Animal name: *Marsupalia*

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

Contraceptive methods	GnRH agonist (implant)	GnRH agonist (injection)	Progestagen (implants)	Progestagen (implant)	Progestagen (injection)	Progestagen (injection)	GnRH vaccine	PZP vaccine	Permanent (surgical)
Contraceptive Product:	Deslorelin acetate	Luprolide acetate	Etonogestrel 68 mg	Levonorgestrel 2x 75mg	medroxyprogesterone acetate;	proligestrone 100mg/ml	GnRH protein conjugate	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).	
Commercial Name:	Suprelorin ® (131 records)	Lupron ® (4 records)	Implanon® Nexplanon®	Norplant®, Norplant-2® (14 records)	Depo-Provera®, Depo-Progevera® (58 records)	Delvosteron®	Improvac®	Porcine Zona Pellucida (4 records)	
Product Availability:	4.7mg ('Suprelorin 6') and 9.4 mg ('Suprelorin 12') widely available through veterinary drug distributors in the EU.	Luprolide acetate licenced for human use	Manufactured by Bayer Schering Pharma AG. Available through human drug distributors	Manufactured by Organon. Available through human drug distributors	Manufactured by Pfizer. Widely available throughout Europe through human drug distributors.	Manufactured by MSD animal Health UK, Intervet Europe. Licensed for use in female dogs, cats, and ferrets; available through veterinary distributors.	Available through veterinary 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	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	Current knowledge: widely available throughout European countries. 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 an agonist of the GnRH initially stimulates 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. Please see below and refer to Deslorelin datasheet for detailed information	GnRH agonist suppress the reproductive endocrine system, preventing production of pituitary and gonadal hormones. As an agonist of the GnRH initially stimulates 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. Please see below and refer to Deslorelin datasheet for detailed information	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	Anti-estrogenic activity. Interference with fertilization by thickening cervical mucus, interrupting gamete transport, disruption of implantation, inhibition of LH surge necessary for ovulation	Anti-estrogenic activity. Interference with fertilization by thickening cervical mucus, interrupting gamete transport, disruption of implantation, inhibition of LH surge necessary for ovulation	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.	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.	**Vasectomy:** Surgical procedure in which the ductus deferens are cut, tied, cauterized, or otherwise interrupted; **Castration:** Surgical procedure in which the testes are removed.
Insertion/Placement:	Sub-cutaneous, in a place where it can be easily detected or seen for removal at a later date (I.e. Upper inner arm); refer Suprelorin fact sheet for effective method of implant placement (tunnelisation)	Injectable	Intramuscular or subcutaneous. EGZAC recommends sub-cutaneous, upper inner arm for visibility (aid for later removal)	Intramuscular or subcutaneous. EGZAC recommends sub-cutaneous, upper inner arm for visibility (aid for later removal)	Injectable intramuscular	Injectable subcutaneously - do not inject intradermally or into subcutaneous fat or scar tissue	Intramuscular or subcutaneous.	Injectable Intramuscularly	Surgical
Females							**Data deficient**		
Dose	1-2 implants depending on species and weight. 1x4.7mg implants for a **minimum** duration of 6 months and 1x9.4mg implants for a **minimum** duration of 12 months. 9.4mg was used in Eastern grey kangaroo (see ref 4). Please contact EGZAC for more dosing information.	**Data deficient.** Please contact EGZAC for more dosing information.	Ground cuscus + sugar gliders: 1/3-1/2 and implant is recommended depending on weight. Data suggests that the implant should be replaced every 3 years. Please contact EGZAC for more dosing information.	Please contact EGZAC for more dosing information.	Ground cuscus + sugar gliders: The recommended dose is 5mg/kg every 45-90 days. Please contact EGZAC for more dosing information.	Please contact EGZAC for more dosing information.	**Data deficient.** Two injections of 400µg are given 35 days apart and boosters are usually administered every 6-7 months, although duration can vary between species and individuals.	~ 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.	
Latency to effectiveness:	~3 weeks so the first bout of Deslorelin must be supplemented with oral megestrol acetate pills (Ovarid) for 7 days before and 8 days after implant placement, or the sexes must be separated during this time.	**Data deficient**	It is advised to use additional contraception or to separate the sexes for 7-14 days after inserting the implant.	Levonorgestrel does not prevent the reactivation of the diapausing blastocyst or its subsequent development in macropods. However, None of the levonorgestrel-treated animals gave birth again or mated during the subsequent 36 months. (Ref3)	1-3 days post injection however if the cycle stage is not known then sexes should be separated for 7 days.		**Data deficient.** Latency to effectiveness can be up to 8 weeks so separation of the sexes is recommended if possible. In a group of 57 mares, 50% were anoestrus after the primary vaccination and 100% after the booster vaccination, the interval from treatment to anoestrus was 2-3 weeks.	2-3 weeks after the last vaccination during year 1 (primary course of vaccination 2 injections 2-4 weeks apart, preferably 3 injections).	
Oestrus cycles during contraceptive treatment:	There will be an initial stimulation phase which can be suppressed with additional contraception.	**Data deficient**	**Data deficient.** However oestrus should be suppressed	Oestrus should be suppressed	Oestrus should be suppressed		**Data deficient**	PZP should not suppress oestrous cycles and may extend the breeding season beyond what is considered typical, resulting in additional oestrous cycles.	
Use during pregnancy:	**Pregnancy** or birth may be affected by **deslorelin** treatment in some animals (ref1). Deslorelin treatment did not affect normal gestation or parturition in 60% (3/5) of animals (ref2)	**Data deficient**	Progestagens in general do not prevent the reactivation of the diapausing blastocyst or its subsequent development, but supress the post-partum oestrus.	Progestagens in general do not prevent the reactivation of the diapausing blastocyst or its subsequent development, but supress the post-partum oestrus.	**Data deficient** but its use during pregnancy should be discouraged		**Not recommended**	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	

Use during lactation:	In a study in Tammar wallaby early phase of lactation was not affected (ref2)	**Data deficient**	**Data deficient.** But presumed not to be affected	**Data deficient.** But presumed not to be affected	**Data deficient.** But presumed not to be affected		**Unknown**	Does not interrupt pregnancy or affect the foetus	
Use in prepubertals or juveniles:	Data deficient	**Data deficient**	**Data deficient**	**Data deficient**	**Data deficient**		**Unknown**	No known contraindications	
Use in seasonal breeders:	Treatment should start at least 1 month before the breeding season. In macropods deslorelin treatment might not inhibit the reactivation of a quiescent blastocyst and subsequent birth, but successfully inhibits follicular development and post-partum oestrus (in 4/5 animals; refs 2)	**Data deficient**	Treatment should start at least 1 month before the breeding season. In macropods progestagen treatment might not inhibit the reactivation of a quiescent blastocyst and subsequent birth, but successfully inhibits follicular development and post-partum oestrus thereafter	Treatment should start at least 1 month before the breeding season. In macropods progestagen treatment might not inhibit the reactivation of a quiescent blastocyst and subsequent birth, but successfully inhibits follicular development and post-partum oestrus thereafter	**Data deficient.** Treatment should start at least 1 month prior to the breeding season.		If used should be done at least 6 weeks prior to the breeding season. Effective in the horse. Use on the onset of the breeding season before cycling starts.	**Data deficient**	
Duration	1x4.7mg implants for a **minimum** duration of 6 months and 1x9.4mg implants for a **minimum** duration of 12 months.	**Data deficient**	2.5-3 years however this can vary between individuals.	36 months in the Tammar wallaby	**Data deficient.** 45 to 90 days.		Unknown for most of species. Improvac® generates short lived antibodies in the domestic pig (after 7-8 weeks following second injection antibodies start to decline).	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.	
Reversibility	Suprelorin is designed to be fully reversible, and we have 5 records of reversal in our database. Two yellow-footed rock wallabies gave birth to live young 2-4 years after being implanted with 1x4.7mg implants. One red kangaroo reversed 4 years after being implanted with 2x4.7mg implants. We have additional records for a yellow-footed rock wallaby and a red kangaroo however, dosing information is missing.	**Data deficient**	Implanon is designed to be fully reversible however we do not have any records of any marsupials reversing in our database. We would recommend removing the implant to facilitate reversal, so please place the implant in a location that facilitates removal.	In a study in tammar wallaby, **Levonorgestrel** implants were removed from six females and four of these **animals** resumed reproductive activity, confirming that the contraceptive effect of the implants is **reversible (**ref 3)	Depo-Provera is designed to be fully reversible however we do not have any examples of marsupalia reversing in our database.		**Data deficient.** Reversibility is **unknown for most species**. It is presumed to be reversible when used in the short term due to short lived antibodies. The longer it is used, the longer the time required for reversal. **Long term effects on fertility are unknown and therefore EGZAC recommends caution when using for an extended period of time.**	There are species differences on reversibility. Treatment for over 5 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. We have one record of a western grey kangaroo who gave birth to live young 1 year after initial treatment. The dose is not known. PZP was used in one study in Eastern Grey Kangaroos (see ref 5).	
Effects on Behaviour	**Data deficient**	**Data deficient**	**Data deficient**	**Data deficient**	An increase in aggression may occur.		Similar to surgical castration (duration of antibody effect). No oestrus behaviours in mares.	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.	
Effects on sexual physical characteristics	Females may experience weight gain due to an increase in appetite.	**Data deficient**	**Data deficient**	**Data deficient**	Females may develop ale secondary sex characteristics		Similar to surgical castration (duration of antibody effect).	**Data deficient**	
Males	**Not recommended**	**Not recommended**	**Not recommended**	**Not recommended**	**Not recommended**	**Not recommended**		**Not Recommended**	
Dose							**Data deficient.** Two injections of 400µg are given 35 days apart and boosters are usually administered every 6-7 months, although duration can vary between species and individuals.		
Latency to effectiveness:							**Data deficient.** At least 2 weeks following the booster.		
Use in prepubertals or juveniles:							No data available, therefore its use is **not recommended**		
Use in seasonal breeders:							**Data deficient**		
Duration and Reversibility							**Data deficient.** Reversibility is unknown for most of species. Improvac® generates short lived antibodies in the domestic pig (after 7-8 weeks following second injection antibodies start to decline).		
Effects on Behaviour							Similar to surgical castration (duration of antibody effect). Decrease male aggression due to downregulation of testosterone synthesis.		
Effects on sexual physical characteristics							Similar to surgical castration (duration of antibody effect).		
General:									
Side effects	Possible weight gain in females						Painful swelling at the vaccination site may occur - need to inject deep intramuscular in equids. EGZAC recommends always reading the manufacturer's data sheet.		
Warnings					Prolonged use may be associated with deleterious effects on the endometrium in other species however, there is no evidence of this in marsupials.		It should be handled with extreme care to avoid handler accidents. EGZAC recommends always reading the manufacturer's data sheet.	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.	

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

References:

1) Long-term effects of deslorelin implants on reproduction in the female tammar wallaby (Macropus eugenii). C A Herbert, T E Trigg, , M B Renfree, , G Shaw, D C Eckery and D W Cooper.(2005) Society for Reproduction and Fertility ISSN 1470–1626 (paper) 1741–7899 (online)

2) Effect of deslorelin implants on follicular development, parturition and post-partum oestrus in the tammar wallaby (Macropus eugenii). C A Herbert, T E Trigg and D W Cooper. 2004 Society for Reproduction and Fertility. Print ISSN: 1470-1626, Online ISSN: 1741-7899.

3) Contraceptive effects of levonorgestrel implants in a marsupial. Nave CD, Shaw G, Short RV, Renfree MB. Reprod Fertil Dev. 2000;12(1-2):81-6.

4) Deslorelin implants in free-ranging female eastern grey kangaroos (Macropus giganteus): mechanism of action and contraceptive efficacy, M E Wilson et al. 2013 Wildlife Research 40(5):403-412.

5) Immunocontraception of Eastern Grey kangaroos (Macropus giganteus) with recombinant brushtail possum (Trichosurus vulpecula) ZP3 protein. Al Kitchener et al 2009. Journal of reproductive medicine Journal of Reproductive Immunology Volume 79, Issue 2, Pages 156-162