2023 Fall Board Meeting

Board on Animal Health Sciences, Conservation, and Research

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TUESDAY, OCTOBER 17, 2023

OPEN SESSION

10:30am–10:45am ET

Opening Remarks and Introductions
Robert Dysko, University of Michigan
Barbara Natterson-Horowitz, University of California Los Angeles

10:45am–12:30pm ET

Keynote Discussions: Contributions of Research with Animals to Biological and Health Sciences
During this discussion, speakers will describe how research with animals broadly can be relevant to elucidating fundamental biological processes and applications for animal and human health. Following formal presentations by the keynote speakers, board members will have opportunities to engage in interactive dialogue with both.

Moderator
Robert Dysko, University of Michigan

Speakers

What dogs wish we knew about their diseases, morphology and behavior
Elaine A. Ostrander, National Human Genome Research Institute

Studying the dynamics of pathogens in reservoir hosts to understand spillover risk
Raina Plowright, Cornell University

12:30pm–1:15pm ET

Lunch

1:15pm–4:15pm ET

Panel Discussion: Frontiers in Animal Health Sciences, Conservation, and Research

During this discussion, speakers will discuss different contexts for research with animals, including those involved in research, zoos and aquaria, and wild and semi-wild environments. Various scientific and animal welfare issues will be raised during the formal presentations and discussions with board members and other panelists.

Moderator

Barbara Natterson-Horowitz, University of California Los Angeles

Speakers

Perspectives on the Care and Welfare of Research Animals
F. Claire Hankenson, University of Pennsylvania

The Deepwater Horizon Oil Spill Case Study: Applying Navy Dolphin Medicine to Conservation Medicine for Small Cetaceans
Cynthia Smith, National Marine Mammal Foundation

One health surveillance to detect and understand zoonotic risk in wildlife, domestic animals and people
Tracey Goldstein, One Health Institute at Colorado State University

Beyond Fences: Policy Options for Wildlife, Livelihoods and Transboundary Animal Disease Management in Southern Africa
Steve Osofsky, Cornell Wildlife Health Center at Cornell University

International Policy and U.S. leadership: Examples of Foreign Policy Intersections and Impacts
Rowena Watson, U.S. Department of State

END OF DAY 1

RELEVANT ARTICLES

- Freire, R., & Nicol, C. (2019). A bibliometric analysis of past and emergent trends in animal welfare science. Animal Welfare, 28(4), 465-485. doi:10.7120/09627286.28.4.465

- Robert R Fitak, Jennifer D Antonides, Eric J Baitchman, Elisa Bonaccorso, Josephine Braun, Steven Kubiski, Elliott Chiu, Anna C Fagre, Roderick B Gagne, Justin S Lee, Jennifer L Malmberg, Mark D Stenglein, Robert J Dusek, David Forgacs, Nicholas M Fountain-Jones, Marie L J Gilbertson, Katherine E L Worsley-Tonks, W Chris Funk, Daryl R Trumbo, Bruno M Ghersi, Wray Grimaldi, Sara E Heisel, Claire M Jardine, Pauline L Kamath, Dibesh Karmacharya, Christopher P Kozakiewicz, Simona Kraberger, Dagan A Loisel, Cait McDonald, Steven Miller, Devon O'Rourke, Caitlin N Ott-Conn, Mónica Páez-Vacas, Alison J Peel, Wendy C Turner, Meredith C VanAcker, Sue VandeWoude, Jill Pecon-Slattery, The Expectations and Challenges of Wildlife Disease Research in the Era of Genomics: Forecasting with a Horizon Scan-like Exercise, Journal of Heredity, Volume 110, Issue 3, May 2019, Pages 261–274, https://doi.org/10.1093/jhered/esz001

- Escribano, N., Ariño, A. H., Pino-del-Carpio, A., Galicia, D., & Miranda, R. (2021). Global trends in research output by zoos and aquariums. Conservation Biology, 35(6), 1894-1902.

- Levin, L. H., and L. J. Muglia. 2022. Alternative Thinking about Animals in Research. NAM Perspectives. Commentary, National Academy of Medicine, Washington, DC. https://doi.org/10.31478/202211a.

- Homberg, J. R., Adan, R. A., Alenina, N., Asiminas, A., Bader, M., Beckers, T., ... & Genzel, L. (2021). The continued need for animals to advance brain research. Neuron, 109(15), 2374-2379.

- Crew. B. 2021. Pandemic puts spotlight on animal experimentation choices. Nature. https://www.nature.com/nature-index/news/pandemic-puts-spotlight-on-animal-experimentation-choices

- Kelly, D.M., Lea, S.E.G. Animal cognition, past present and future, a 25th anniversary special issue. Anim Cogn 26, 1–11 (2023). https://doi.org/10.1007/s10071-022-01738-x

- Domínguez-Oliva A, Hernández-Ávalos I, Martínez-Burnes J, Olmos-Hernández A, Verduzco-Mendoza A, Mota-Rojas D. The Importance of Animal Models in Biomedical Research: Current Insights and Applications. Animals. 2023; 13(7):1223. https://doi.org/10.3390/ani13071223

- de Castañeda, R. R., Villers, J., Guzmán, C. A. F., Eslanloo, T., de Paula, N., Machalaba, C., ... & Bolon, I. (2023). One Health and planetary health research: leveraging differences to grow together. The Lancet Planetary Health, 7(2), e109-e111.

Suggested reading from Tracey Goldstein:

- 2021 Wells, HL, Letko M, Lasso G, Ssebide B Nziza J, Byarugaba DK, Navarrete-Macias I, Liang E, Cranfield M, Han BA, Tingley MW, Diuk-Wasser M, Goldstein T, Johnson CK, Mazet J, Chandran K, Munster VJ, Gilardi K, Anthony S. The evolutionary history of hACE2 usage within the coronavirus subgenus Sarbecovirus. Virus Evolution, Virus Evolution, 2021, 7(1): veab007.

- 2020 Amman BR, Bird BH, Bakarr IA, Bangura J, Schuh AJ, Johnny J, Sealy TK, Conteh I, Koroma AH, Foday I, Amara E, Bangura AA, Gbakima AA, Tremeau-Bravard A, Belaganahalli M, Dhanota J, Chow A, Ontiveros V, Gibson A, Turay J, Patel K, Graziano J, Bangura C, Kamanda E, Osborne A, Saidu E, Musa J, Bangura D, Williams SMT, Wadsworth R, Turay M, Lavalie E, Mereweather-Thompson V, Kargbo D, Bairoh F, Kanu M, Robert W, Lungay V, Emeric R, Coomber M, Kanu O, Jambai A, Kamara SM, Taboy CH, Singh T, Mazet JAK, Nichol ST, Goldstein T, Towner JS, Lebbie A. Isolation of Angola- like Marburg virus from Egyptian rousette bats from West Africa. Nature Communications,11:510. https://doi.org/10.1038/s41467-020-14327-8.

- 2019 VanWormer E, Mazet JAK, Hall A, Gill VA, Boveng PL, London JM, Gelatt T, Fadely BS, Lander MA, Sterling J, Burkanov VN, Ream RR, Brock PM, Rea LD, Smith BR, Jeffers A, Henstock M, Rehberg MJ, Burek-

Huntington KA, Cosby SL, Hammond JA, Goldstein T. Viral emergence in marine mammals in the North Pacific may be linked to Arctic sea ice reduction. Scientific Reports, 9: 15569, doi:10.1038/s41598-019-51699-4.

- 2018 Goldstein T, Anthony SJ, Gbakima A, Bird BH, Bangura J, Tremeau-Bravard A, Belaganahalli MN, Wells H, Dhanota JK, Liang E, Lasso G, Smith BR, Jambai A, Kamara BO, Kamara S, Bangura W, Monagin C, Shapira S, Johnson CK, Saylors K, Rubin EM, Lipkin WI, Mazet JAK. The discovery of Bombali virus adds further support for bats as hosts of ebolaviruses. Nature Microbiology, 3: 1084-1089.

- 2017 Anthony SJ, Johnson CK, Greig DJ, Kramer S, Che X, Wells H, Hicks AL, Joly DO, Wolfe ND, Daszak P, Karesh W, Lipkin WI, Morse SS, PREDICT Consortium, Mazet JAK, Goldstein T. Global patterns in coronavirus diversity. Virus Evol, 3(1): vex012.

- 2017 Anthony SJ, Gilardi K, Menachery VD, Goldstein T, Ssebide B, Mbabazi R, Navarrete-Macias I, Liang E, Wells H, Hicks A, Petrosov A, Byarugaba DK, Debbink K, Dinnon KH, Scobey T, Randell SH, Yount BL, Cranfield M, Johnson CK, Baric RS, Lipkin WI, Mazet JAK. Further Evidence for Bats as the Evolutionary Source of Middle East Respiratory Syndrome Coronavirus. mBio, 8(2): e00373-17.

- 2016 Mazet JAK, McDermott H, Goldstein T: Chapter 14: One Health in the Twenty-first Century, McNabb SJN, Conde JM, Ferland L, MacWright W, Memish Z, Okutani S, Park M, Ryland P, Shaik Singh V, (ed), Transforming Public Health Surveillance, 1st Edition, Proactive Measures for Prevention, Detection, and Response, Elsevier, 181-91.

Selected citations from Steven A. Osofsky, DVM:

General Audience

- Osofsky, S. 2019. “Of Animal Germs and Pachyderms: A Novel Approach for Making Africa’s Largest Transfrontier Conservation Area a Success,” https://blogs.scientificamerican.com/observations/of-animal-germs-and-pachyderms/.

- Osofsky, S. A. and R. D. Taylor, 2021. “Piecing Together an African Peace Park,” Science, vol. 373 (6557): 864. https://doi.org/10.1126/science.abl7447

Peer-Reviewed Literature

- Thomson, G. R., Penrith, M.-L., Atkinson, M. W., Atkinson, S. J., Cassidy, D., and S. A. Osofsky. 2013. “Balancing Livestock Production and Wildlife Conservation in and around Southern Africa's Transfrontier Conservation Areas,” Transboundary and Emerging Diseases, vol. 60 (6): 492–506. http://dx.doi.org/10.1111/tbed.12175

- Thomson, G. R., Penrith, M.-L., Atkinson, M. W., Thalwitzer, S., Mancuso, A., Atkinson, S. J., and S. A. Osofsky. 2013. “International Trade Standards for Commodities and Products Derived from Animals: The Need for a System that Integrates Food Safety and Animal Disease Risk Management,” Transboundary and Emerging Diseases, vol. 60 (6): 507–515. http://dx.doi.org/10.1111/tbed.12164

Editorials

- Karesh, W. B., Osofsky, S. A., Rocke, T. E., and P. L. Barrows. 2002. “Joining Forces to Improve Our World,” Conservation Biology, vol. 16 (5): 1432-1434. http://www.wcs-ahead.org/documents/pilanesberg.pdf

- Osofsky, S. A. 2019. “The Global Burden of (How We Manage) Animal Disease: Learning Lessons from Southern Africa,” Journal of Wildlife Diseases, vol. 55 (4): 755-757. https://meridian.allenpress.com/jwd/article/55/4/755/442072/THE-GLOBAL-BURDEN-OF-HOW-WE-MANAGE-ANIMAL-DISEASE

Edited Volume

- Osofsky, S. A., Cleaveland, S., Karesh, W. B., Kock, M. D., Nyhus, P. J., Starr, L., and A. Yang, (eds.). 2005. Conservation and Development Interventions at the Wildlife/Livestock Interface: Implications for Wildlife, Livestock and Human Health. IUCN, Gland, Switzerland and Cambridge, United Kingdom. xxxiii and 220 pp. http://www.wcs-ahead.org/wpc_launch.html

Book Chapters

- Osofsky, S. A., Kock, R. A., Kock, M. D., Kalema-Zikusoka, G., Grahn, R., Leyland, T., and W. B. Karesh. 2005. "Building Support for Protected Areas Using a 'One Health' Perspective," pp. 65-79, in McNeely, J. A. (ed.) Friends for Life: New Partners in Support of Protected Areas. IUCN, Gland, Switzerland and Cambridge, United Kingdom.

- Osofsky, S. A., Cumming, D. H. M., and M. D. Kock. 2008. "Transboundary Management of Natural Resources and the Importance of a 'One Health' Approach: Perspectives on Southern Africa," pp. 89-98, in Fearn, E. and K. H. Redford (eds.) State of the Wild 2008-2009: A Global Portrait of Wildlife, Wildlands, and Oceans. Island Press, Washington, D. C.

- Barrett, M. A. and S. A. Osofsky. 2013. "One Health: Interdependence of People, Other Species, and the Planet," pp. 364-377 (and online supplement pp. 407(e1)-416(e10) at studentconsult.com), in Katz, D. L., Elmore, J. G., Wild, D. M. G., and S. C. Lucan (eds.) Jekel's Epidemiology, Biostatistics, Preventive Medicine, and Public Health (4th ed.). Elsevier / Saunders, Philadelphia, Pennsylvania.

- Cumming, D. H. M., Osofsky, S. A., Atkinson, S. J., and M. W. Atkinson. 2015. "Beyond Fences: Wildlife, Livestock and Land Use in Southern Africa," pp. 243-257, in Zinsstag, J., Schelling, E., Waltner-Toews, D., Whittaker, M., and M. Tanner (eds.) One Health: The Theory and Practice of Integrated Health Approaches. C.A.B. International, Oxfordshire, United Kingdom.

White Papers, Guidelines, Proceedings and other Peer Outreach

- D'Amico Hales, J., Osofsky, S. A., and D. H. M. Cumming. 2004. "Wildlife Health in Africa: Implications for Conservation in the Decades Ahead," pp. 129-130, in Burgess, N., D'Amico Hales, J., Underwood, E., Dinerstein, E., Olson, D., Itoua, I., Schipper, J., Ricketts, T., and K. Newman (eds.) The Terrestrial Ecoregions of Africa and Madagascar: A Conservation Assessment. Island Press, Washington, D. C.

- Cook, R.A., Karesh, W.B., and S. A. Osofsky. 2004. *The Manhattan Principles on 'One World, One Health'*: Building Interdisciplinary Bridges to Health in a Globalized World, New York, Wildlife Conservation Society. http://www.oneworldonehealth.org/sept2004/owoh_sept04.html

- Atkinson, S. J., Bing, M., McNutt, J. W., Marshall, C., Masedi, M., Osofsky, S. A., Penrith, M-L., Ramsden, N., Ross, K. S., Thomson, G. R., van Rooyen, J., and R. W. Worobo. 2019. "Gap Analysis on the Implementation of Commodity-Based Trade of Beef in Ngamiland, Botswana." Report prepared in consultation with the Government of Botswana's Department of Veterinary Services. *AHEAD* Program, Cornell University. 120 pp. http://www.wcs-ahead.org/kaza/rpt-cbt-gap-analysis-ngamiland-final-190912.pdf

- SADC, AHEAD. 2021. Guidelines on Commodity-Based Trade Approaches for Managing Foot and Mouth Disease Risk in Beef in the SADC Region, 4th Edition. Southern African Development Community, Animal & Human Health for the Environment And Development, Gaborone, Botswana & New York, USA. 16 pp. ISBN: 978-99968-919-2-2, https://www.sadc.int/document/guidelines-commodity-based-trade-approaches-managing-foot-and-mouth-disease-risk-beef-sadc

Film

- *Beauty and the Beef: Achieving Compatibility between Wildlife Conservation and Livestock Production*

Additional reading material from Raina K. Plowright:

- Eby, P., A. J. Peel, W. Madden, J. R. Giles, P. J. Hudson, and R.K. Plowright. Pathogen spillover driven by rapid changes in bat ecology. *2023. Nature.* doi.org/10.1038/s41586-022-05506-2.

- Becker, Daniel, Peggy Eby, Wyatt Madden, Alison Peel, and Raina K. Plowright. Ecological Conditions Experienced by Bat Reservoir Hosts Predict the Intensity of Hendra Virus Excretion over Space and Time

- Vora, NM, L Hassan, RK Plowright, R Horton, S Cook, N Sizer, and A Bernstein. The Lancet–PPATS Commission on Prevention of Viral Spillover: reducing the risk of pandemics through primary prevention. *The Lancet*. https://doi.org/10.1016/S0140-6736(23)01064-4.

- TJ Lunn, B Borremans, DN Jones, MK Kessler, AS Dale, KC Yinda, M Ruiz-Aravena, CA Falvo, D Crowley, JO Lloyd-Smith, VJ Munster, P Eby, H McCallum, PJ Hudson, O Restif, LP McGuire, IL Smith, Bat One Health Group, RK Plowright*, Alison J. Peel* (*joint senior authors). Periodic shifts in viral load increase risk of spillover from bats. *2023*. Preprint: doi: https://doi.org/10.1101/2023.09.06.556454

- Plowright R.K., J. K. Reaser, H. Locke, S. Woodley, J. A. Patz, D. J. Becker, G. Oppler, Peter J. Hudson, and G. Tabor. Land use-induced spillover: A call to action to safeguard environmental, animal, and human health. *2021. Lancet Planetary Health*. doi.org/10.1016/ S2542-5196(21)00031-0

- Plowright, R.K., D.J. Becker, H. McCallum, and K. Manlove. Sampling to elucidate the dynamics of infections in reservoir hosts. *2019*. 374(1782). *Philosophical Transactions of the Royal Society B: Biological Sciences.*

- Plowright, R.K., C. Parrish, H. McCallum, P.J. Hudson, A. Ko, A. Graham, J. Loyd-Smith. Pathways to zoonotic spillover. 2017. 15(8), 502-510. *Nature Reviews Microbiology*. doi:10.1038/nrmicro.2017.45. *Made free to access during COVID-19 pandemic

- Plowright, R.K., A. Peel, D. Streicker, A. Gilbert, H. McCallum, J. Wood, M. Baker, and O. Restif. Transmission or within-host processes driving pulses of infection in reservoir hosts. 2016. *PLoS Neglected Tropical Diseases.* 10(8):e0004796.

Key articles relevant to Cynthia Smith's discussion:

- The *Deepwater Horizon* oil spill marine mammal injury assessment**.** Takeshita R, Sullivan L, Smith CR, Collier T, Hall A, Brosnan T, Rowles T, Schwacke L. Endang Species Res. 2017; 33:95-106.
- A review of the toxicology of oil in vertebrates: what we have learned following the *Deepwater Horizon* oil spill. Takeshita R, Bursian SJ, Colegrove KM, Collier TK, Deak K, Dean KM, De Guise S, DiPinto LM, Elferink CJ, Esbaugh AJ, Griffitt RJ, Grosell M, Harr KE, Incardona JP, Kwok RK, Lipton J, Mitchelmore CL, Morris JM, Peters ES, Roberts AP, Rowles TK, Rusiecki JA, Schwacke LH, Smith CR, Wetzel DL, Ziccardi MH & Hall AJ. Journal Toxicol and Environ Health 2021 Part B 24:8, 355-394.

- Modeling population effects of the *Deepwater Horizon* oil spill on a long-lived species. Schwacke LH, Marques TA, Thomas L, Booth CG, Balmer BC, Barratclough A, Colegrove K, De Guise S, Garrison LP, Gomez FM, Morey JS, Mullin KD, Quigley BM, Rosel PE, Rowles TK, Takeshita R, Townsend FI, Speakman TR, Wells RS, Zolman ES, Smith CR. Conserv Biol. 2022 Aug;36(4):e13878.

- Poor pulmonary health in Barataria Bay dolphins in the eight years following the *Deepwater Horizon* oil spill. Smith CR, Rowles TK, Gomez FM, Ivančić M, ColegroveKM, Takeshita R, Townsend FI, Zolman ES, Morey JS, Cendejas V, Meegan JM, Musser W, Speakman TR, Barratclough A, Wells RS, Schwacke LH. (2022) Frontiers in Marine Science, 9.

- Slow recovery of Barataria Bay dolphin health following the *Deepwater Horizon* oil spill (2013-2014) with evidence of persistent lung disease and impaired stress response**.** Smith CR, Rowles TK, Hart LB, Townsend FI, Wells RS, Zolman ES, Balmer BC, Quigley B, Ivancic M, McKercher W, Tumlin MC, Mullin KD, Adams JD, Wu Q, McFee W, Collier TK, Schwacke LH. Endanger Species Res 2017; *33:127-142.*

- Health of common bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, following the *Deepwater Horizon* oil spill. Schwacke LH, Smith CR, Townsend FI, Wells RS, Hart LB, Balmer BC, Collier TK, DeGuise S, Fry MM, Guillette LJ Jr, Lamb SV, Lane SM, McFee WE, Place NJ, Tumlin MC, Ylitalo GM, Zolman ES, Rowles TK. *Environ Sci Technol* 2014; 48(1):93-103.

- Health assessments of common bottlenose dolphins (*Tursiops truncatus*): past, present, and potential conservation applications**.** Barratclough A, Wells RS, Schwacke LH, Rowles TK, Gomez FM, Fauquier DA, Sweeney JC, Townsend FI, Hansen LJ, Zolman ES, Balmer BC, Smith CR. Front Vet Sci. 2020 Dec 13;6:444.

- Low reproductive success rates of common bottlenose dolphins (*Tursiops truncatus*) in the northern Gulf of Mexico following the *Deepwater Horizon* disaster (2010-2015). Kellar NM, Speakman TR, Smith CR, Lane SM, Balmer BC, Trego ML, Catelani KN, Robbins MN, Allen CD, Wells RS, Zolman ES, Rowles TK, Schwacke LH. Endanger Species Res 2017; 33:143-158.

- Reproductive outcome and survival of common bottlenose dolphins sampled in Barataria Bay, Louisiana, USA, following the *Deepwater Horizon* oil spill. Lane SM, Smith CR, Mitchell J, Balmer BC, Barry KP, McDonald T, Mori CS, Rosel PE, Rowles TK, Speakman TR, Townsend FI, Tumlin MC, Wells RS, Zolman ES, Schwacke LH. *Proc Biol Sci.* 2015; 282(1818):20151944.

- Biochemical and hematological biomarkers of reproductive failure in bottlenose dolphins, *Tursiops truncatus*. Barratclough A, Gomez FM, Morey JS, Meegan JM, Parry C, Schwacke L, Jensen ED, Smith CR. Dis Aquat Organ. 2021 May 27;144:197-208.

- Pregnancy profiles in the common bottlenose dolphin (Tursiops truncatus): Clinical biochemical and hematological variations during health gestation and a successful outcome. Barratclough A, Gomez FM, Morey JS, Deming A, Parry C, Meegan JM, Carlin KP, Schwacke L, Venn-Watson S, Jensen ED, Smith CR. Theriogenology. 2020 Jan 15;142:92-103.

- Ultrasonographic findings associated with normal pregnancy and fetal well-being in the bottlenose dolphin (*Tursiops truncatus*). Ivančić M, Gomez FM, Musser WB, Barratclough A, Meegan JM, Waitt SM, Cárdenas Llerenas A, Jensen ED, Smith CR. Vet Radiol Ultrasound. 2020 Mar;61(2):215-226.

- Cardiac assessments of bottlenose dolphins (*Tursiops truncatus*) in the Northern Gulf of Mexico following exposure to *Deepwater Horizon* oil. Linnehan BK, Gomez FM, Huston SM, Hsu A, Takeshita R, Colegrove KM, Harms CA, Barratclough A, Deming AC, Rowles TK, Musser WB, Zolman ES, Wells RS, Jensen ED, Schwacke LH, Smith CR. PLoS One. 2021 Dec 14;16(12):e0261112.

- Accurate epigenetic aging in bottlenose dolphins (*Tursiops truncatus*), an essential step in the conservation of at-risk dolphins. Barratclough A, Smith CR, Gomez FM, Photopoulou T, Takeshita R, Pirotta E, Thomas L, McClain AM, Parry C, Zoller JA, Horvath S, Schwacke LH. J Zool Bot Gard 2021; 2(3):416-420. https://doi.org/10.3390/jzbg203003.

- High site-fidelity in common bottlenose dolphins despite low salinity exposure and associated indicators of compromised health. Takeshita R, Balmer BC, Messina F, Zolman ES, Thomas L, Wells RS, Smith CR, Rowles TK, Schwacke LH. PLoS ONE 2021. 16(9): e0258031. https://doi.org/10.1371/journal.pone.0258031

Additional reading material from Rowena Watson: TBA

SPEAKER BIOGRAPHIES

Keynote Discussions: Contributions of Research with Animals to Biological and Health Sciences

Elaine A. Ostrander is Chief and Distinguished Senior Investigator of the Cancer Genetics and Comparative Genomics Branch at the National Human Genome Research Institute of NIH. She also heads the Section of Comparative Genetics. She received her Ph.D. from the Oregon Health and Science University and did her initial postdoctoral training at Harvard and UC Berkeley. She then went to the Lawrence Berkeley National Labs where, with collaborators, she began the canine genome project, assembling the foundational resources needed to navigate the canine genome. Dr. Ostrander joined the faculty of the Fred Hutchinson Cancer Research Center and University of Washington in 1993, rising to the rank of Member in the Human Biology and Clinical Research Divisions, and head of the Genetics Program. She moved to NIH in 2004 to assume a position of Chief and Senior Investigator at NHGRI.

Raina Plowright is the Rudolf J. and Katharine L. Steffen Professor at Cornell University and a Cornell Atkinson Scholar at the Cornell Atkinson Center for Sustainability. Dr. Plowright's research helps develop the science of pandemic prevention through delineation of the mechanisms of cross-species transmission (spillover), environmental drivers of spillover, the dynamics of viral pathogens in reservoir hosts, and prevention of spillover through ecological interventions. Her research involves field, laboratory, and modeling studies of henipaviruses, and coronaviruses in bats in Australia, Asia, and Africa. She was elected to the National Academy of Medicine and the American Association for the Advancement of Science and has been a Fulbright Fellow, an Australian Centenary Scholar, a DARPA Young Faculty Awardee, and a David H. Smith Fellow in Conservation Research. She is currently serving on the US National Academies committee for Countering Zoonotic Spillover, and she is a co-chair of the Lancet Commission on Prevention of Viral Spillover.

Panel Discussion: Frontiers in Animal Health Sciences, Conservation, and Research

Tracey Goldstein, PhD, is the Director of the One Health Institute and Professor in the Department of Microbiology, Immunology and Pathology at Colorado State University Immunology and Microbiology and Associate. Prior to joining Colorado State University, she was the Division Chief of the Emerging Threats Division, Bureau for Global Health at USAID since 2020, where she led the Global Health Security Program working with partner countries and the global community to build better preparedness for future emerging infectious disease threats. In her previous position she was a Professor in the Department of Pathology, Immunology and Microbiology and Associate Director of the One Health Institute at the University of California, Davis. At UC Davis, she managed a research program understanding the health of people, wildlife and the environment; as well as a marine mammal virology diagnostic service and served as the Co-Principle Investigator for the 10-year global PREDICT project. She is the Chair of the NOAA Fisheries Working Group on Marine Mammal Unusual Mortality Events. She continues to study health and diseases in marine mammal and other wildlife populations, and understanding the risk of spillover to people.

F. Claire Hankenson, DVM, MS, DACLAM is the Associate Vice Provost for Research and Executive Director of University Laboratory Animal Resources at the University of Pennsylvania. She serves as the Attending Veterinarian and holds a faculty position as Professor of Laboratory Animal Medicine within the Department of Pathobiology at the School of Veterinary Medicine. Dr. Hankenson obtained her veterinary degree from Purdue University, completed her graduate work and residency at the University of Washington and then became a Diplomate of the American College of Laboratory Animal Medicine (ACLAM) in 2002. Dr. Hankenson has been active on committees within AALAS since 2002, served on the Executive Board for ACLAM, including ACLAM President in 2015, and is an ad-hoc specialist with AAALAC. In addition, she is the immediate Past Chair of the PRIM&R Board of Directors. From 2019-2021, she participated as one of two veterinarians on the NIH Advisory Committee to the Director (ACD) Working Group (WG) on Enhancing Reproducibility and Rigor in Animal Research.

Steven A. Osofsky, DVM, works on developing and helping to apply science-based landscape scale approaches to conservation, particularly in terms of policy guidance to address challenges at the interface of wildlife, agriculture and other types of land use, and people. Dr. Osofsky, the Jay Hyman Professor of Wildlife Health & Health Policy at Cornell University's College of Veterinary Medicine, is one of the pioneers of the One Health movement, having led the drafting of the core Manhattan Principles on One World, One Health in 2004. He has developed, launched and managed some of the first major applied One Health programs, including the AHEAD (Animal & Human Health for the Environment And

Development) Program (launched in South Africa in 2003) and the HEAL (Health & Ecosystems: Analysis of Linkages) Program (launched in 2009), which became the Planetary Health Alliance in 2016. As the only veterinarian serving on The Rockefeller Foundation-Lancet Commission on Planetary Health, he was able to bring his range of practical experiences (from both health and environmental conservation perspectives) to the task of shaping the highly interdisciplinary conceptual approach underpinning the field of Planetary Health. Professor Osofsky previously held senior positions at the World Wildlife Fund (WWF) and the Wildlife Conservation Society (WCS), as well as with the Government of Botswana. He was also honored to serve as an American Association for the Advancement of Science (AAAS) Science and Diplomacy Fellow, working as a Biodiversity Program Specialist at the U. S. Agency for International Development (USAID). Steve is also shepherding the University's new Cornell Wildlife Health Center.

Cynthia Smith, DVM, serves as the President and CEO of the National Marine Mammal Foundation (NMMF), a 501(c)3 nonprofit organization based in San Diego, California. Smith has led the organization since 2010, and served as Chief Medical Officer for more than a decade. She continues to provide her veterinary expertise for high-priority marine mammal projects, specifically those focused on at-risk, threatened and critically endangered cetaceans (dolphins, porpoises, and whales). She has more than 25 years of veterinary and research experience, resulting in more than 80 peer-reviewed scientific manuscripts. Smith contributed as a lead veterinarian for NOAA's Natural Resource Damage Assessment of the *Deepwater Horizon (DWH)* oil spill, and she has continued to study its long-term impact on marine mammals in the Gulf of Mexico. She served as the General Program Manager for the Consortium of Vaquita Conservation, Recovery, and Protection (VaquitaCPR), an international effort aimed at rescuing the endangered vaquita porpoise from extinction. Smith co-founded JANE: Justice and Action Network for the Earth, which was selected as a top 100 finalist for MacArthur Foundation's 100 and Change Competition and is part of the Bold Solutions Network. Her NMMF team provides veterinary, research, and animal care support to the US Navy's Marine Mammal Program. Smith received a Bachelor's of Science degree from Texas A&M University and a Doctor of Veterinary Medicine degree with a veterinary thesis in aquatic biomedicine from Tufts University. She completed executive education at Harvard Business School, Harvard Kennedy School, and Berkeley Haas School of Business.

Rowena Purcell Watson is with the U.S. Department of State, serving as the Division Chief for Wildlife Conservation and Combating Wildlife Trafficking in the Bureau of Oceans, and International Environmental and Scientific Affairs, in the Office of Conservation and Water. Rowena regularly collaborates with the U.S. interagency as well as other governments, NGOs, IOs and the private sector. She has deep expertise combating wildlife trafficking globally, as well as other nature crimes (i.e. trafficking in timber, precious metals and gemstones, and crimes associated with IUU fishing). In the realm of environment and health, she engages on efforts to prevent future pandemics by decreasing risks from zoonotic disease emergence and spillover, and promoting a One Health approach - focused on the animal (both domestic and wild) and environmental elements. She also works on a broad range of other environmental challenges in the foreign policy arena, including illegal deforestation, illegal mining, chemicals pollution and air quality, and oceans topics. Rowena has extensive diplomatic experience in multilateral negotiations, serving in leadership roles on U.S. delegations to multiple forums and conventions. She has a strong science background (studying zoonotic diseases and bioterrorism) with a doctorate in animal sciences/veterinary pathology. Before joining the civil service at the U.S. State Department in 2011, she was a freelance consultant and an American Association for the Advancement of Science (AAAS) Diplomacy Fellow for scientists in policy making. Rowena is currently on detail with the State Department's Office of Sanctions Coordination, focused on the nexus of sanctions and environment including efforts to combat transnational organized crime, corruption, and human rights abuses, and protect environmental defenders.