Burmese brow antlered deer *(Rucervus eldii thamin)*

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We would recommend assessing the efficacy of any contraceptive bout with behavioural and hormone monitoring. For more information on this, please contact contraception@chesterzoo.org

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Contraceptive methods:	GnRH agonist (implant)	GnRH agonist (injection)	GnRH Vaccine	Progestogen (injection)	Progestogen (oral)	Progestogen (implant)	PZP vaccine	Surgical/ Permanent
Contraceptive Product:	Deslorelin acetate	Leuprolide acetate	GnRH protein conjugate	Depot medroxyprogesterone acetate	Altrenogest	Etonorgestrel 68 mg	PZP vaccine main components are antigens derived from porcine zona pellucida glycoproteins and an adjuvant to stimulate the immune response (Freund's modified complete adjuvant for primary vaccination and Freund's incomplete adjuvant for boosters).	N/A
Commercial Name:	Suprelorin ® implants of 4.7 mg and 9.4 mg	Lupron ®	Improvac® 2ml dose contains 300 ug of GnRH analogue-protein conjugate	Depo-Provera®, Depo-Progevera®	Regu-mate®	Implanon® Nexplanon®	Porcine Zona Pellucida	Vasectomy
Product Availability:	Implants containing 4.7mg ('Suprelorin® 6') and 9.4 mg ('Suprelorin® 12') widely available through veterinary drug distributors in the EU. 9.4 mg ('Suprelorin® 12') is also available through Virbac.	Leuprolide acetate is licenced for human use	Available through veterinary drug distributors.	Manufactured by Pfizer. Widely available throughout Europe through human drug distributors.	Regu-mate® Equine 2.2ml/mg oral solution and Regu-mate® Porcine 0.4% w/v oral solution widely available through veterinary drug distributors.	Manufactured by Organon. Available through human drug distributors	Not commercially available in Europe. Can be imported from the USA.	N/A
Restrictions and/or permit required by Importing Country:	EGZAC recommends: always check with your local licencing authority	Data deficient	Current knowledge: widely available throughout European countries. EGZAC recommends: always check with your local licencing authority	EGZAC recommends: always check with your local licencing authority	EGZAC recommends: always check with your local licencing authority	EGZAC recommends: always check with your local licencing authority	License required UK and France; all other Countries unknown. EGZAC recommends always checking with local licencing authority	N/A
Mechanism of action:	GnRH agonist suppress the reproductive endocrine system, preventing production of pituitary and gonadal hormones. As agonists of the GnRH these products initially stimulate the reproductive system, which can result in oestrus and ovulation in females or temporary enhancement of testosterone and spermatogenesis in males. Therefore this stimulation phase needs to be managed either by administering additional contraception (progestogens) in the females to suppress it or by separation of the sexes (males and females).	GnRH agonist suppress the reproductive endocrine system, preventing production of pituitary and gonadal hormones. GnRH agonists initially stimulate the reproductive system -which can result in oestrus and ovulation in females or temporary enhancement of testosterone and spermatogenesis in males. Therefore additional contraception needed during this time.	Stimulates the production of anti-GnRH antibodies by the immune system, neutralising endogenous GnRH activity. This results in a reduction of FSH and LH production by the anterior pituitary and, ultimately, in a reduction of ovarian follicular development and /or inhibition of testosterone secretion from the testes and spermatogenesis.	Interference with fertilization by thickening cervical mucus, interrupting gamete transport, disruption of implantation, inhibition of LH surge necessary for ovulation	Interference with fertilization by thickening cervical mucus, interrupting gamete transport, disruption of implantation, inhibition of LH surge necessary for ovulation	Interference with fertilization by thickening cervical mucus, interrupting gamete transport, disruption of implantation, inhibition of LH surge necessary for ovulation	The PZP antibodies interfere with fertilisation by binding to the ZP glycoprotein receptors that surround the egg of the vaccinated female, blocking the binding and subsequent penetration of sperm.	Surgical procedure in which the ductus deferens are cut, tied, cauterized, or otherwise interrupted
Insertion/Placement:	Sub-cutaneously, in a place where it can be easily detected or seen for removal at a later date; refer to the Suprelorin® fact sheet for effective method of implant placement (tunnelisation)	Injectable intramuscular or subcutaneously	Injectable intramuscularly or subcutaneously	intramuscular injection	Administered orally in feed or by syringe. **Gloves must be worn when administering Regu-mate® (absorption through the skin can cause disruption to the menstrual cycle and prolongation of pregnancies in humans).**	Intramuscular or subcutaneous. EGZAC recommends sub-cutaneous, upper inner arm for visibility (aid for later removal)	Injectable Intramuscularly	Surgical
Females								
Dose	Approximately 1-2 implants are required to contracept this species, depending on body weight. As a general rule, a minimum of 1 implant per 100kg body weight should be used. 4.7mg implants are recommended for a **minimum** duration of 6 months and 9.4mg implants are recommended for a **minimum** duration of 12 months. **Please contact EGZAC for more information.**	There are various formulations ranging from 1-6 months. Please see Baker et al. (2005)[5] for a guide on dosing.	Two injections of 400µg are given 35 days apart and boosters are initially administered every 4 months, before extending to every 5 months.	The recommended dosage for this species is 2-5mg/kg every 45-90 days (if oestrus occurs, dose can be increased incrementally until suppression is achieved).	0.044 mg/kg should be administered daily throughout the duration of the breeding season.	Doses not well established. Recommended 1 implant per 100kg BW. For an individual weighing <100kg, 1 implant should be sufficient.	~ 100 ug of protein. Recommended dose is 2 injections given typically 2+ weeks apart then a booster every 8 months for most species. For species with a well defined and short (2-3 months) breeding season, give first dose 1-2 months prior to the breeding season and the second inoculation no later than 1 month prior to breeding activity. Year-round breeders booster inoculations should be given every 7 to 8 months.	N/A
Latency to effectiveness:	3 weeks average as GnRH agonists initially stimulate the reproductive system (please refer to the Deslorelin datasheet for detailed information). Either separation of the sexes or additional contraception is needed during this time, such as an oral progestogen (~2mg/kg Megestrol acetate pills; Megace/Ovarid or 0.044 mg/kg altrenogest (Regumate)) daily 7 days before and 8 days after the contraceptive has been administered to suppress initial stimulation phase.	Same as for deslorelin - **please refer to Deslorelin datasheet for detailed information**	Unknown for most species, minimum of 6 weeks from primary vaccination	1-3 days post injection. However, if the cycle stage is not known then extra time must be allowed. Therefore, separation of the sexes or alternate contraception should be used for at least 1 week.	It has been demonstrated that 95% of mares will be suppressed within 3 days. However separation or other contraceptive methods should be used for 7-14 days after the contraception is administered.	In general inhibition of ovulation after 1 day when inserted on day 1-5 of cycle or when replacing oral progestogen. As the right stage during menstrual cycle is often unknown, it is advised to use other contraceptive methods for at least 7-14 days after insertion of the implant depending on administration route (intramuscularly or subcutaneously).	2-3 weeks after the last vaccination during year 1 (primary course of vaccination 2 injections 2-4 weeks apart, preferably 3 injections).	N/A
Oestrus cycles during contraceptive treatment:	Initial oestrus and ovulation (during the 3 weeks of stimulation) then no oestrus cycle. To supress the initial oestrus and ovulation you can follow the megestrol acetate/oral progestogen protocol mentioned above.	Same as with Deslorelin	Unknown but it should be suppressed; highly successful at inducing anoestrus in domestic horses.	Oestrus is inhibited, although ovulation and cycling might occur in adequately contraceptive animals at the lower level (this is unlikely and the degree of suppression is dose dependant)	Oestrus is inhibited, although ovulation and cycling might occur in adequately contraceptive animals at the lower level (this is unlikely and the degree of suppression is dose dependant).	Oestrus is inhibited, although ovulation and cycling might occur in adequately contraceptive animals at the lower level (this is unlikely and the degree of suppression is dose dependant)	PZP should not suppress oestrous cycles and may extend the breeding season beyond what is considered typical, resulting in additional oestrous cycles.	N/A
Use during pregnancy:	Not recommended, can lead to an abortion	Same as with Deslorelin	**Data deficient**	Progestogens are not recommended in pregnant animals because of the possibility of prolonged gestation, still birth, abortion, etc.	Progestogens are not recommended in pregnant animals because of the possibility of prolonged gestation, still birth, abortion, etc.	Progestogens are not recommended in pregnant animals because of the possibility of prolonged gestation, still birth, abortion, etc.	Separation of the sexes from the beginning of the initial vaccination course until at least 2 weeks after the last injection during the first year	N/A
Use during lactation:	No known contraindications once lactation has been established; however, treatment during pregnancy may impede proper mammary development and potentially hinder lactation.	Same as with Deslorelin	**Data deficient**	Considered safe for nursing infant.	Considered safe for nursing infant.	Considered safe for nursing infant.	Does not interrupt pregnancy or affect the foetus	N/A
Use in prepubertals or juveniles:	Because deslorelin suppresses gonadal steroids, its use may delay epiphyseal closure of the long bones, resulting in taller individuals, similar to the effects of pre-pubertal neutering in domestic animals.	Same as with Deslorelin	**Data deficient**	The use of synthetic progestogens in pre-pubertals or juveniles has not been fully assessed. Possible long-term effects on fertility are not known.	The use of synthetic progestogens in pre-pubertals or juveniles has not been fully assessed. Possible long-term effects	The use of synthetic progestogens in pre-pubertals or juveniles has not been fully assessed. Possible long-term effects	No known contraindications	N/A
Use in seasonal breeders:	Treatment should be given more than 2 months prior to expected breeding season	**Data deficient.** Should start at least 2 months before the start of breeding season.	Data deficient but if used should be done at least 6 weeks prior to the breeding season.	Should be injected at least 2 weeks before the breeding season starts.	Should be injected at least 2 weeks before the breeding season starts.	Should be injected at least 2 weeks before the breeding season starts.	PZP-treated prepubertal white-tailed deer and feral horses were fertile as adults. Not associated with side effects in elephants. But there are no data for other species	N/A

Duration	Duration of efficacy has not been well established. As a guide: 4.7 mg implants will suppress for a **minimum** of 6 months; 9.4mg will be effective for a **minimum** of 12 months	Lupron® is available in various formulations lasting from 1 to 6 months, but because the release of hormone from the depot formulation varies per individual, actual duration of efficacy can vary considerably.	Data deficient for most of species. Improvac® generates short lived antibodies in the domestic pig (after 7-8 weeks following second injection antibodies start to decline). Data from domestic horses varies: a full season in mares after the first booster.	Dose dependant: 45-90 days in general. However, effects could last 1-2 years in some individuals. In some species, contraception with medroxyprogesterone acetate can extend the breeding season; this requires an extension of the period of contraceptive treatment.	Duration may not be more than one day, so has to be administered daily. Clearance of Regu-mate® from the system can occur in a few days however, latency to conception can very between individuals.	Data deficient in these species, however expected to be effective for 2-3 years.	Can be used in seasonal breeders but initial treatment and annual boosters should be carried out 2 and 1 months before the start of the breeding season respectively.	N/A
Reversibility	Suprelorin is designed to be fully reversible, and we have records of female deer reversing in our database. One female muntjac implanted with 1x9.4mg implant reversed 2 years after initially being implanted, while two female tufted deer implanted with 2 and 3x9.4mg implants gave birth between 4 and 5 years after their initial treatment began. To facilitate reversibility, implants should be removed, and therefore placed in a location with thinner skin e.g. umbilical region, inner thigh, base of the ear.	Lupron® is designed to be fully reversible however there are no current cases of reversal in cervidae , and there are also no cases of this contraception failing.	Data deficient for most of species. Reversibility following Improvac has been demonstrated in white-tailed deer (Miller et al, 2000). Improvac antibodies are short-life and it is presumed to be reversible.	Designed to be fully reversible and we have two records of reversal in moose. Both females reversed 2-2.5 years after initially being treated.	Designed to be fully reversible although variations can occur.	Designed to be fully reversible although variations can occur. To facilitate reversibility, implants should be removed, and therefore placed in a location with thinner skin e.g. umbilical region, inner thigh, base of the ear.	There are species differences on reversibility, and we have one record of a female white tailed deer reversing 3 months after initial treatment. Caution with prolonged use (>3 years) as it may result in infertility. Treatment for over 3 years has been associated with ovarian failure in some cases. The possibility of ovarian damage makes this method unsuitable for animals highly valuable to captive breeding programmes or where reversibility is important.	N/A
Effects on Behaviour	**Data deficient**	**Data deficient**	Similar to surgical castration but short-acting (duration of antibody effect).	Effects on behaviour have not been studied, every individual may react differently. Because it binds readily to androgen receptors and is antiestrogenic, females may experience male-like qualities (increased aggression , development of male secondary sex characteristics, etc.). Further research in the subject is necessary.	Effects on behaviour have not been studied, every individual may react differently. Because it binds readily to androgen receptors and is antiestrogenic, females may experience male-like qualities (increased aggression , development of male secondary sex characteristics, etc.) Further research in the subject is necessary.	Effects on behaviour have not been studied, every individual may react differently.	Since usually the vaccine doesn't suppress oestrus cycles it has almost no effects on social behaviour, and no undesirable behavioural effects have been registered in free-ranging elephants treated for up to 9 years. In some species the failure to conceive can results in longer than usual breeding season and in some cases this can results in aggression and social disruption.	N/A
Effects on sexual physical characteristics	Data deficient in this species, although secondary sexual characteristics might be affected.	GnRH agonists may cause the suppression of physical secondary sexual characteristics.	Similar to surgical castration but short-acting (duration of antibody effect).	Because it binds readily to androgen receptors and is antiestrogenic, females may experience male-like qualities (increased aggression, development of male secondary sex characteristics, etc.)	Data deficient	Data deficient, however no effects are expected	Data deficient	N/A
Males	**GnRH agonists are not effective in male ungulates**	**GnRH agonists are not effective in male ungulates**		**Not Recommended**	**Not Recommended**	**Not Recommended**	**Not Recommended**	
Dose	N/A	N/A	Two initial injections of 400µg are given 35 days apart and boosters are initially administered every 4 months, before extending to every 5 months.	N/A	N/A	N/A	N/A	N/A
Latency to effectiveness:	N/A	N/A	At least 2 weeks following booster.	N/A	N/A	N/A	N/A	Approximately 12 weeks post-vasectomy
Use in prepubertals or juveniles:	N/A	N/A	Data deficient	N/A	N/A	N/A	N/A	Data deficient
Use in seasonal breeders:	N/A	N/A	Unknown, but if used should be done at least 6 weeks prior to the breeding season.	N/A	N/A	N/A	N/A	N/A
Duration and Reversibility	N/A	N/A	Antibodies are short-life and it is presumed to be reversible. Irreversible destruction of testicular stroma has been observed in some deer species so it may cause sterility. Improvac should be used with caution.	N/A	N/A	N/A	N/A	Permanent, although some reversible techniques are being tried.
Effects on Behaviour	N/A	N/A	Similar to surgical castration but short-acting (duration of antibody effect). It may decrease male aggression due to downregulation of testosterone synthesis.	N/A	N/A	N/A	N/A	None
Effects on sexual physical characteristics	N/A	N/A	Similar to surgical castration but short-acting (duration of antibody effect). Effect on secondary sexual characteristics. The antler cycle will be affected; antlers may drop off and become maloformed[1].	N/A	N/A	N/A	N/A	None
General:								
Side effects	In general weight gain and changes in secondary sexual characteristics as would be seen with ovariectomy or castration.	In general weight gain as would be seen with ovariectomy or castration. Increased appetite will result in weight gain, especially in females. **EGZAC recommends always reading the manufacturer's data sheet**	Occasional swelling at the vaccination site - need to inject deep intramuscular in elephants and horses.	Possible weight gain, possible increased or decreased frequency of bleeding during menstruation. **EGZAC recommends always reading the manufacturer's data sheet.**	Possible weight gain, possible increased or decreased frequency of bleeding during menstruation. **EGZAC recommends always reading the manufacturer's data sheet.**	N/A	Treatment for over 5 years has been associated with ovarian failure in some species (species differences). Significant ovarian disruption has been noted in dogs, rabbits, mice and domestic sheep. Oophoritis unknown if transient or permanent. In some species the failure to conceive can result in a breeding season that is longer than usual (aggression and social disruption)	N/A
Warnings	Duration may be reduced if implant is broken. Do not cut the implant.	Causes initial gonadal stimulation	It should be handled with extreme care to avoid handler accidents. **EGZAC recommends always reading the manufacturer's data sheet**	Do not administer to any pregnant female due to the possible duration of efficacy extending beyond the expected time of parturition which has potential deadly effects. **EGZAC recommends always reading the manufacturer's data sheet**	Do not administer to females who have had a previous or current history of uterine inflammation (I.e. endometritis). The use of progestins can intensify existing uterine inflammation in to a serious uterine infection in some cases.	N/A	The only adjuvant used with PZP is Freund's Modified adjuvant, which **DOES NOT CAUSE TB+ TEST RESULTS**, and injection site reactions are less than 0.05%. Following the initial treatments, boosters are required, using only Freund's Incomplete adjuvant. In rabbits and possibly canids PZP vaccine can cause depletion of oocytes, and in some primates it can cause temporary cessation of oestrous cycles. There are few data for its use in carnivores, aside from pinnipeds and bears, and recent research with felids indicates that the antibodies will not cross-react with the sperm receptors.	Infection of the surgical wound might occur. Intradermal closure of the skin is advised together with prophylactic antibiotic treatment and NSAID

Reporting Requirements: **In order to increase our knowledge of the efficacy of contraception methods in the Cervidae family it is recommended that all individuals on contraception be reported to EGZAC**

References:

1) Killian, G., Wagner, D., Miller, L. (2005) Observations of the Use of the GnRH Vaccine GonaCon™ in Male White-Tailed Deer (*Odocoileus virginianus*). *Proceedings of the 11th Wildlife Damage Conference.*

2) Lüders, I., Örke, AK. (2016) GnRH vaccination in elephants. Available: http://egzac.org/home/viewdocument?filename=Statement%20on%20GnRH%20Vaccination%20in%20Elephants.pdf

3) Baker, D.L., Wilkds, M.A., Connor, M.M., Ravivarapu, H.B., Dunn, R.L., Nett, T.M. (2004) Gonadotropin-releasing hormone agonist: a new approach to reversible contraception in female deer. *Journal of Wildlife Diseases* , 40(4):713-724.

4) Miller, L.A., Johns, B.E., Killian, G.J. (2000) Immunocontraception of White-Tailed Deer with GnRH Vaccine. *American Journal of Reproductive Immunology* . 44(5):266-274.

5) Baker, D.L., Hussain, M.D., Nett, T.M. (2005) Evaluation of remotely delivered leuprolide acetate as a contraceptive agent in female elk (*Cervus elaphus nelsoni*). *Journal of wildlife diseases* . 41(4):758-767.