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PRACTICAL IMMOBILIZATION TECHNIQUE OF BLACK AND WHITE RHINO USED BY SOUTH AFRICAN NATIONAL PARKS

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Key words: Black rhino, white rhino, M99, Azaperone, M50-50, Nalorphine, Naltrexone, Cloxipol Acuphase, partial reversal

Extended abstract
Black rhino (*Diceros bicornis*) and white rhino (*Ceratotherium simum*) are frequently immobilized and translocated by the Veterinary Wildlife Services Unit (VWS) of South African National Parks (SANParks). The two species occupy overlapping habitats but differ considerably in their social behaviour, diet and response to the drugs used. Knowledge of these differences is essential for any successful capture and translocation of these species.

**White rhino** are gregarious grazers and respond fairly predictably to the selected drugs when captured. M99 (etorphine) and azaperone are used routinely for all immobilizations on white rhino. Hyalase is added to the initial cocktail to improve absorption and reduce knockdown time. White rhino are very sensitive to the respiratory depressive effects of the opioid drug (M99) and the animal is partially reversed soon after immobilization to counter this negative effect. This is achieved by using nalorphine (partial antagonist/antagonist) and M50-50 (Diprenorphine – a more potent antagonist/agonist). This state of near anaesthesia is used to walk the rhino into its transport crate. During transit M50-50 is given, which produces a tranquilised state of recovery. Long-acting tranquilizers like Cloxipol Acuphase tranquilize the rhino for 3 days and assist with reducing long distance transport stress including acclimatisation stress after release. Naltrexone (pure antagonist) is given before release so that no re-narcotization takes place. SANParks move up to 100 white rhino per year successfully using this immobilization technique.

**Black rhino** are complex social animals. They are browsers and live in thick bush, making immobilization difficult. They are habitually more aggressive than white rhino and respond better to the drugs used. Higher doses of M99, azaperone and cloxipol acuphase tranquilizer are used than in white rhino. They are also more responsive to the reversal drugs and for walking and transport only the weak partial antagonist nalorphine is used. No reversal with M50-50 is given during transit to obtain the maximum state of tranquilization from the partial antagonism. The key to successful black rhino translocation is to protect the animal from itself and its highly aggressive nature. Release into holding facilities requires careful planning and use of the different drugs. A very low dose of M99, with high doses of azaperone is given before release from the crate so that a near immobilized state is achieved. This results in the animal calmly walking out of the crate into its new surroundings. Should the animal become immobilized after release, then IM administration of M50-50 adequately reverses this state. Naltrexone is only used as a reversal (preferably IM) when short procedures are done in its normal environment.
and when all disturbances can be removed before the animal is reversed. Introduction of black rhino into established populations is far more difficult than white rhino due to the increased incidence of aggression between individuals that do not know each other.

The knowledge of the different behaviour and nature of the two species is extremely important to ensure that they are successfully captured, immobilized, transported and then released.

References

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NOVEL USE OF TWO LONG ACTING NEUROLEPTICS TO FACILITATE THE TRANSPORTATION OF TWO OKAPI (Okapi johnstoni).

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Keywords: okapi, tranquilliser, transport, zuclopenthixol, haloperidol

Extended abstract
This is a report of the use of two tranquilizers, zuclopenthixol and haloperidol, in okapi (Okapi johnstoni) to facilitate transportation. Two okapi, a male and a female, were transported out of the zoo and back again three months later using this protocol (Redrobe 2003).

Okapi are notoriously difficult to transport. Confinement and transportation can be sources of significant stress and anxiety to stress susceptible species such as okapi. These high levels of anxiety may lead to refusal of food and water, self-injury, exhaustion and may result in death (Ebedes and Raath 1999). The current recommendations are to train okapi for weeks or months to enter a transport crate. Even following this training, it is not unusual for the crating attempts to take more than 4 hours, as the animals are reluctant to enter the crate. Once inside the crate, these animals may damage themselves in the crate through escape attempts.

The use of tranquillisers to facilitate transportation of wild animals was originally developed in South Africa (Ebedes and Raath 1999) where the basic principles of successful transportation have been described as using the correct equipment, working with trained personnel and using tranquillisers appropriately (McKenzie 1993). Tranquillisers have also been found to reduce the stress associated with new environments (Ebedes and Raath 1999).

Stereotypic behavior has been reported in captive okapi as a response to stress (Bashaw 2001). The use of long acting tranquillisers would also reduce the stress over many days perceived as a result of moving to a new environment.

Long acting tranquillisers should be used together with short acting tranquillisers because of the lag time before the long acting drug will take effect if both are given at the time of expected stress. The short acting drug will bridge the time taken for the long acting one to take effect.

Zuclopenthixol is a long acting tranquilliser. It takes up to one hour to begin its effect and the duration is reported to be 3-4 days. It is used in people with schizophrenia or other psychotic illnesses and is known in man to have low levels of side effects and minimal pain at the injection site (Fenton 2001). It has been used in a number of antelope species (Ebedes & Raath 1999, Read et al 2001). Its use in okapi has not been reported.

Haloperidol is a fast acting, short acting tranquilliser, with the effects noted after 10-15 minutes and may lasts 8-18 hours. An overdose can result in deep sedation that may prevent eating and drinking or catatonia (a state of muscle rigidity and mental stupor which may be fatal). Haloperidol has been used in many species of antelope, African elephant, black and white rhinoceroses and zebras (Ebedes & Raath 1999). Previous papers have described the use of haloperidol and perphenazine in giraffe (Ebedes and Raath 1999) and haloperidol alone in okapi (Raphael 1999, Citino 1996).

The male okapi had two journeys, the female 3 journeys giving a total of five transportations in two okapi.

Each animal was given 100mg of zuclopenthixol 15 hours before the move then 10-20mg to facilitate loading; both administered intramuscularly by dart. Both animals loaded into the...
crates calmly and within 20 minutes. Previous attempts had taken over 2 hours in the past. Unloading was equally without incident. The animals remained in a 'calm and tame' state for approximately three weeks following dosing.

Acknowledgments
My thanks for the skill and dedication of the animal staff at Bristol Zoo Gardens, particularly those looking after the okapi, and for the support of Dr B Carroll, D Bolton, J Partridge, K Wyatt in working with these animals.

References
TRANSLOCATION OF ETOSHA LIONS (*Panthera leo*) TO THE BASLE ZOO
A VETERINARY PERSPECTIVE

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Abstract
Three subadult Etosha lions (*Panthera leo*) from an isolated reserve in South Africa were translocated to the Basle zoo to establish an *ex situ* feline immunodeficiency virus (FIV)-negative zoo founder population. Veterinary procedures included anesthesia, health examination, various testing and preventive measures against infectious diseases before and after translocation, long-acting tranquillization for transport, quarantine, and preparation of other species for integration in a new mixed species enclosure. The lions sera were examined for the presence of antibodies to canine distemper virus (CDV), feline calicivirus (FCV), feline herpesvirus (FHV), feline parvovirus (FPV), feline coronavirus (FCoV), FIV, feline leukemia virus (FeLV) antigen, and rabies; all tested negative. Consequently, they were vaccinated against CDV, FCV, FHV, FPV, and rabies before shipment. The anesthetic and preventative measures, together with careful adaptation to the captive situation, resulted in successful translocation of three healthy lions.

Key words: African lion, *Panthera leo*, translocation, anesthesia, canine distemper, feline immunodeficiency virus

Introduction
Translocation of free-ranging mammals to zoological institutions for stocking-up purposes has fortunately become a rare event in the last decades. However, with more animal populations or subpopulations in danger of extinction, increasing efforts are taken to translocate individuals to establish *ex situ* breeding programmes. The critically endangered Namibian lion population, estimated to be 300 individuals today (1980: 700) (9, 10), is reported to be the last FIV-seronegative lion subpopulation in Africa (5). Contact with FIV-seropositive animals may have a serious or even fatal impact on this highly endangered subpopulation. Therefore, the Basle zoo, together with other zoos, have started an *ex situ* breeding programme for Etosha lions, approved and supported by the IUCN/SSC Cat Specialist Group and others (4). The translocation of three Etosha lions from South Africa to the Basle zoo required intensive preparatory veterinary work and was accompanied by the zoo veterinarian. The purpose of this paper is to present all veterinary aspects of the translocation.

Case description and results
One male and two female subadult Etosha lions (*Panthera leo*), estimated to be 9, 12, and 15 months old, were caught in August 2003 from three different prides in the national parks of Pilanesberg and Madikwe in the Province of the North West in South Africa. The Pilanesberg and Madikwe lion populations originate from Etosha National Park in Namibia. Nine years ago, lions were reintroduced to the two reserves. The population is managed, each pride includes a radio-collared female member, and all individuals are identified and of known genetic origin. The area is described to be free of immunodeficiency virus (FIV), bovine tuberculosis and rabies. At the time of the capture, blood samples were collected and sera were examined for the presence of antibodies to canine distemper virus (CDV), feline calicivirus (FCV), feline herpesvirus (FHV), feline parvovirus...
(FPV), feline coronavirus (FCoV), FIV and feline leukemia virus (FeLV) antigen; all tested negative. Rabies antibody titre was < 1:2, or < 0.1 international units/ml, respectively. The lions were vaccinated against rabies (1 ml Rabisin, Rhone-Merieux, France, i.m.) and put together in an on-site enclosure, measuring 4 hectares, for bonding purposes. Intensive training was performed to get them used to the captive situation, including close contact with humans.

One month later, the three 72 hours-fasted lions were darted simultaneously, by two persons using CO₂ rifles (Dan-Inject CO₂, JM Special, Borkop, Denmark). One person darted from a car that was driving through the enclosure, the other from a hidden shelter outside the enclosure. Each animal received 200 mg tiletamine and zolazepam (Zoletil, Virbac, Carros, France), which resulted in a rapid onset of immobilization with good muscle relaxation. All animals were thoroughly examined and found fit for transport. Blood samples were taken and sera retested for rabies antibody titres, which resulted in sufficient vaccine-induced titres in the two females with 1:70 = 2.8 international units/ml, and 1:56 = 2.3 international units/ml, respectively. The titre of the male lion was insufficient with < 1:2 = < 0.1 international units/ml. All animals received a booster vaccination against rabies (1 ml Rabisin, Rhone-Merieux, France, i.m.) and were vaccinated against CDV (1 ml Purevax ferret, Merial Inc., Athens, USA, i.m.) and against feline rhinotracheitis-, calici- and panleukopenia-virus (1 ml Fel-O-Vac PCT; Fort Dodge, Wyeth Pharmaceuticals, AHP AG, Zug, Switzerland, s.c.). Anthelmintic treatment was performed, using 20 mg praziquantel and 80 mg pyrantel (Drontal, Provet, Lyssach, Switzerland, p.o.) and 20 mg doramectin (Dectomax, Pfizer AG, Zurich, Switzerland, s.c.). External parasites were treated with a flumethrin wash (Bayticol, Bayer, Leverkusen, Germany) and visible ticks were removed manually. Additional treatments included injection of multivitamins and a broad-spectrum antibiotic. 90 minutes after the initial darting, additional individual doses of 50, 60, and 70 mg tiletamine and zolazepam were injected i.m. because a lighter plane of anesthesia was noticed. Individual doses of 60, 70, and 75 mg zuclopenthixol (Clopixol acuphase, H. Lundbeck Ltd., Randburg, Republic of South Africa), a long-acting tranquillizer, were finally applied intramuscularly and the immobilized lions were placed in separate, specially designed crates and transported by road to the Johannesburg International Airport within three hours. At the airport, the lions started to show signs of agitation and tiletamine and zolazepam (individual doses of 50, 60, and 70 mg), each dose in combination with 5 mg xylazine, were injected i.m. The crates were loaded into the aircraft and after a flight of 10 hours, they arrived at Zurich airport. During the flight, the veterinarian could not get to the animals. At the arrival, all animals were sleeping but it was possible to wake them up by touching their bodies. After the customs health check and another road transport of one hour, the animals arrived safely at the Basle zoo. One lioness was sitting in the container, the other two were still sleeping in lateral recumbence. The containers were opened at their new indoor enclosure but no reaction occurred for two hours. I decided to antagonize the xylazine with individual doses of 5 mg atipamezole (Antisedan, Dr. E Gräub AG, Berne, Switzerland), applied by blowpipe. Within five minutes, all animals got up, left the crates and walked into the indoor enclosure. Total transport time from first darting to release to the enclosure was 24 hours. At this time, the body weights of the animals were measured to be 90 and 61 kg for the females, and 76 kg for the male. Effects of sedation with long sleeping phases were observed for the next 4 days. However, they fed on horse meat and drank water within 24 hours after arrival at the zoo.

Quarantine time was 100 days. The authorities accepted that the quarantine facility took place in the new lion enclosure. Since the outdoor enclosure was planned to be a mixed species one, shared with six yellow mongooses (Cynictis penicillata), both species were included in the quarantine procedures. All yellow mongooses had been anesthetized with isoflurane in oxygen and examined six weeks prior to the lions’ arrival. Blood samples were then taken and sera were tested for antibodies to CDV, FCV, FHV, FPV, FCoV, FIV and FeLV antigen; all tested negative. Rabies antibody titre was < 1:2, or < 0.1 international units/ml, respectively. They were vaccinated against rabies (Nobi-Vac rabies, Veterinaria AG, Zurich, Switzerland) and CDV (1 ml Purevax ferret, Merial Inc., Athens, USA, i.m.) and then released to the enclosure in order for them to become familiar with the enclosure’s hiding places before the lions arrived.

The male lion received a second rabies booster vaccination, applied by blowpipe two weeks after the translocation. During quarantine, four faecal samples of the lions and mongooses were examined for endoparasites and two faecal samples for salmonella ssp.; all tested negative. The lion enclosure is separated from an African wild dog enclosure by an eight-meter wide water moat.
All the seven African wild dogs had been revaccinated against CDV 5 weeks prior to the lions’ arrival. The lions were kept in the indoor dens for the first ten days. Then, the access to the outdoor enclosure was opened. In the first few months they came out only at night but they used the outdoor ground intensively and even swam in the water. In the meantime, they have got used coming out every afternoon and they adapt progressively to the new environment. The mixed species outdoor enclosure, shared by lions and yellow mangooses, works very well and no harmful interactions have happened so far. In January 2004, the authorities withdrew the quarantine requirement after 100 days.

Methods
The Etosha lion translocation was accompanied by CITES export permit 37420 and CITES import permit 6088/03. All sera were stored at –20°C and processed at the Clinical Laboratory of the Department of Internal Medicine at the University of Zurich, Switzerland (CDV, FCV, FHV, FPV, FCoV, FIV, FeLV) and at the Swiss rabies centre, Institute for Veterinary Virology at the University of Berne, Switzerland (rabies). For the detection of antibodies to CDV, sera were tested against the Onderstepoort strain of CDV adapted to Vero cells as described previously (1). Antibodies to FCV, FHV and FPV were detected by immunofluorescence assay (IFA) as described previously (5). Antibodies against FCoV were tested by IFA, as described previously (2, 6), with transmissible gastroenteritis virus (Purdue strain). Testing for antibodies to FIV was performed using the Western blot technique as described previously (6). FeLV p27 antigen in the sera was assayed by a double-antibody sandwich ELISA (7). The serum neutralisation test (RFFIT) was used for detection of rabies antibodies. All positive controls tested positive. Testing of the yellow mangooses’ sera was performed using a combination of anti-cat and anti-dog IgG, which was conjugated with FITC.

Discussion
This case report describes veterinary procedures for the translocation of three Etosha lions from a South African national park to a European zoo. Identification of potential infectious diseases should be an important feature of every translocation. Therefore, these lions were tested, vaccinated or treated against a variety of viral and bacterial pathogens and parasites. Canine distemper virus was of special interest because it has been found in all families of terrestrial carnivores (3) and a fatal epidemic was reported in lions from the Serengeti (8). After testing, the three seronegative lions were vaccinated with a monovalent recombinant form of canarypox-vectored CDV vaccine (Purevax ferret, Merial Inc., Athens, USA). The product has been approved safe in nondomestic carnivores and is recommended by the American Association of Zoo Veterinarians (13). Vaccine-induced infections in nondomestic carnivores caused by traditional vaccines are a serious concern to the zoo community and often result in risky renunciation of preventive measures against CDV infection. Unfortunately, in many European countries, the current use of Purevax ferret® is illegal or permits are very difficult to obtain because of its recombinant nature. In our case, all the species living close to the lions at the zoo, including members of the canine and viverrid family, were included in the testing and vaccination regimen against CDV and rabies to protect the lions from infection and vice versa.

Rabies was of concern to the Swiss veterinary authorities because the Republic of South Africa is not OIE-listed to be free of the disease. Therefore, repetitive testing to detect rabies antibody titres and vaccine-induced titres was performed. After negative initial results, the three lions were vaccinated against rabies, and in the two females, the first application produced sufficient titres. In the male, which was caught last, the titre was insufficient two weeks after the initial vaccination. Perhaps it was tested too shortly after the vaccination and sufficient antibodies were not detectable at that moment. However, all animals received a booster vaccination before shipment, and the male got an additional booster two weeks after arriving at the zoo. This was accepted by the authorities, although for the male lion, a sufficient titre was not diagnosed during the following quarantine to spare the individual from another immobilization for blood sampling reasons.

The main goal of this translocation was to obtain FIV-seronegative Etosha lions for ex situ breeding purposes. Repetitive laboratory testing to detect antibodies to FIV revealed negative results. One must be aware that we did take FIV-seronegative animals to a non FIV-free environment. However,
the risk for the endangered lion population in Etosha is reduced by the global distribution of ex situ individuals. Reported drugs and doses were used for anesthesia and long-acting tranquilization of the three lions (11). The combination of repeated doses of tiletamine and zolazepam, which was once combined with xylazine, together with zuclopenthixol resulted in initial immobilization and prolonged sedation during the 24h transport. In the first four days at the zoo, this was followed by intermittent sleeping phases, during which the lions could be woken up. These phases were caused by the long acting tranquilizer, which dissolved in oil, and when injected intramuscularly, diffuses rather slowly into the surrounding body fluids, where it undergoes enzymatic breakdown to release the active component, zuclopenthixol. Zuclopenthixol then induces a transient dose-dependent sedation (12). No vomiting was observed at all in the animals after their 72h fast. We were worried about sufficient water intake during the sedation, so we were very happy to see the animals taking up food and water within 24 hours after arrival. This was also a reason for antagonizing the alpha 2 agonist xylazine with atipamezole. Although the advantages of transporting nondomestic animals in deep sedation are obvious, one has to be aware that adequate monitoring is impossible during all phases of the transport. Possible antagonization of the zolazepam component with sarmazenil was not performed. In conclusion, the anesthetic and preventive measures taken resulted in the successful translocation of three healthy Etosha lions and can be recommended for similar undertakings.

Acknowledgements
We thank the staff of the Pilanesberg National Park and the Basle zoo for their excellent support and cooperation of this translocation, and Reto Zanoni of the Swiss rabies centre, Institute for Veterinary Virology at the University of Berne, Switzerland, for performing the analysis of rabies antibodies.

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TRANSLOCATION OF AN ADULT MALE AFRICAN ELEPHANT
(Loxodonta africana) FROM ROME TO BASEL

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Abstract
The African Elephant “Calimero“ (Loxodonta africana), born in the wild in Rhodesia (Zimbabwe) approximately in the late seventies was transferred in 1980 via Zoo di Napoli and Germany to the Zoo of Rome. In October 2000 he was translocated from Rome to Basel with the help of the specialized company Interzoo Gelsenkirchen. The elephant had to be sedated for chaining and crating, with a total dose of 800.0 mg Xylazine + 800.0 mg Ketamine (500.0 mg Rompun© Powder Bayer solved in 5.0 ml Ketasol-100© Dr. E. Graeub AG) plus 0.95 ml Immobilon© (with 2.25 mg Etorphine + 10.0 Acepromazine per ml, Novartis Animal Health GB). During the nearly 1’000 km drive from Rome to Basel, which took 26 hours, “Calimero“ was calmed with 100.0 mg Haloperidol decanoate (Haldol© decanoas Jansen-Cilag), an anxiolytic and anti-aggressive tranquilizer but with no muscle relaxation effect. In Basel, another sedation using a mixture of a total of 200.0 mg Xylazine + 200.0 mg Ketamine plus 1.3 ml Immobilon was necessary in order to unload the container and unchain “Calimero“. The whole translocation could be performed without any severe incidence.

Key words: African Elephant, Loxodonta africana, translocation, sedation, technical equipment

Introduction
Early in 2000, the EPP coordinator, Dr. Amelia Terkel, invited the Basel Zoo, which keeps two African cows in breeding age, for African Elephants to take over “Calimero“ for a period of about two years. In the meantime, Safari Park Beekse Bergen (Netherlands), the final destination of the elephant, could finish the construction of a new bull enclosure. The Zoo of Rome, where he had lived for the last twenty years - and since the late eighties without females - urgently needed more space for its Asian Elephants during the necessary renovation of the Elephant House.
In April, a delegation of the Basel Zoo went to Rome to have a closer look at “Calimero“, who should be the future mating partner of the two cows „Malayka“, born in 1971, and „Heri“, born in 1976. After a positive decision was made, the management of the Basel Zoo contacted Roy Smith from Interzoo Gelsenkirchen to organise the translocation, which should take place after the hot season in October 2000. In the meantime, all the necessary CITES certificates, veterinary health certificates, etc. were requested as well as lists of materials and a provisional time schedule was prepared. Basel zoo and Rome zoo decided that two elephant keepers and the veterinarian from Basel Zoo would accompany the transport.

Case Report
In the morning of October 9th 2000, Roy Smith (Interzoo), Thomas Ruby and Michel Jan (elephant keepers), Jürg Völlm (Vet) and Anne-Kathrin Oerke (Vet and specialist for hormones from the German Primate Centre interested in Cortisol levels during transport, which will be published elsewhere) left Basel in a private car filled with technical and medical equipment. At the same time, a trailer containing the elephant crate left Germany.
The next day was reserved for the detailed preparation of the crating together with Roy Smith. The zoo vets from Basel and Rome determined the potential dose of a mixture of Xylazine and Ketamine completed with Immobilon for a deep sedation without immobilisation.
“Calimero” had been kept hands-off for the last years and therefore didn’t tolerate any person in his box. His weight was estimated to be within the range of 5.5 tons. In the early afternoon, the trailer with the crate, a specially adapted container for elephant transports, arrived in Rome. The Swiss Police had stopped the vehicle on the Gotthard ramp because of its unusual length, height and weight.

In Rome, the crate was unloaded and put in position in the outside enclosure in front of the door to “Calimero’s” box. Beforehand, the roof had been adapted to his shoulder height of 3.1 meters. In spite of our noisy work and even after all the visitors and keepers had left the zoo, “Calimero” kept quiet inside the house.

On Wednesday morning, “Calimero” was sedated with a mix of 400.0 mg Xylazine + 400.0 mg Ketamine (500.0 mg Rompun® Powder Bayer solved in 5.0 ml Ketasol-100® Dr. E. Graeub AG) administered in two blowpipe darts, and then, 19 minutes later, with 0.5 ml Immobilon (with 2.25 mg Etorphine + 10.0 Acepromazine per ml, Novartis Animal Health GB) 19. Despite obvious effects such a penile prolaps, "Calimero" was still aggressive and it was impossible to put him on chains. Therefore, 24 minutes later, another dart was blown containing 300.0 mg Xylazine + 300.0 mg Ketamine, which resulted in slight staggering and loud snoring noises. Another dose of 0.15 ml Immobilon was applied 20 minutes later because chaining was still impossible. Now the trunk got paralysed.

Various attempts to chain “Calimero's” right rear foot during the next 30 minutes failed. As soon as he heard the metallic noise of the chain, he immediately tried to attack. After 31 minutes, another 100.0 mg Xylazine + 100.0 mg Ketamine + 0.3 ml Immobilon were necessary to gain access. Some minutes later, the elephant was leaning against the wall and his rear legs were very unstable. Finally, his right rear leg could be put on chains and fixed with a steel cable running over an electrical winch inside the crate to prevent him from returning to his box. The keepers used loud and repeated whip cracks to force “Calimero” to walk backwards towards the crate. At that time, he was so sleepy that he stepped several times on his trunk's tip and tried to lie down. But after 7 minutes, the elephant was in the container and the crane lowered the vertical Guillotine door made of massive steel bars. The next step consisted of chaining the very sleepy elephant on all four legs via small service openings on the side walls of the container. Since he tried again to lie down, we decided to administer 0.5 ml Revivon (= 1.5 mg Diprenorhine Novartis Animal Health GB) intravenously to antagonize at least partly the effect of Immobilon.

<table>
<thead>
<tr>
<th>Time</th>
<th>Action</th>
<th>Reaction of “Calimero”</th>
</tr>
</thead>
<tbody>
<tr>
<td>8,15</td>
<td>400.0 mg Xylazine + 400.0 mg Ketamine</td>
<td>no sedation, attacking any person in his enclosure</td>
</tr>
<tr>
<td>9,01</td>
<td>0.5 ml Immobilon</td>
<td>penile prolaps, still attacking</td>
</tr>
<tr>
<td>9,34</td>
<td>300.0 mg Xylazine + 300.0 mg Ketamine</td>
<td>staggering, snoring, but still attacking</td>
</tr>
<tr>
<td>9,54</td>
<td>0.15 ml Immobilon</td>
<td>snoring, paralysed trunk, chaining impossible</td>
</tr>
<tr>
<td>10,25</td>
<td>100.0 mg Xylazine + 100.0 mg Ketamine + 0.3 ml Immobilon</td>
<td>leaning against the wall, weak rear legs</td>
</tr>
<tr>
<td>10,37</td>
<td>chaining the right rear leg and fixing it on steel wire</td>
<td>only weak defence</td>
</tr>
<tr>
<td>10,40</td>
<td>starting to force “Calimero” to go backwards with some whip cracks</td>
<td>refusal to walk backwards and danger of breaking down, very sleepy</td>
</tr>
<tr>
<td>10,42</td>
<td>more whip cracks to wake him up and to force him to go backwards</td>
<td>he starts going backwards, stepping twice on his trunk</td>
</tr>
<tr>
<td>10,46</td>
<td>still repeated and loud whip cracks</td>
<td>standing in the crate with both hind legs</td>
</tr>
<tr>
<td>10,47</td>
<td>the guillotine door is closed</td>
<td>afterwards he went into the container</td>
</tr>
<tr>
<td>10,49</td>
<td>“Calimero” is chained on all his four legs</td>
<td>no reaction, the sedation is now very deep</td>
</tr>
<tr>
<td>10,54</td>
<td>an intravenous catheter is set on the left ear to take a blood sample</td>
<td>he is now very weak and threatens to break down on his rear legs</td>
</tr>
<tr>
<td>10,58</td>
<td>intravenous application of 0.5 ml Revivon</td>
<td>7 minutes later, “Calimero” is awake again</td>
</tr>
<tr>
<td>11,15</td>
<td>first, not very gentle, trial to lift the crate</td>
<td>in spite of the rough movements, he keeps rather quiet</td>
</tr>
<tr>
<td>11,29</td>
<td>further preparations for lifting the container finally on the trailer</td>
<td>he is moving his trunk again</td>
</tr>
<tr>
<td>11,30</td>
<td>the container, weighing a total of 13.7 tons is now definitely lifted</td>
<td>he keeps rather quiet but slightly changes his position several times</td>
</tr>
<tr>
<td>11,45</td>
<td>the container is on board of the trailer</td>
<td>no problems</td>
</tr>
</tbody>
</table>
12.30  100.0 mg Haloperidol decanoate are injected i.m.  he is checking all the details of his crate
15.00  start of the trip back to Basel          he is quiet and not at all aggressive

> Table 1: Timetable of crating and loading the container in Rome <

> Fig. 1: “Calimero” chained in his crate <

Some 15 minutes later, the crane operator made a very rough attempt to lift the container weighing 13.7 tons. Fortunately, “Calimero” kept quiet. Half an hour later, the heavy load was on board of the trailer after colliding with the wall of the elephant house and the small food container, which was caused by “Calimero's” slight changes in position.

About one and a half hours later, we implemented a personal suggestion made by Douw Growler and injected 100.0 mg Haloperidol decanoate (Haldol© decanoas Jansen-Cilag) intramuscularly into the left rear leg. Another one and a half hours later, that was at 3 pm, our vehicle left the zoo of Rome, well equipped with food and water in additional containers fixed on the trailer. “Calimero” kept quiet but if he had slightly moved from one side of the container to the other, the shift would have been clearly seen in the suspension of the trailer. Several checks during short stops did not reveal any problems.

> Fig. 2: The transport leaves the zoo of Rome <

Four hours later, at 7 pm, we stopped for a longer break. "Calimero" quietly fed on the vegetables, fruits and hay offered to him but refused to drink any water. A superficial skin abrasion on his left rear leg was treated with an antibiotic spray. After sunset, the temperature dropped and rain set in. Therefore, it was decided to switch on the heater to blow 20°C warm air into the container.

After a four and a half hours’ drive, we arrived at Bergamo, where we intended to spend the rest of the night on the parking lot of a zoo. The weather had now turned to heavy rain but fortunately, the forecast drop in temperature did not happen. Anyway, inside the container, “Calimero” seemed to be rather comfortable. He had a healthy appetite and was also drinking enough water. However, a typical, white, foamy secretion of his eyes implied that he felt cold. We therefore closed the last small opening in the back of the container. The drivers of both cars were sleeping while two of us kept watch on the elephant.

In order to be in the first row at the customs checkpoint, we started already after 4 a.m. and arrived two hours later at the Italian/Swiss border just to find out that the various offices would not open before 8 a.m. Furthermore, our private car, which contained the medical equipment and the tranquilizers, had to be parked outside the customs area.

About 15 minutes after our veterinarian had informed the person in charge that we were transporting an elephant, which could get nervous and frightened by all the noise around him during his long wait,
we were allowed to park our car next to the trailer. From then on, everybody wanted to have a look at “Calimero”, which was feeding quietly. When we wanted to give him some more hay, we noticed that the door of the small container with the food could not be opened again because the door had been damaged while the crate was loaded. Fortunately, a driver, who was transporting horses, could help us. When the Italian CITES and veterinary Officials finally arrived, a copy of one of the certificates was missing and had first to be faxed from Rome. The authorities were very surprised to see the elephant being accompanied by trained keepers and a veterinarian. They had never seen this before but stated that this should be a general rule for the future.

After a short check by the Swiss customs and the veterinarian, we received an exact description of the way from the Swiss Traffic Police and had to pay the Swiss highway fee. Before we started from Chiasso at 10.30 a.m., we had to announce our transport to the Police of Airolo at the Southern gate of the Gotthard tunnel. Again, heavy rain set in and we were worried that it may be snowing at the Gotthard ramp.

We informed the Basel Zoo that our arrival could be expected between 3 and 4 p.m. in the afternoon provided that everything – including the weather – was running normally. On the Gotthard ramp, water fountains were falling down from the surrounding mountains and sometimes even flooding the motorway. We felt relieved when we arrived at the tunnel entrance without further problems. We became aware of our critical situation when only two days later, parts of the motorway had to be closed down for the traffic because of the bad weather.

On the Northern side of the Gotthard, the weather was better and the streets were dry. We made a short stop in order to feed “Calimero” and have a quick lunch. Shortly after leaving again, we were stopped by a police patrol since they wanted to weigh the whole vehicle. As we had to be in Basel to unload the crate before sunset, we were in a hurry. The veterinarian tried to explain to the policeman that an elephant was locked in the container. His remarks nearly caused him to get arrested for misleading the police. But thanks to the police patrol, we now had the official confirmation that “Calimero's” body weight was 6.5 tons! At Luzern, we had to leave the motorway and cross the city. For one street, we had got the written order to take the left lane in order to avoid any contact with the trolley wires on the right one. The highest point of the container was on a level of 4.05 m and a maximum of 4.10 m was allowed.

Shortly after 4 p.m., we arrived at the Basel zoo, guided by the police. After some very tricky manoeuvres to place the trailer as closely as possible to the enclosure, we were able to start the process of unloading the crate. The crane for weights up to 250 t had to be placed outside the zoo wall and the operator could not see directly what he was doing. Again, a sedation containing a mix of 100.0 mg Xylazine + 100.0 mg Ketamine + 0.8 ml Immobilon had to be implemented by blowpipe. Although the penile prolaps indicated a clear effect, the sedation was not deep enough to lift “Calimero” safely in his container for more than two meters over a massive door. 36 minutes later, a second dart containing 100.0 mg Xylazine + 100.0 mg Ketamine + 0.5 ml Immobilon therefore had to be applied. After 4 minutes, the load of 10.5 t was gently lifted without any reaction of the elephant. 14 minutes later, the crate was put into the right position in front of the door to “Calimero's” new home. After the first chain was removed, he kicked with his left foreleg and we had to pull out Roy from the small service door. During this short incident, the whole container moved some centimetres. The unchaining of the other three legs was uneventful and 38 minutes later, the guillotine door could be opened.

The keeper from the Rome zoo, who had decided to accompany “Calimero” and spend some days in Basel, then called him from inside the house. The elephant was still hesitating and carefully checking the new surroundings but left the crate some minutes later and immediately started feeding.

<table>
<thead>
<tr>
<th>Time</th>
<th>Action</th>
<th>Reaction of “Calimero”</th>
</tr>
</thead>
<tbody>
<tr>
<td>17,18</td>
<td>100.0 mg Xylazine + 100.0 mg Ketamine + 0.8 ml Immobilon</td>
<td>he immediately pulls out the dart</td>
</tr>
<tr>
<td>17,37</td>
<td>the roof of the container is removed</td>
<td>he is slightly trembling</td>
</tr>
<tr>
<td>17,48</td>
<td>different attempts to approach</td>
<td>he still reacts and moves although a passing penile prolaps indicates that the drug has some effect</td>
</tr>
</tbody>
</table>
Approximately 35 hours after starting the sedation in Rome and after driving for 26 hours and covering 1000 km, “Calimero” safely arrived in his new home in the zoo of Basel.

Conclusions
The, and we did so when we unloaded the container in Basel. At that time, we used only one application of Xylazine + Ketamine + Immobilon is a proven method for the sedation of elephants. The risk of undesirable immobilisation, which could be reason enough to cancel the whole procedure, is rather low in this method. The relation of the three components may be changedquarter of the Xylazine and Ketamine dose but a 38% higher dose of Immobilon, which resulted in a faster onset of the sedation. The sedation had an impact after only 40 minutes while it had taken 106 minutes in Rome. One explanation could be that the estimation for the bodyweight was too low and therefore the initial dose as well. Another reason could be that the Haloperidol decanoate, which belongs to the long acting butyrophenone tranquilizers, is said to be effective for up to 24 hours and increases the potential effect of the Xylazine/Ketamine/Immobilon combination. It may, however, be recommended for long-term tranquilisation without muscle relaxation during translocations.

As a result of the experience with “Calimero’s” translocation, we may summarize the following important points:

- The planning tasks, including the request of the necessary certificates for the transport, such as CITES and veterinary health documents as well as a provisional time schedule, should be started early enough
- Translocations, particularly those carried out on the road, should not be planned to take place during extremely cold or hot seasons or during peak periods of holiday traffic
- Only an experienced and well equipped company can guarantee a safe transport; a solution at low cost may result in a risk for the animal
- Planning an optimal route for special transports – including the necessary recommendations of the police – helps to prevent problems on the road
- Check-lists for food and additional technical and medical equipment help to avoid unpleasant surprises
- The transport should be accompanied by trained keepers and whenever possible by an experienced veterinarian
- By having two drivers, additional breaks owing to a restriction of working hours may be avoided
- Customs checks and clearance take at least two hours. Furthermore, the customs officials have to be informed before the transport starts

Table 2: Timetable of unloading the container in Basel and causing the elephant to leave the crate
• For the next translocation, it may be helpful to record any special incidents and events and even everything that went smoothly.

Acknowledgements
We would like to thank Roy Smith and Dow Grobler, who helped us with their tremendous experience. We are very thankful to Mrs. Beatrice Steck for carefully reviewing our paper.
BOXING A WILD HORSE FOR MONGOLIA – TIPS, TRICKS AND TREATS

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Key words: Equid, transport, Equus Przewalskii, Przewalski’s horse, Mongolia

Extended Abstract

The Przewalski’s horse (Equus caballus przewalskii), or ‘takhi’ in Mongolian, became extinct in the wild by the mid 1960’s. The last recorded sightings of Przewalski’s horses occurred in the Dzungarian Gobi desert in SW Mongolia. The species has only survived due to captive breeding based on 13 founder animals. The private Christian Oswald Fund (COS) and the Mongolian Society for the Conservation of rare animals (MSCRA) of the Ministry of Environment initiated the Takhin Tal Project with the support of various international sponsors. In 1999 the International Takhi Group (ITG) was established to continue and extend this project in accordance with the IUCN reintroduction guidelines. In 1992 the first group of captive born Przewalski’s horses were airlifted to the Takhin Tal site (45.53.80 N, 93.65.22 E) at the edge of the 9,000 km² Gobi-B national park and international biosphere reserve. Subsequent transports were carried out in the following years and to date a total of 77 (29,48) horses have been transported. In 1997 the first harem group was released into the wild from the adaptation enclosures and 1999 the first foals were successfully raised in the wild. At present 59 Przewalski’s horses live at the Takhin Tal site. In January 2003, forty-eight horses belonging to 4 harem and 1 bachelor group ranged freely in the Gobi-B national park (2). Information concerning the actual group compositions and locations of the individual free-ranging groups are updated regularly in the public domain and can be viewed at http://www.takhi.org.

Using a modelling approach (VORTEX v. 8.4) to determine the importance of supplementation to this population we were able to determine that continued supplementation is presently still necessary to increase the chances of long-term (100 yrs +) survival for this reintroduced population. The supplementation regime needs to provide a constant number of animals in which the sex and age distribution is balanced. The model also showed that the supplementation regime can be adapted according to logistic restrictions and transport capacity without significant consequences to the population (Slotta-Bachmayr et al. 2003 submitted).

Due to the distance and limited accessibility the Gobi B national park represents a general logistic challenge for all aspects of the project. This is all the more true when horses have to be transported. Figure 1 gives an overview of the essential steps in planning and implementing a transport to the Takhin Tal site. The process is evaluated at each step and allows for adaptations if they become necessary. Essential “plan B” scenarios have to be developed for various phases. This is especially important for the final phase as bad weather could hinder landings on the desert strip at Takhin Tal. In this case an alternative enclosure has to be available in the Ulaan Bator area in order to release the horses from the crates. During the pre-shipment phase various procedures need to be completed: Veterinary examinations, sample collection, freeze branding and therapeutic actions. These need to be carried out to fulfil the various authorities requests and also to fulfil IUCN (1) and project...
guidelines (3). Figure 2 gives an overview of the various procedures that need to be taken into consideration.

Over the years specific techniques and methods have been developed in order to facilitate loading of the horses. For the first time in 2002 non-chemical capture and crating was possible for the majority of the horses. The system was based on training each individual horse to feed in large crate. These crates could subsequently be closed using a remote system (Fig. 3). Additionally the chemical restraint and anaesthesia of the horses has been refined over the years. As a standard for an adult horse we now use a combination of 2.5 mg etorphine (M99, C-Vet Veterinary Products, Lancs, UK), 10 mg detomidine-HCl (Domosedan, Orion Corp. Farmos Finland) and 10 mg butorphanol (Torbugesic, Fort Dodge Animal Health, Iowa, USA). This combination has reduced the pacing stage, but still allows for “walk-in” crate loading. The etorphine is reversed with naltrexone (Trexonil, Wildlife Laboratories Inc., Fort Collins, Colorado, USA) that has a far longer half-life than the standard diprenorphine (Revivon, C-Vet Veterinary Products, Lancs, UK) and eliminates in- and post-transport renarcotization. However, it is important to note that due to the long half-life a subsequent anaesthesia induction with etorphine, in case of emergency, would not be possible – an alternative method needs to be considered. The use of long acting neuroleptics has greatly facilitated the in-crate phase during flight and re-loading (4). All horses are presently pre-treated with 0.2 - 0.3 mg/kg haloperidol (Haldol, Janssen-Cilag, Vienna, Austria) and 150-200 mg perphenazine (Decentan-Depot, Merck KgaA, Darmstadt, Germany). It is important to carry out this treatment at least 12-24 hours prior to transport.

The transport crates are based on the IATA recommendations but have been adapted over the years for this specific transport scenario. The size of the actual crate is primarily restricted due to the limitations in the cargo hold of the Antonov 26 airplane that flies the final leg of the trip. Head and neck movement in the crate has been limited (Fig.4) in order to reduce the risk of a horse turning onto it’s back while inside the crate. The headroom of the crates is additionally lined with high-density foam mats to prevent injuries due to rubbing. In order to unload the crates at Takhin Tal removable carrying handles are mounted at each corner of the crate. These handles make it possible for 8 people to carry the crate out of the cargo bay.

While the transport is but a small part in any reintroduction program it is essential that it be well planed and regularly evaluated in order to guarantee the arrival in the best possible condition. At a cost of some 10,000 Euro per horse by the time it reaches SW Mongolia, the transport also constitutes a major cost factor in this species.

Acknowledgements
We gratefully acknowledge the support of the numerous EEP institutions that have supported the transports in the past years. Similarly ITG staff in Ulaan Bator and Takhin Tal for organizing the Mongolian side of the transport venture.

References
Fig. 1 Flow chart showing the most important steps in the transportation process
Fig. 2 Preshipment checklist detailing the various procedures which must be completed prior to the final transport.
Fig. 3 Non-chemical capture system consisting of capture crates (left) which animals are trained to feed in. Horses are subsequently moved into the actual transport crate.

Fig. 4 Headroom of the adapted crates is reduced in order to limit the possibility of a horse turning onto it's back in-flight. Additionally the headroom is lined with high-density foam to prevent injury.
PHYSICAL AND ANAESTHETIC RESTRAINT OF MACROPODS, KOALAS AND CASSOWARIES – SOME PRACTICAL TIPS.

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Abstract
This paper provides a brief summary of handling and anaesthetic practises employed in the authors experience at various Australian zoos and wildlife parks. Explanations of methodology used in handling, and comparing various restraint methods for macropods, koalas and cassowaries (both physical and chemical) will be discussed. A suggested koala examination protocol is also presented.

Key words: Anaesthetics, Manual restraint, macropods, koalas, cassowaries

Introduction
A variety of Australian native fauna are widely held throughout European zoos and wildlife parks. Anaesthesia of these animals offers a unique challenge and I have chosen three particular groups of animals here on the basis of European zoological holdings, and general veterinary interest. Up until recently, physical restraint was more commonly used for many procedures, however with the development of safer anaesthetic drugs many of these procedures are now performed using chemical restraint alone or in conjunction with physical restraint (Vogelnest 1999). In the case of Macropods (wallabies and kangaroos), these animals are often kept in extensive enclosures, and thus can be difficult to restrain quickly without chemical immobilisation. Prevention of capture myopathy (acidosis due to excessive acute muscle breakdown from physical exertion), which macropods are acutely sensitive to, must be aimed for. Chemical immobilisation helps with this aim.

Koalas are particularly challenging to intubate. While historically koalas have been anaesthetised with either Tiletine/ zolazepam (Bush et al 1990) or isoflurane and maintained via a mask (Blanchard 1994, McGowan et al 1995, Vogelnest 1999), anaesthetic deaths have been encountered on recovery, believed to be associated with laryngeal oedema (V. Nicolson pers. Comm.). I present information here on intubating koalas using an endoscope, but this technique could equally be applied to macropods.

Early studies on cassowary anaesthesia (see Vogelnest 1994) concentrated on physical restraint and intravenous administration of various chemical anaesthetic agents. I will report on more recent work on success of remote chemical immobilisation in this potentially dangerous animal.

Much of the information presented in this paper is anecdotal, but readers will be directed to more in depth sources of literature where appropriate.

Macropod (Kangaroo and wallaby) Manual and chemical restraint

1. Physical Restraint
Many simple procedures, for example, a brief examination, injections, or venepuncture can be carried out on some macropods using physical restraint alone providing an appropriate technique is used with confidence (Booth 1994). Kangaroos and wallabies up to 15kg – An adequate environment for capture, and well trained staff are vital for safe handling of smaller macropods to minimise stress and the possibility of capture myopathy.
Ideally, a circular or rectangular catching pen, attached to the main enclosure, should be employed. Minimising injury to the animal is important, and a circular enclosure reduces the risk of the animal running into it – it’s more likely to follow the line of the fence. Animals should enter this catching area one at a time. It should be high walled (2.5m or higher would be ideal) and if possible roofed, all with strong close weave nylon mesh. On catch up, chasing of the animal should be avoided. Thus the person catching should initially grab the base of the tail as the animal runs past. The animal can then be held briefly, with the second hand and arm under the animal’s rump, holding the legs away, or held just holding the base of the tail. A second operator should then have a Hessian (or similar) sack ready opened for the animal to be placed in. If many animals need to be caught, the animals in sacks can then be hung to one side for short periods of time. The sack mimics the pouch and just being in one reduces stress in most macropods. Use of long term coralling should be avoided in animals that are not used to it, as coralling or long catch up times can induce capture myopathy.

To gain venous access (tail vein), one operator places weight over the rump and shoulders on the animal in the sack, while the second operator can safely extrude the tail.

To access the head for mask anaesthetic induction, or for physical examination, the animal can easily be rotated within the sack until the head emerges from the opening.

**Kangaroos and wallabies 15-20kg.** Animals of this size should be tail restrained only for the purpose of hand injection. The animal can be tail caught as above and restrained by 2 operators to allow injection. This procedure very much depends on the capability of the handlers and the attitude of the animal. If it is a more aggressive or easily stressed individual, chemical immobilisation should be utilised.

**Kangaroos and wallabies over 20kg** should not be manually restrained for health and safety reasons.

2. **Sedation for shipment and change of enclosure**

Azaperone, (Stresnil) provides excellent standing sedation in the smaller wallaby species such as pademelons and quokkas using the standard suid dose ranges of 2.5 mg/kg IM. At these doses, azaperone does not appear to have adverse effects on thermoregulation, heart rate and cardiac output (Vogelnest 1999). Onset of action is in 15 to 20 minutes with duration up to 8 hours.

Diazepam (Valium/pamlin) has been widely used in macropods at a dose range of 0.5-2 mg/kg. I recommend the higher dose rates for animals after procedures, such as manual restraint and during transport, if no other sedation is to be given.

Fluphenazine decanoate, (Modecate), a long acting phenothiazine neuroleptic, has been utilised for introducing new animals to a group at 2.5mg/kg IM or SC, with initial effects at 24-36
hours, maximal effects by 96 hours and a duration of 3-4 weeks. This dose reduces anxiety, as opposed to inducing sedation, in species such as the whiptail wallaby or pademelon. Note however that no pharmacokinetic studies have been carried out with these drugs in macropods and there have been limited trials done to assess their effects (Vogelnest 1999). The dose rate and duration of action presented here is based on the experiences of zoo and wildlife veterinarians. Diazapam can also be used to 'cover the gap' before fluphenazine takes effect when introducing an animal to a new environment.

3. **General Anaesthesia**

*Remote administration.* Zolitel (Tiletimine/ zolazapam) has been the drug of choice in most macropod species if darting is required, for a number of years. Dose rates are 5-10 mg/kg for larger species, and 10-15 mg/kg for smaller species. Reliable anaesthesia is produced within 5-10 minutes. For a more rapid recovery, a zolitel/ medetomidine mix can be employed (please refer to table below for dose rates). Hypersalivation can be a problem with zolitel alone, but this can be controlled with atropine 0.02-0.05mg/kg SC (Holz 2003). Note that when using medetomidine, the atipamizole reversal dose is five times the medetomidine dose (Holz 2003).

*Masks induction and intubation.* Mask induction can be employed with joeys and smaller species after being manually captured, using isoflurane or sevoflurane. Intubation is difficult and not usually necessary unless working on the head or in the mouth, or for prolonged procedures (Vogelnest 1999). Use of a long bladed larungoscope, a stylet, or in larger species, a technique similar to the koala below can be employed. Blind placement is also possible when the animal is at a deep plane of anaesthesia, with the head fully extended, and the animal in lateral recumbency. In all methods, visualisation of the glottis is tricky at best. Preanaesthetic fasting is not necessary or possible in many cases. However, macropods may regurgitate under anaesthesia (Holz 2003).

**Koala intubation and initial clinical examination.**

The use of masks to induce anaesthesia in marsupials is widespread and allows for many different face and muzzle sizes. However, if this method is used for maintenance once under anaesthetic, provision of oxygen if the animal stops breathing is problematic. Koalas represent a special anaesthetic challenge. At Currumbin Wildlife Sanctuary we regularly received enquiry’s from small animal clinicians about injured koalas presented at their clinic and how to anaesthetise them. The oral anatomical conformation of the koala, (small mouth, narrow dental arcade, long soft palate, a caudally placed glottal opening) and a propensity to apnoeic, leading to low blood oxygen saturation conspire to make koala anaesthetics a stressful time for all involved.

Vogelnest (1999) and Blanchard (1994) provide good reviews of koala anaesthetic procedures in general. The following discussion is an adaptation of these procedures. Annual examinations under anaesthetic are carried out on Currumbin Sanctuary’s 40 koalas. The procedure takes between 25 and 45 minutes and follows a protocol outlined in the next section. This section also provides an indication of normal physiological parameters. It can be used as a basis for initial examination of a koala in your collection. In the past, the koalas were induced using Isoflourane in Oxygen via a mask, and were maintained in kind. Isoflurane has been investigated as an anesthetic in koalas (McGowan et al. 1995), and was found to be safe and effective. Sevoflurane has not yet been adequately evaluated for use in koalas.

For intubation, I have found the most successful technique uses a 4.0mm endotracheal tube for females and 4.5mm for males, sleeved over a rigid endoscope (for example Hopkins 30° forward oblique 4mm diameter, 30cm length) which allows reflection of the soft palate and direct visualisation of the glottal opening. The soft palate obscures the epiglottis from direct view (Shima 1999), and needs to be reflected dorsally. The endoscope is a tight fit with the 4.0mm tubes. Silicon spray can be used on the endoscope to facilitate insertion. Placing the animal in sternal recumbency, provides the greatest success for me, but changing the position of the koala from this to lateral or dorsal recumbency may assist intubation (Vogelnest 1999).
Choice of tube diameter is important. I have used a 5.0mm on one male, but at 8.5kg, he was a big individual. If the tube is too big, damage to laryngeal tissues and the epithelial lining of the trachea may induce inflammatory change and resultant breathing difficulty. By radiographing koalas with endotracheal tubes inserted (Nicolson unpubl. data 2000) it has been found that a depth of 18cm in females and 19cm in males is adequate. Any deeper and there is a risk of traumatising the tracheal bifurcation and extending the tube down a bronchus. Once the tube is through the glottal opening and the tracheal lumen is visualised, the scope can be withdrawn. A survey of the trachea can be made at this time to check for pathology. The tube is withdrawn to the appropriate depth and tied in normally.

One shortfall of this technique is in young koalas that may only need a 3.0mm ET tube, making the endoscope too big to be threaded. In this situation, a canine urinary catheter can be used to thread the endotracheal tube, with visualisation being assisted with a laryngoscope (Blanshard 1994).

**Annual veterinary koala examination.**

1. Temperature (35.5-36.5°C) Heart Rate (65-90bpm) Respiratory Rate (10-15bpm)
2. Mucous Membrane Colour
3. Pulse Rate (65-90) and Blood Oxygen Saturation (90-100%)
4. Pouch Check (for Joey and/or infection). Remember koala pouches open caudally.
5. Abdominal Palpation. If abnormal lumps are found, radiographs can be taken. Mammography film provides the best contrast. A normal koala abdomen radiograph has a ‘cut glass’ appearance.
6. Testes-size, shape, consistency/Penis-extrude and check
7. Examination of Nails and Paws
8. Faecal Flotation and wet prep.
9. Check microchip (Trovan) ID. Placement by convention is over the left scapula. This is an easy place to access when a koala is in the enclosure.
10. Blood Collection for haematology and biochemistry, Cryptococcal antibody serology, and serum banking (EDTA 0.5ml and Serum gel 6ml - minimum amounts)
11. Auscultation-chest and abdominal cavity. Unlike other hindgut fermentors, gut sounds are not normally heard. A lack of sound does not indicate ileus, rather the lack of air pockets within the gut to produce the sounds.
12. Eyes/Ears/Nose (if discharges swab for Chlamydia and Cryptococcus)
13. Weight
14. Fur- Check for alopecia, ectoparasites, fungal infections, trauma or evidence of fighting
15. Lymph Nodes – Deep and superficial axillary, inguinal, mandibular, parotid, rostral mandibular, facial, superficial cervical. Note that the koala does not have popliteal nodes.
16. Parasite Treatments if necessary (at standard mammal doses)

**Cassowary chemical restraint**

Cassowaries can run at up to 50km/h, and can kick with one or both legs while in motion (Smith 2003). Thus chemical immobilisation is required in adult birds. Zolitel intravenously has been used in cassowaries (and emus) in the past. Although anaesthesia is adequate, recovery can

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1. Idexx Laboratories, Brisbane
2. John Emmins, D. Dept. Pathology and Immunology, Monash University, VIC
3. Clearview antigen test, or contact A/ Prof Peter Timms, QUT for PCR details.
be traumatic, and is not recommended to be given intramuscular (Vogelnest 1999). Gaining venous access on an adult conscious cassowary is not recommended. Manual restraint and mask inductions of tractable adult emus has been employed successfully in the past, but, because of their more aggressive nature, anaesthetics of adult cassowaries have proved problematic. The following sedation and general anaesthetic protocols have proved reliable in the authors experience.

1. **Sedation using medetomidine.**

Zalopine (Medetomidine 10mg/mL) is used when darting due to the relatively large volumes required. Westcott and Reid (2002) conducted initial research on the use of medetomidine in cassowaries with a sample size of eleven. They found doses of 0.26-0.31 mg/kg IM provided light sedation sufficient to allow approach and limited handling. Doses of 0.38-0.54mg/kg IM provided heavy sedation adequate for full clinical examination. Sternal recumbency occurred in 6 birds, three in each dose range. In 9 birds sedation was reversed with atipamezole at a dose of 15-80 mg/kg IM, which produced a return to alertness in 40 to 139 minutes. Forceful sneezing occurred during recovery in three birds. This sneezing side effect was also seen in birds on recovery sedated at Currumbin Wildlife Sanctuary. We used a standard dose of 0.5mg/kg for heavy sedation. Reasons for this sneezing require further investigation. Sneezing is not a known side effect of atipamezole (which include occasional vomiting, diarrhoea, hypersalivation, tremours and brief excitation/apprehensiveness).

The adverse effects reported with medetomidine don’t include sneezing either, unless this is an indication of a mild hypersensitivity. Medetomidine side effects are generally an extension of its pharmacological effects including bradycardia, occasional AV blocks, decreased respiration, hypothermia, urination, vomiting, hyperglycaemia and pain on intramuscular injection. Rare effects have also been reported such as paradoxical excitation, prolonged sedation, apnoea and death from circulatory failure. Because of this potential sneezing, and the risk of aspiration, it is recommended that the birds are starved for at least 8 hours before sedation.

2. **General anaesthesia**

Full anaesthesia has been achieved using the Medetomidine regime above, followed by 0.05-0.5mg/kg butorphanol IM and then propofol intravenously to effect (up to 10mg/kg), and intubation for gaseous anaesthesia. Venous access can be gained via the jugular, ulnar or medial metatarsal vein – this last being my preferred option, as it usually means causing the least disturbance to the animal. Intubation is elementary and maintenance on isoflurane or sevoflurane is as for other ratites. Butorphanol may be required for painful procedures or depending on how the medetomidine sedation has affected the bird, for further sedation. It is not recommended to increase the dose of medetomidine beyond that indicated here. Reversal is with Atipamazole 1.5-2.5mg/kg for the Medetomidine, and Naloxone 2mg IV for the butorphanol if used. This regime provided excellent general anaesthesia for between 60 and 90 minutes.

**Conclusion.**

The methods described here are not exhaustive, but have provided the most satisfactory results in a number of situations. Vogelnest (1999) and Pye (2001) provide thorough overviews of Australian wildlife restraint methods. The table of anaesthetic dose rates presented below is based on both published and anecdotal information. Gaps in the table indicate where particular anaesthetics have not been widely used in that species. It does not indicate that those drugs should not be used. More anaesthetic trials need to be conducted to further improve the quality of Australian wildlife anaesthetics.

**Acknowledgements**

I thank KE Reid; V. Nicolson and the animal husbandry staff at Currumbin Wildlife Sanctuary, and the vet team at Chester Zoo.
References

Table 1. Marsupial, Monotreme and Australian Ratite Anaesthetic drug dose guide.  
Note – all doses are in mg/kg

<table>
<thead>
<tr>
<th>Published doses In <strong>bold</strong>, extrapolated doses in <em>italics.</em></th>
<th>Macropods</th>
<th>Wombats</th>
<th>Dasyurids</th>
<th>Possums</th>
<th>Koalas</th>
<th>Monotremes</th>
<th>Cassowaries/ Emus</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Zolitel&quot; Titilamine/Zolazapam</td>
<td>5-15 IM</td>
<td>3-8 IM</td>
<td>7-10 IM</td>
<td>4-10 IM</td>
<td>4-10 IM (7 optimum)</td>
<td>5-7 IM</td>
<td>2-3 IV</td>
</tr>
<tr>
<td>&quot;Zolitel&quot;:meditomidine</td>
<td>1-3:02-0.1 IM</td>
<td>1-3:0-2-0.1 IM</td>
<td>7-10 IM</td>
<td>4-10 IM</td>
<td>4-10 IM (7 optimum)</td>
<td>20 IM q48h</td>
<td></td>
</tr>
<tr>
<td>Ketamine</td>
<td>15 IM</td>
<td>15 IM</td>
<td>15 IM</td>
<td>15 IM</td>
<td>10-25 IM/SC</td>
<td>20 IM q48h</td>
<td></td>
</tr>
<tr>
<td>Ketamine:xylazine</td>
<td>5-5 IM</td>
<td>5-5 IM</td>
<td>5-15:5 IM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meditomidine (Domitor/Zolazapine)</td>
<td>0.04-0.08 IM/SC</td>
<td>0.04-0.08 IM/SC</td>
<td>0.26-0.54 IM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atipamazole (Antisedan)</td>
<td>0.525 IV/IM</td>
<td>5-400 IM/SC</td>
<td>5-400 IM/SC</td>
<td>5-400 IM/SC</td>
<td>1.5-2.5 IM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xylazine (Xylaze/Rompun)</td>
<td>5 IM/IV</td>
<td>5 IM/IV</td>
<td>5 IM/IV</td>
<td>5 IM/IV</td>
<td>5 IM/IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Azaperone (Stresnil)</td>
<td>2 IM</td>
<td>0.5-2 IM</td>
<td>0.5-2 IM</td>
<td>0.5-2 IM</td>
<td>0.5-2 IM</td>
<td>0.5-2 IM</td>
<td></td>
</tr>
<tr>
<td>Diazapam (pamlin)</td>
<td>0.5-2 IM/IV</td>
<td>0.5-1 IM/IV</td>
<td>1-2 IM/IV</td>
<td>0.5-1 IM/IV</td>
<td>0.5-1 IM/IV</td>
<td>1 IM/IV</td>
<td>1 IM/IV</td>
</tr>
<tr>
<td>Fluphenazine dicanolate (Modecate)</td>
<td>2.5 IM/SC</td>
<td>2.5 IM/SC</td>
<td>2.5 IM/SC</td>
<td>2.5 IM/SC</td>
<td>2.5 IM/SC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propofol</td>
<td>6-8 IV</td>
<td>6-8 IV</td>
<td>6-8 IV</td>
<td>6-8 IV</td>
<td>6-8 IV</td>
<td>6-8 IV</td>
<td>6-10 IV to effect</td>
</tr>
</tbody>
</table>