Delivery of GonaCon™ -Equine to Feral Horses (Equus caballus) Using Prototype Syringe Darts

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Outline

- Horses at Theodore Roosevelt National Park
- GonaCon: earlier research and opportunities
- Remote dart delivery research
- Results to date
- Management implications
Study Area – Theodore Roosevelt NP

- THRO, ~ 46,000 acres in North Dakota
- Badlands ecology
- Fenced perimeter
- Horses present since 1800s
  - ~130 in 2009
  - ~150 now
  - ~90 on study
GonaCon™ - Equine

- Gonadotropin Releasing Hormone (GnRH)
- Vaccine = GnRH + adjuvant
- Antibodies to GnRH
- Remote delivery?
- Re-vaccination?
Prior Research

- 2009 – 2013 single hand vaccination = 2 years moderate contraception (~30% decrease)
- Safe for mares and neonates
- No adverse behavior effects observed
- Consistent injection site reactions
- 2013 revaccinate by hand injection
- 2014 reconfirm safety and behavior observations
- 2015 100% effective
- 2016 ~85% effective

Conclusion: Re-immunization increases efficacy
Current Research – Remote Delivery

- No reliable remote delivery method
- Needed a practical application method

Objectives
- Primary: Remote delivery options
- Secondary: Re-vaccination intervals
Current Research – Remote Delivery

- **Pneu-Dart Slo-Inject**
  - Relatively new technology
  - 3.81cm, 14 ga, Tri-port needle
  - Gel collar 1.27 cm ahead of ferrule
Methods

- 2013 Roundup
  - Darts loaded with ~2.0 ml GonaCon
  - Weighed before and after
  - 11 new mares darted with vaccine
Pilot trial
Field - methods

- 2015-2016 Field Darting Operations
  - Measured speed at target
  - Optimum velocity
  - Consistency between delivery systems

<table>
<thead>
<tr>
<th>Projector</th>
<th>Range (meters)</th>
<th>Pressure (bar)</th>
<th>Mean velocity (meter/second)</th>
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<tbody>
<tr>
<td>Dan-Inject</td>
<td>10</td>
<td>4.0</td>
<td>46.0</td>
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<tr>
<td></td>
<td>20</td>
<td>4.5</td>
<td>47.0</td>
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<tr>
<td>Pneudart</td>
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<tr>
<td>Excalibur</td>
<td>20</td>
<td>4.0</td>
<td>47.8</td>
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**Study Design**

- Re-immunization schedule – darting

  (sample size) [mean age#]

- 6 mo  \( n = 15 \) [2.2] (1-14)
- 1 year  \( n = 15 \) [1.6] (1-5)
- 2 year  \( n = 11 \) [2.9] (2-4)
- 4 year  \( n = 25 \)* [5.5] (2-17)
- Control  \( n = 25 \)* [5.1] (2-11)

* From the original 2009 cohort

# At time of initial vaccination
Field Methods

Weighing empty  Loading dart  Weighing loaded  Approaching and darting

Observing darted animal  Collecting dart  Weighing fired darts
Darting
Field Darting Data

- Field Darting Observations 2015 - 2016
  - 88 darts loaded and fired
  - 74 delivered full dose
  - 6 lost
  - 5 delivered insufficient vaccine
  - 2 bounced out
  - 1 missed
- 84.1% success rate for delivery of full vaccine payload
  - All animals eventually dosed remotely
Preliminary Contraception Results

- Contraceptive efficacy - animals darted 2013-2016
  - 6 month
  - 1 year
  - 2 year
  - 4 year (previously reported Baker et al. 2018)

- Fertility prior to darting unknown
- Compare foaling rates with control (4 yr)
- Primary vaccination had similar modest decrease
- 2014 was a tough year and had low foaling rates
Preliminary Injection Site Results

- Injections site reactions are more frequent and more severe.
- But....
- May recover more quickly; no lameness observed
Conclusions

- Dart delivery is feasible for GonaCon™-Equine
  - Close range
  - Habituated and identifiable animals
  - Plenty of time
- Optimal vaccination schedule remains unknown
  - Preliminary results suggest intervals are similar
  - On-going evaluation – return to fertility
- Injection site reactions may be more severe than hand injection but may resolve more quickly
Management Implications

- Contraception may be an important part of horse management at THRO in the future.
  - Closed, accessible, identifiable, population
- Management plan and compliance is needed
- Dart delivery is likely to be the method of choice.
- Removals may still be needed
  - Ability to remove treated animals important
  - Regulated product is important
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