

Record of the Technical Workshop on Remote Delivery of Biologics to Free-Ranging Wildlife

January 23-24, 2002

Fort Collins, Colorado

In January 2002, the National Park Service Biological Resource Management Division assembled a small group of experts on ballistics, polymer chemistry, and wildlife management to discuss development of new technology for ballistic delivery of biologics to wildlife. The workshop goal was twofold: (1) develop product specifications for a new bullet and a ballistic system for its delivery, and (2) establish various alternatives on which to base further research. The most pressing need for this technology in the National Park Service is for the remote delivery of brucellosis vaccine to bison at Yellowstone National Park; however, this technology could also be useful in other wildlife management applications including remote delivery of contraceptives, medications, and other vaccines.

The workshop included technical presentations and subsequent moderated group discussions. This record primarily details the substantive results generated from the group discussions. The workshop concluded by projecting five “action items” to stimulate further action and development.

General Requirements for the Bullet and Gun

Presentations from disease, polymer, wildlife management, and ballistics experts generated discussion addressing the formulation of the needs of the bullet and gun to be used for delivery of RB-51, the designated brucellosis vaccine. The following general requirements were established as guidelines:

- Minimize tissue damage to target
- Minimize foreign debris to environment
- Establish optimum site for tissue target
- Ensure delivery of vaccine
- Payload: live vaccine (RB-51)
- Minimum delivery of 10^{10} CFUs
- Ground application (applies specifically to Yellowstone)
- Prototype bullet and gun within 24-36 months

More specific needs and considerations for the bullet and gun are as follows:

Considerations for Bullet Configuration

- titanium tube
- improved viability
- aerodynamics
- biodegradable/metal trace component
- biocompatible/biodegradable delivery
- environmentally activated degradation
- bullet identification
- incorporation of tracing components (dyes, powders, etc.)
- mate bullet and payload
- no hard pathogens
- terminal impact
- tissue reactivity
- mass and volume
- weight
- phased delivery
- phase change polymers (LCST)
- oil vehicle
- shotgun

Considerations for Gun

- 60m-100m range
- portable
- all-weather capability
- accurate

Considerations for each stage of vaccination delivery

Projectile	Breach to Muzzle	Muzzle to Skin
minimize leaching	suitable propellant	accuracy vs. precision
foreign debris	noise factor	sabot
pulsed release	fire rate	range distance
physics of skin	muzzle adjustment	environmental factors
intra dermal vs. intramuscular	muzzle break	degradable and recoverable
injection	heat	human safety
phase change	optics	staged projectile
dart	residue	
	stability	

Results of Gun and Bullet Breakout Sessions: Goals and Projections

Workshop participants separated into groups according to their respective area of expertise to establish more directed goals for the bullet and the gun.

Bullet

1. Scaled-up version of existing pellet-loaded biobullet to achieve optimum distances
2. Biodegradable dart with injection molded components with front end incorporation of metal (high density) powders to optimize external ballistics

3. Multi-stage projectile that combines existing technologies

Gun

Objective: Accurate delivery of payload to the target

Current Status:

Biobullet CO2-BTI
 DanInject CO2 Dart
 Palmer Capture: explosive charge CO2 or powder
 PNEU Dart: CO2, compressed air, powder charge
 Simmons: powder charge
 Paxarm: powder charge
 Various companies: blow darts

Available Maintenance:

Paxarm-New Zealand,
 DanInject-Wildlife Pharm.
 PNEUDart-good
 BTI-good
 Palmer-good
 Simmons-poor

Attributes of the Gun	Options	Available Technology
Propellant: 60 m limit		X
Noise	Silencer	
Rate of Fire: single shot and repeater		X
Velocity adjustment		DanInject, Simmons, Paxarm, BTI
Range Finder		X
Optics		X
Stability		X
Field Application Ground + Aerial: 30-40 meters max stability, 10-15 m max mobility		X
Reliability		
Simplicity		X
Mobile-Portable Foot, Vehicle, Horse, Aerial		X
All weather		X
Sighting mechanism Scopes, lasers		X
Range of 5 to 60 m		

New Technology for the Gun

Cartridge – biobullet

Laser sight for daytime, 60 m

Kevlar gun

Stun gun

Bullet and marker

Five points of further action will guide future research and development of the desired bullet and ballistic delivery system:

Action Items

1. Determine the feasibility of an NPS-sponsored “Remote Ballistic Vaccination Consortium,” consisting of academic, private sector, and agency participants. Group will:
 - a. determine the viability of the vaccine and the polymer
 - b. address short-term goals for Yellowstone
 - c. continue to develop and improve models for long-term use
 - d. establish a multi-park goal
2. Terry Kreeger (WY Game & Fish Department) to examine the established timeline for Yellowstone’s implementation of the Remote Ballistic Vaccination Program and provide feedback in regards to his own work.
3. Terry Kreeger will continue working to achieve a bullet that will travel the required distance (50-70 yards). (This distance is required for Yellowstone’s needs.)
4. David Hunter (Turner Enterprises) and Terry Kreeger will begin working toward the development of a new biodegradable dart, depending on support from PNEUDart.
5. NPS will continue to search for and solicit information from people not in attendance at the conference, and seek out funding and other resources for future testing.