provided innovative and valuable information to a variety of African wildlife managers, biologists and veterinarians regarding elephant anesthesia and surgical techniques. Consistent with the project objective of capacity building, the sharing of these developed skills has already been initiated.

In 2006 and 2007, this team has improved the practicality of this procedure by greatly reducing the surgical time for each elephant. The project team is now capable vasectomizing several animals in a day.

This is an international collaborative project that brings together conservation groups, universities and private industry to address this complex problem. We recognize that surgical vasectomy will not provide the solution for the controversy of controlling very large elephant populations. Additionally, further research will be necessary to fully understand if the procedure may have any negative impact on the individual elephant, its herd, or the ecosystem. It is our hope that this team of dedicated professionals can provide a new tool and a legitimate option for elephant population management.

Project Team

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Disney's
ANIMAL PROGRAMS



The Equine Hospital
Colorado State University

Corporate Sponsors

- Karl Storz Company, Tuttlingen, Germany. Design and manufacture of specialized laparoscopic surgical equipment.
- Covidien Health Care, Animal Health & Dental Division, 15 Hampshire Street, Mansfield, MA 02048. Surgical supplies, equipment and elephant telemetry collars. ❖