ELEPHANT HERPESVIRUS (EEHV) WORKSHOP REPORT

24-25 January 2011
Houston, Texas

Hosted by the Houston Zoo, the International Elephant Foundation and the Elephant Managers Association
Facilitated by the IUCN Conservation Breeding Specialist Group

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An electronic version of this report can be downloaded at www.cbsg.org.

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WORKSHOP STATEMENT

Elephant endotheliotropic herpesvirus (EEHV) is the leading infectious cause of death in juvenile Asian elephants. Since 1978, 60 confirmed cases of EEHV have occurred in North America and Europe, with an additional 20 cases occurring in Asia among wild and managed elephants. This devastating disease is a significant threat to self-sustaining populations of managed and free ranging Asian elephants worldwide.

On January 24th and 25th 2011, more than 80 participants from five countries, including veterinarians, virologists, epidemiologists, elephant care specialists, and administrators gathered to collaborate and provide updates on critical ongoing EEHV research. During this 7th Annual International EEHV workshop, we re-affirmed our commitment to unraveling the epidemiology of this disease and to developing science-based treatment and management recommendations.

To date we have identified seven separate herpesviruses that have been found in elephants. Based on current research, it is evident that many, if not all, Asian elephants may shed the virus without illness, yet only one in five juveniles becomes ill as a result of infection. A handful of young elephants have survived EEHV-associated illness. While there have been confirmed cases of EEHV-associated illness and death in African elephants, the impact remains unclear and requires further investigation. It is imperative that institutions that house elephants remain educated about EEHV preparedness and monitoring, contribute biological samples, provide financial support for research projects, and continue responsible breeding of elephants as recommended by population managers. Immediate and sustained funding is essential to achieving the goals listed above and to ensuring the long-term survival of the Asian elephant.

Sincerely,

Elephant Herpesvirus (EEHV) Workshop Participants

EXECUTIVE SUMMARY

Introduction

Elephant endotheliotropic herpesviruses (EEHV) were first identified as agents of lethal disease in elephants in 1995 but they have retrospectively been linked with elephant deaths well before that time. EEHV is known to have been associated with disease and/or death in at least 80 elephants worldwide, including those in range countries. EEHV is the most important infectious disease that elephants face, both in managed care and in the wild.

The first workshop to gather researchers, veterinarians, and elephant managers around the topic of EEHV was convened in 2005. This year, the seventh annual EEHV workshop was held in Houston, Texas on January 24-25, 2011. There is a critical need for stakeholders to come together to focus on the sharing of information and to collaborate on detecting, diagnosing, treating, and ultimately reducing the impact of this devastating disease so that we may ensure a future for captive and wild elephants.

Keeping these aims in mind, a structured workshop approach was taken with a view towards developing specific goals, actions, responsible parties, and timelines in the broad areas of research, disease management, public relations and fundraising, and herd monitoring and herd management.

Workshop Objectives

- Raise awareness of EEHV and inform attendees about currently available knowledge and best practices
- Promote collaboration and coordination of efforts among researchers
- Build relationships between, and integrate the efforts of, researchers, veterinarians, and animal managers
- Develop short-term and long-range goals in the areas of research, disease management, herd monitoring, herd management, funding, and public relations

Process

CBSG facilitated workshops are designed to bring together the full range of stakeholders with a common interest in the conservation of a species. CBSG uses processes that promote sharing of information and ideas. Structured analysis of problems is used to develop creative and inclusive solutions. Most of the workshop is spent working in small working groups, with occasional reports back to all participants in plenary sessions for comments and revision. Small group work allows for effective and efficient use of time while plenary sessions allow all participants to have input on all workshop recommendations.

The EEHV Workshop was designed to help participants achieve the agreed upon objectives listed above. In order to ensure that all participants had a common base of understanding, the workshop agenda included overview presentations on each of the four workshop themes: research, disease management, herd monitoring/herd management, and public relations/funding. After each set of presentations, the group brainstormed goals for

addressing the issues raised. In theme-based working groups, participants were asked to review the goals and ensure there was a common understanding of each. The goals were then consolidated and missing goals were added. Next the group prioritized the goals to identify those they felt were most promising. Finally, each group identified detailed action steps for implementing their top priority goals.

After each working group session, presentations were made to share one groups' progress and to get feedback from members of the other group. This feedback was incorporated into the working group reports. The reports can be found on pages 7-22 of this document. The workshop ended with a session in which participants ranked top priority goals presented by all four groups to identify the workshop priorities. These goals are listed below.

Results

The goals related to the four working group themes, and actions step to implement them, can be found in the individual working group reports on pages 7-22 of this document. The top priority goals from each working group were brought to plenary and ranked by all participants. In order of priority, the goals that the group feels most need to be achieved are:

1. Develop methodology to culture the EEHV virus: a viable EEHV cell culture will provide research opportunities in basic EEHV viral biology which in turn will lead to development of areas of research including, but not limited to antiviral epidemiological studies, drug efficacy, sequencing of the EEHV genome, development of immunoassays, and promoting development and testing of a vaccine (24 votes).
2. Create an EEHV information resource/website that meets the needs of all facilities, is a place where people can share experiences in a safe, secure environment, and where information of value to the elephant community is disseminated quickly and updated frequently. This resource will be designed to educate and raise awareness (22 votes).
3. Develop a vaccine candidate for use in susceptible elephant herds (19 votes).
4. Determine effectiveness of antiviral drugs (11 votes)
5. Ensure adequate funding for the laboratories responsible for the testing of herpes-relevant elephant samples (10 votes).
6. Screening of all elephants (African and Asian) to obtain information about virus prevalence, number of strains, understand transmission, assess risks, and for the purposes of dissemination of accurate information (6 votes).
7. Gather more data/information from wild populations to determine the frequency and prevalence of EEHV in free-ranging populations (6 votes).

Tables of goals and actions, including responsible parties and timelines, can be found on beginning on page 23. These tables will be circulated to workshop participants on a quarterly basis so that progress can be tracked. When the group meets again the first order of business will be a review, and revision as necessary, of these actions.

Research Working Group Report

The working group reviewed the list of goals brainstormed in the plenary session and then prioritized them. Actions steps were identified for the highest priority goals. The goals and the number of votes each received are listed below:

Top Priority Goals (in order of priority):

1. **Culture virus** (13/63 votes)

   Action*:* Isolate EEHV virus (any/all subtypes – primary focus EEHV1a & 1b) in a laboratory setting.

   How? A continuous supply of the virus itself (untreated blood/tissue from suspect cases) and host cell lines (umbilical cord tissue from healthy neonates) is required. Fluid and tissue handling protocols to guide potential and continuing participants are required.

   Why? A viable EEHV cell culture will provide basic knowledge or allow additional findings:

   Test drug efficacy against the EEHV in vitro
   Provide the DNA to sequence EEHV genome
   Define the cell types EEHV attacks (tropism)
   Promote development of a more robust vaccine strategy
   Provide building blocks for development of attenuated vaccine
   Provide in vitro setting for evaluation of vaccine efficacy and efficiency
   Aid development of immunoassays
   Aid development of neutralization testing protocols

   Obstacles? Despite 15 years of effort, EEHV has not been sustainably propagated in vitro for a variety of factors, including the following challenges: lack of adequate fresh samples from ailing animals infected with the virus, lack of adequate or appropriate fresh tracheal wash samples from carriers, insufficient elephant cell lines (endothelial or fibroblast), and unsteady funding streams.

   Responsible Parties:

   - Gary Hayward (John Hopkins University, School of Medicine, USA (JHU))
   - Noha Abou-Madi (Cornell University College of Veterinary Medicine, USA)
   - Paul Ling and Jeff Stanton, Alan Herron, Thuy Phung (Baylor University, College of Medicine, USA (BCM))
   - Andrew Routh, Tim Bouts and Akbar Dasjerdi (Weybridge Veterinary Laboratories Agencies, UK)

   Resources Needed: $250,000 annually over 5-10 year timeline ($1,250,000)

2. **Develop a vaccine** (11/63 votes)

Action: Develop a vaccine candidate for use in susceptible elephant herds.

How? Recombinant DNA vaccine technology requires the insertion of a section of EEHV DNA (gB portion) into the modified vaccinia ankara (MVA) vaccine for delivery as a vectored vaccine. Subunit vaccine technology requires the identification of the major antigenic sites of EEHV, purification of the peptide protein, and addition of an immunogenic adjuvant for delivery as a purified protein preparation. Alternative methods of vaccine production may be considered as determined by changes in technology or knowledge regarding EEHV biology.

Why? Reduce morbidity and mortality from EEHV in Asian and African elephants; Prevent primary disease.

Obstacles? In progress work suggests the following challenges: international movement of samples and vaccine product, proper licensing for widespread clinical usage, vaccine production regulations, choice of appropriate vehicle for expression of the protein, work with the baculovirus, ability to purify the peptides containing the major antigenic site in sufficient quantities, availability of serologic assays to evaluate whether the vaccine stimulates a host immune response.

Responsible Parties:

- Willem Schaftenaar (Rotterdam Zoo)
- Byron Martina and Ab Osterhaus (Erasmus University, Rotterdam, Netherlands) – recombinant MVA & subunit vaccine
- Paul Ling and Jeff Stanton (Baylor University, College of Medicine, USA) – subunit vaccine

Resources Needed: $100,000 annually over 3 year timeline ($300,000)

3. **More sensitive serologic tests** (7/63 votes)

Action: Develop ELISA-like serologic testing to demonstrate host antibody response to all identified EEHV subtypes (EEHV1a, EEHV1b, EEHV2, EEHV3, EEHV4, EEHV5, EEHV6, EEHV7).

Why? Sensitive serologic testing will provide more disease and host information:

- Provide more accurate evidence of previous disease exposure in individuals
- Promote awareness of disease exposure across the elephant population
- Demonstrate evidence of host seroconversion to vaccination
- Monitor individuals and populations over time
- Allow in-depth epidemiologic study
- Provide prognostic information [possibility?]

Obstacles? The lack of complete sequencing of the EEHV genome (minimally EEHV1) and funding have challenged continued progress in serologic test development.

Responsible Parties:

- Gary Hayward (John Hopkins University, School of Medicine, USA) – sequencing and serologic test
- Erin Latimer (The National EEHV Laboratory - Smithsonian National Zoological Park, USA) – serologic test
- Willem Schaftenaar (Rotterdam Zoo), Byron Martina and Ab Osterhaus (Erasmus University Rotterdam, Netherlands) – parallel with vaccine work

Resources Needed: $67,000 annually over 3 year timeline ($200,000)

4. **More data//information from wild population** (6/63 votes)
Action: Collect data from range-country populations: India, Sri Lanka, Thailand, Sumatra, Borneo, South Africa (focus on India is proposed).

How? Data on disease presence and distribution is required to document existence of EEHV in non-captive elephants in range countries. Opportunistic blood collection, trunk wash, or necropsy samples may reveal presence of the EEHV antigen. Longer-term epidemiologic studies require additional information: demography, population characteristics, birth origin, life events (work-camp, temple/city association, orphan, captive periods, free-ranging). Additional clarification of desired data is required.

Why? Investigate frequency and prevalence of disease in free-ranging populations. Suggest EEHV not only disease of captive elephants

Obstacles? Opportunistic samples from animals handled for other objectives/studies/regulations may be more easily acquired than from data purpose-driven interventions on healthy wild animals. Epidemiology studies will be challenged by lack of comparative samples from healthy controls, lack of denominator information for entire population, as well as, sampling bias.

Responsible Parties:

- Arun Zachariah (Wildlife Disease Research Laboratory, Kerala, India)
- Erin Latimer (The National EEHV Laboratory - Smithsonian National Zoological Park, USA)
- Gary Hayward (John Hopkins University, School of Medicine, USA)
- Jeff Stanton (Baylor University, College of Medicine, USA)
- Peter Buss (Kruger National Park, South Africa)

Resources Needed: $100,000 annually over 3 year timeline ($300,000: 50% Asia & 50% Africa)

5. **Develop real-time PCR for other EEHV strains; trunk wash shedding studies** (5/63 votes)
   Action: Real time PCR machine located at a second testing facility (National Zoo) to expand current testing facilities able to run rtPCR samples. This is critical if the elephant community is to expand testing strategies to include regular sampling of trunk wash samples.

   Responsible Parties: Erin Latimer, NZP, Jeff Stanton/Paul Ling, BCM.

   Resources needed: US$60,000 (real-time PCR machine for National Zoo = $30K, disposables and reagents = $10K/year x three years)

6. **Evaluate drug efficacy (NOTE: this goal that was not ranked within the group but was ranked fourth highest overall in the plenary session.)**

   Goal: Develop reliable and repeatable methods for the testing of anti-EEHV drugs in vitro and in vivo, and assess the efficacy of supportive therapies and treatment modalities.

   Action: development of elephant cell culture and growth of EEHV in vitro required for efficacy testing, development of consistent recording sheet for documentation of treatments used in EEHV cases, retrospective review of modalities used and meta-analysis of treatment regimens.

   Responsible parties: Jon Cracknell, Ramiro Isaza, Ellen Wiedner, Lauren Howard

   Resources needed: Completion of elephant cell culture and in vitro growth of virus (see 1.), US$ 2,000 for study of retrospective review

Lower Priority Goals:

7. **Gain understanding of cellular immune response**: juveniles vs. adults; Asians vs. Africans (5/63 votes)
8. **Achieve consensus on consistent numbers and statistics** (3/63 votes)
   Includes definition of EEHV case, case permutations, and co-infections/disease (publish review article)
9. **Develop capacity/consistency of tests in Europe** (3/63 votes)
10. **Conduct epidemiology study** (3/63 votes) Verify content of current study (Ramiro Isaza, University of Florida); consider different angles, formulate research questions, ascertain dataset & factors considered
11. **Develop risk assessment and management strategy** (2/63 votes)
12. **Develop point-of-care** (field, elephant-side) **test for clinicians** (2/63 votes)
13. **Collect samples for pharamcokinetic/pharmacodynamic study of antivirals** (2/63 votes)

Additional Research Goals (0 votes):

- Prioritize sample requests; ensure best use of resources
    - Verify minimum and ideal sample volume
    - Consider in relation to other requests (e.g., IMLS Elephant Welfare Grant)
- Organize elephant necropsy protocol to ensure samples efficient and appropriate
- Provide drawings of anatomic structures to aid necropsy sample collection
- Collect more lung nodules
- Build capacity for laboratories
- Consider designated animals or herds for research contributions
- Identify appropriate adjuvant for elephant immune system
- Determine role data and samples from African elephant (neonates , adults) to add to knowledge base
- Establish genetics/pedigree/origin of affected animals as risk factor? - Sri Lanka, India, Thailand
- Study reactivation of latent virus and shedding of virus
- Monitor and collect information regarding survivors (n=9) in breeding situations and offspring from such
- Screen all elephants
- Investigate other diagnostic parameters (e.g., fibrin, haptin)

Disease Management Working Group Report

The working group reviewed the list of goals brainstormed in the plenary session and then prioritized them. Actions steps were identified for the six highest priority goals. The goals and the number of votes each received are listed below:

1. Create a resource list to include a discussion forum, suppliers, people, protocols, drugs, images, and staff training. (33 votes – 10 long-term, 23 short-term)
2. Standardization of recording of physiological data; develop ICU chart. (13 votes – 11 long term, 2 short term)
3. Establish baseline profile for each animal-internal; currently no in-house resources. (8 votes – 1 long term, 7 short term)
4. Standardization of testing of suspect clinical cases. (7 votes – 6 long term, 1 short term)
5. Design and create specialized equipment, e.g., for blood collection, delivery of medications, etc. (5 votes – 4 long term, 1 short term)
6. Create easy access to the drugs; web lab online, EMA. (1 vote – 1 long term, 0 short term)
7. Sedation protocols for disease diagnosis and therapy for affected animals. (1 vote – 1 long term, 0 short term)
8. Get pre-clinical samples (for herd mgmt group?) and recommendations for samples on sick and healthy animals. (0 votes)
9. Determine if drug dosages are high enough; need cultures, collect samples. (0 votes)
10. Create on-call transfusion list; high titer animals. (0 votes)
11. Share info from case studies, signs, and treatments. (0 votes)
12. Inform people about how to handle blood. (0 votes)
13. Prognostic indicators for treatment vs. euthanasia. (0 votes)

Goal 1: Create an EEHV information resource that meets the needs of all facilities, is a place where people can share experiences in a safe, secure environment, and where information of value to the elephant community is disseminated quickly and updated frequently. This resource will be designed to educate and raises awareness.

Action: Develop an on line resource (such as a website, listserve)

- Identify a host (EMA, IEF)
- Identify a point person/coordinator to moderate site
- Ensure that site is secure/private (consider beginning by posting only public information)
- Communicate site's existence to all relevant parties
- Make explicit on the site the difference between postings that are "recommendations" vs. sample documents
- Include a discussion board or forum
- Provide an Alerts section

Responsible Parties: Andrew Smith, Deborah Olson, Daryl Hoffman, Jon Cracknell

Timeline: By 1 April 2011 will report back to group via email
Website up by 1 July 2011

Goal 2: Recommend establishing a baseline profile for each animal to serve as a reference during growth and development, against which an animal in ill health can be compared to aid in diagnosis of EEHV.

Action: Form a subcommittee to establish which parameters would be best to monitor for all stakeholders (zoos, privately owned animals, international colleagues)

Responsible parties: Kelly Helmick, Doug Whiteside to establish subcommittee

Timeline: Subcommittee will be established by COB 25 Jan 2011 – includes Kelly Helmick, Doug Whiteside, Jon Cracknell, Ellen Wiedner, Lauren Howard and Willem Schaftenaar
Reporting: NO DATE SET

Goal 3: Standardization of recording physiological data on clinical cases to enable comparisons of outcome to a standard database of objectively measured animal conditions and therapies delivered.

Action 1: Adopt a standard ICU form

Responsible party: Jon Cracknell will distribute an existing draft form to workshop participants

Timeline: Draft form now available from Jon Cracknell (jonwildvet@gmail.com)
Document finalized by 1 July 2011

Action 2: Communicate availability of document to people to all interested parties and encourage its use

Responsible party: None identified

Timeline: No completion date stated

Goal 4: Design and build equipment to facilitate treatment of elephants (Mila-potential source, http://milainternational.com/)

Action: Investigate specialized equipment for use in treatment delivery

Responsible party: Jim Oosterhuis to pursue

Timeline: Update by 1 July 2011

Goal 5: Standardization of testing for "suspect" clinical cases to develop credible dataset to assist in diagnosis of EEHV.

Action: Set up subcommittee

Responsible parties: Kelly Helmick, Jon Cracknell

Timeline: NO DATE SET

Goal 6: Increase access to drugs to allow for rapid administration of therapy in acute and peracute cases.

Action: Investigate availability of drugs

Responsible Party: Lisa Marie Avendano

Timeline: Update by 1 July 2011

Public Relations and Funding Working Group Report

The Public Relations and Funding working group defined seven primary goals. These goals are listed below, in order of priority. Six specific goals were developed further, and action steps to implement those goals were identified.

1) Funding acquisition/distribution (18 votes)
   - Business model for lab support
   - Statement of funding needs for herpes labs
   - Develop new funding streams
   - How to integrate with EU
   - Statement of needs from labs
   - Mechanism for distribution of funding
   - Accounting system to handle donations and disbursements

2) Build relationships w/pharmaceutical companies – developing purchasing power, donations (0 votes)

3) Drug registry and exchange program w/ zoos (4 votes)

4) OIE recognition of herpesvirus in elephants similar to chytrid (0 votes)

5) International collaboration and cooperation-keeping what we have done at this workshop alive (11 votes)

6) Internal messaging for our community (7 votes)
   - One page statement regarding state of science, treatment etc
   - Professional Education - Presence at conferences and schools to get the word out
   - Distribute info form from 1 source (website?)

7) External media plan (7 votes)
   - Glossy publication including lots of baby elephant pictures
   - Press release at close of this workshop
   - Provide/use laymen's terms for publications and background info
   - Develop generic info pack for media
   - Engage w/FDA/USDA
   - Engage with local humane society
   - Celebrity spokesperson to champion cause – Water for Elephants stars?

Goal 1: Ensure adequate funding for the laboratories responsible for the testing of herpes-relevant elephant samples.

Action 1: Develop a business model to ensure adequate funding for the laboratories responsible for the testing of herpes-relevant elephant samples. Lab funding is the priority of this business model, and any "excess" funds will go to research. The first action will be to identify the funding needs of each lab. Consider creating a consortium of institutions that contribute to support the labs. Perhaps consortium members get tests run for free, while non-contributors pay a fee for samples run. Depending on how the increased load of testing affects the lab(s), there may need to be a "surcharge" for everyone for increased pre + post shipment.

Responsible Parties: Rick Barongi, Martha Fischer, Deborah Olson, Dennis Kelly

Timeline: 1 year

Goal 2: Identify new revenue streams to support labs and research including corporate sponsors and private individuals at the individual institution level and at the national (AZA) level.

Action 1: Developing messaging for solicitation of new donors. Enlist help of development departments in elephant-holding institutions to create messages and materials, and to identify potential donors. Consider recruitment of a celebrity spokesperson (excellent opportunity presented to capitalize on "Water for Elephants"). Consider using live elephants to raise funds. Packaging the request for funding for herpes work with other requests for support of broader elephant conservation projects may be effective.

Responsible parties: Sharon Joseph, Tracy Clippinger, Deborah Olson

Timeline: Messages and materials will be prepared and distributed within 1 year

Action 2: Elephant holding institutions will collaborate in the pursuit of grants. This will require improved communication so that collaborating institutions are aware of what proposals are pending, what proposals are successful, and what granting agencies should be under consideration.

Responsible parties: Tim, Lauren Howard, Laura Richman, Deborah Olson. Coordinate with those working on the web clearinghouse of EEHV information (Jon Cracknell, Andrew Smith, Deborah Olson, and Daryl Hoffman)

Timeline: 6 months

Goal 3: Maintain and enhance international collaboration/cooperation so that research, treatment, and resources can be shared to assist all in dealing with herpes in elephants.

Actions:

- Continue to convene EEHV workshops regularly
- Encourage EEHV session/workshop as part of IEF research symposium and ensure participation of international colleagues when meeting in US and US participation when meeting elsewhere
- Encourage EEHV session at EMA, AAZV, etc.
- Promote academic collaboration in research
- Support research work in EU and in elephant range countries
- Explore the potential for vet schools to sponsor students to travel to range countries
- Make a list of labs, projects, treatment, etc., available on the EEHV website

Responsible parties: Andrew Routh, Jon Cracknell, Tim Bouts, Tracy Clippinger, Noha Abou-Madi

Timeline: 6 months

Goal 4: Greater, more affordable access to drugs necessary for EEHV treatment.

Action 1: Develop a drug registry of antivirals and a drug exchange program among zoos.

Responsible parties: Sharon Joseph, Lisa Marie Avendano, Lauren Howard, Erica Wilson

Timeline: TBD

Action 2: Build relationships with pharmaceutical companies and distributors to help with anti-viral acquisition

Responsible parties: Lisa Marie Avendano, Sharon Joseph, Erica Wilson

Timeline: TBD

Goal 5: Internal Messaging – to ensure consistency of communications about this disease within our professional communities.

Action: Create an internal messaging overview of EEHV and then distribute to others for review. Tailor some messages for specific audiences.

Responsible parties: Laura Richman, Gary Hayward, Baylor College of Medicine, Jon Cracknell

Timeline: March 15

Goal 6: External Messaging – to ensure that we are communicating with accuracy and consistency to those outside of our professional community and that we are presenting information in a way that garners support.

Action: Develop a packet of information that can be used as part of a media plan and that could also be used for fund-raising purposes.

Responsible parties: Brian Hill, Steve Feldman, Jill Alread, Gigi Allianic, Deborah Olson, Ringling Bros. PR Staff

Timeline: TBD

Herd Monitoring and Herd Management Working Group Report

The working group reviewed the list of goals brainstormed in the plenary session, consolidated them into five overarching goals, and prioritized those. Actions steps were identified for the two highest priority goals. The goals and the number of votes each received are listed below:

Goals:

- Define and identify non-case population to determine if EEHV is an emergent disease
- Define non-case population to provide accurate denominator for statistics and to determine if EEHV is an emergent disease
- Consider linking comprehensive sample collection (blood, TW) to TB surveillance requirements
- Describe concrete risk assessment/management factors regarding transfer and breeding recommendations in light of EEHV
- Establish and ensure implementation of rigorous monitoring of all animals to be transferred
- ID most significant samples to collect in situations with animals in new/unfamiliar situation after transfers
- Define normal parameter for age groups (e.g. ISIS, MedARKS data)/Collate reference ranges for healthy juvenile elephants
- Expand study population (n=23 TW shedding n=300 NA)
- Screen all elephants
- Clarify samples needed from breeding/EEHV affected herds vs. other non-breeding/geriatric herds
- Consider designated animals/herds for research contributions (non-breeding institutions)
- Determine role of data and samples from African elephants (adults, juveniles to increase knowledge
- Determine if survivors are hyper-immune (can't do until research done)

Goals as consolidated and prioritized:

1. Define and identify non-case population (0 votes)
    - Denominator for statistics
    - Is EEHV an emergent disease

2. Link EEHV monitoring with TB screening through USDA (1 vote)

3. Risk assessment for transfers (29 votes)
    - Pre- and post-monitoring
    - sample collection

4. Define normal parameters for all age groups (1 vote)

5. Screen all elephants (30 votes)
   - Non-breeding elephants
   - African elephants
   - Samples needed

Note: the first goal was removed from consideration because the group felt that the epidemiological study currently underway by Dr. Ramiro Isaza will address this objective.

Goal 1: Screening of all elephants (African and Asian)
Rationale. All captive elephants should be screened for EEHV via serology (ELISA) and PCR of trunk wash, urine, blood (whole blood and serum), semen, feces, and swabs of ocular, musth gland, or other secretions. These samples will provide additional information about virus prevalence, number of existing strains, viral transmission, risks, and may assist in greater public understanding, dispelling the myth of "hot spots." PCR testing of individual animals is recommended by the Baylor College of Medicine team at a minimum of 1-2 times/week for 4-6 weeks. The National Elephant Herpes Lab is testing elephants participating in a nation-wide, blinded study using weekly samples for a two-year duration. Testing is by ELISA on serum and PCR of whole blood. Ideally, all animals will be tested but if resources are limited, a targeted population of animals at highest risk (calves and pregnant cows) should be priority.

Obstacles. Perceived obstacles to testing are resistance from individuals or institutions that may not want to know their herd or individual elephant status because of the potential impact on management decisions. The two facilities (Baylor College of Medicine and the National Zoo's EEHV Laboratory) currently running assays cannot handle all the submissions if all US facilities were to submit samples on all their animals. Institutions with elephants would need to secure storage space and bank samples until the labs could process samples. Samples which are partially "processed" prior to submission (such as preparation of a trunk wash sample into a concentrated pellet) would have reduced value due to potential variability of handling and processing at multiple facilities.

Levels of animal training vary between institutions. Although AZA mandates that zoos train animals to accept routine blood collection and other medical and husbandry procedures, some zoos are not able to comply with all husbandry behaviors. Shipment of samples can be problematic, especially when transfers are across international borders. And finally, many institutions have limited resources of staff, time, and finances, and have to choose between multiple projects when they acquire samples.

There is ongoing screening of selected samples from all elephants in AZA facilities. Whole blood and serum from any elephant held in the United States has been accepted by the National Zoo's EEHV Laboratory for the past several years. Additional samples (trunk wash, urine, etc.) are assayed by BCM on an invitational basis from high priority herds (herds

with known recent mortality and currently high risk animals). A list of the highest priority samples and highest priority animals should be created by the AZA Elephant TAG/SSP. The TAG/SSP should prioritize research studies and requests, but individual zoos will need to identify to what extent they can comply with requests based on their abilities. Every effort should be made to make the best use of each sample.

While it is important for priorities to be established on a national basis, individual zoos need to prioritize their ability to comply with requests in accordance with their animal management ability and resource availability. Zoos that have the resources and capability should participate to the fullest extent possible in order to "lead by example." It is thought that capacity to analyze more samples will expand in the next 1-2 years so that as more zoos come "on line" the labs will be able to accommodate the work load.

Action 1: The Elephant TAG/SSP will develop a list of highest priority animals for screening.

Responsible parties: Martha Fischer and TAG/SSP Steering Committee

Timeline: TBD, discussion to occur at the group's mid-year meeting in May 2011.

Action 2: The Elephant TAG/SSP will review and revise annually the research request document distributed in August 2010. All institutions will be individually responsible for understanding the information presented in this document and applying that knowledge.

Responsible parties: Martha Fischer and TAG/SSP Steering Committee; each individual institution holding elephants

Timeline: Annual

Action 3: Update "the website" with information and recommendations on calf training, methods of sample collection and handling, and opportunistic samples that would be desired. Information will also be posted here to serve as a guide for institutions participating in EEHV screening and assessment.

Responsible parties: Jon Cracknell, Jeff Stanton

Timeline: Upon development of website (1 July 2011)

Goal 2: Create a risk assessment for transfers

Rationale. Currently, there is a recommendation from the TAG/SSP to test all animals prior to and after animals are moved. However, the level of compliance with this recommendation is unknown. Elephants are to be tested by ELISA for serum antibody levels and by PCR for antigen in blood. It appears that trunk wash samples may also be an indicator of viral infection/shedding and consideration should be given to including trunk washes in the screening process.

Obstacles. There is currently limited information about EEHV disease transmission, making it difficult to come to agreement about how screening results should be factored into transfer and breeding recommendations. At the present time it is thought the only action warranted is to collect data (see screen all animals goal) until there is enough information to analyze in order to determine if transfers are associated with increased risk for an EEHV case.

Action 1: Review recent elephant transfers to determine compliance with screening recommendations

Responsible parties: Martha Fischer and TAG/SSP Steering Committee

Timeline: at mid-year meeting in May 2011

Action 2: Distribute EEHV information to elephant facilities through these workshop proceedings and the EEHV-specific website being developed

Responsible parties: Jon Cracknell and Sharon Joseph

Timeline: Workshop proceeding distributed by 28 February 2011; website up and running by 1 July 2011

Action 3: Develop TAG/SSP position statement on the transfers of elephants as they relate to EEHV status

Responsible parties: Martha Fischer and TAG/SSP Steering Committee

Timeline: At mid-year TAG meeting in May 2011