APPENDIX 6: Criteria Identifying Ideal Contraceptive Agent

The following criteria have previously been identified by federal agencies (NPS and BLM) as requirements for an ideal contraceptive agent. Below each criteria is a list of published papers, specific to horses, which address the merit of PZP vaccine in each category. This vaccine has been in existence for more than 35 years and there also exists many more references specific for deer, elk, zoo animals, African elephants and non-human primates.

1. The agent should be at least 90% effective.

Liu et al. 1989. J. Reprod. Fert. 89:19-29
Kirkpatrick et al. 1990. Wildl. Soc. Bull. 18:326-330.
Kirkpatrick et. al. 1992. J. Reprod. Fert. 94:437-444.
Kirkpatrick et al. 1995. Bio. Reprod. Monograph Series 1: Equine Reproduction VI: 411-418.
Turner et al. 1996. J. Reprod. Fert. 107:31-35
Turner et al. 2001. J. Wildl. Manage. 65:235-241.
Turner and Kirkpatrick 2002. Reproduction (Suppl. 60):in press

2. The agent should be capable of administration by remote delivery.

Kirkpatrick et al. 1990. Wildl. Soc. Bull. 18:326-330.
Kirkpatrick et al. 1991. J. Reprod. Fert. (Suppl. 44): 321-325.
Turner et. al. 1992. J. Wildl. Manage. 56:154-157.
Kirkpatrick et al. 1995. Bio. Reprod. Monograph Series 1, Equine Reprod. VI: 411-418.
Turner et al. 1996. J. Reprod. Fert. 107:31-35.

3. The agent should be reversible.

Liu et al. 1989. J. Reprod. Fert. 89:19-29
Kirkpatrick et al. 1991. J. Reprod. Fert. (Suppl.44): 321-325.
Kirkpatrick et al. 1992. J. Reprod. Fert. 94:437-444.
Kirkpatrick et al. 1995. Bio. Reprod. Monogr. Series 1: Equine Reproduction VI:411-418.
Turner et al. 1996. J. Reprod. Fert. 107:31-35
Turner et al. 1997. J. Wildl. Manage. 61:873-880.
Kirkpatrick and Turner, 2002. Reproduction (Suppl. 60): in press

4. The agent should be safe for pregnant animals.

Kirkpatrick et al. Wildl. Soc. Bull. 18:326-330.
Kirkpatrick et al. 1992. J. Reprod. Fert. 94:437-444.
Kirkpatrick et al. 1995. Bio. Reprod. Monograph Series 1, Equine Reprod. VI: 411-418
Kirkpatrick and Turner 2002. Reproduction (Suppl. 60): in press.

5. The agent should not pass through the natural food chain.

The PZP vaccine is simply glycoprotein in nature (Dunbar et al. 1980. Biochemistry

19:356-365). Proteins are not absorbed whole because they are digested. Even in cases where the digestion is not complete, the digestion products are di- or oligopeptides, which are not biologically active. "It
has been demonstrated that proteins are not completely hydrolyzed to amino acids before absorption, but that a certain fraction is absorbed as di- or oligopeptides, which are hydrolyzed inside the mucosal cell." (Newey and Smith 1960. J. Physiol. 152:367.). Any freshman level biochemistry or physiology text will provide basic information about the failure of proteins to be absorbed in biologically active forms.

6. The agent should be inexpensive.

Under the INAD authorization the vaccine must be made available for no more than the cost of production, which is currently $20/dose (65 µg).

7. There should be no debilitating side effects on the health of the horses.

Kirkpatrick et al. 1992. J. Reprod. Fert. 94:437-444.
Kirkpatrick et al. 1995. Bio Reprod. Monograph Series 1, Equine Reproduction VI: 411-418.

8. The agent should not influence the social behavior of the horses.

Kirkpatrick et al. 1990. Wildl. Soc. Bull. 18:326-330.
Kirkpatrick et al. 1992 J. Reprod. Fert. 94:437-444.
Powell 1999. J. Appl. An. Welfare Sci. 2:321-335.

9. The treatment must be easy to store, handle, and apply under field conditions and not represent a significant risk for BLM employees or their contractors.

The PZP vaccine must be stored frozen. It can be lyophilized but it loses biological activity and the cost begins to increase because larger volumes are necessary. It can be thawed out prior to use and re-frozen. It is usually mixed with the adjuvant just before use, but also can be pre-mixed. This tends, however, to result in significant loss of PZP and an overall increase in cost.

The vaccine has been used in this form for 14 years on Assateague Island National Seashore, under very poor field conditions (as opposed to a sheltered area next to a chute) without problems. Risks are limited to users as it cannot be taken orally or absorbed through the skin. After 14 years there are at least 12-15 (at least 50% are women) people who have administered the vaccine annually, in frequent darting activities, and there have been no reported problems of any kind. In addition, approximately 100 zoo veterinarians administer the vaccine on a regular basis and have reported no problems.