



A Roundtable on Science and Welfare in Laboratory Animal Use Workshop

CARE, USE AND WELFARE OF MARMOSETS AS ANIMAL MODELS FOR GENE EDITING-BASED BIOMEDICAL RESEARCH

October 22-23, 2018

Keck Center| 500 Fifth Street NW| Washington, DC| Keck 100

Workshop Context

The New World primate, the common marmoset (*Callithrix jacchus*), is a research model of increasing importance for biomedical research in the United States and globally. Marmosets present certain advantages compared to more traditional nonhuman primate species and may be particularly useful for the development of new disease models using genetic engineering (achieved using the CRISPR/Cas9 technology) and assisted reproductive technologies. Germline transmission of a transgene in marmosets was first shown in 2009 while mapping of their genome was published in 2014. Production of transgenic models of disease in marmosets is currently being tested in the United States and in Japan among others. However, a number of concerns have been voiced with respect to the increasing popularity of marmoset animal models based on the advent of genetic engineering/gene editing. Planned by an ad hoc committee, the Roundtable on Science and Welfare in Laboratory Animal Use will host a public workshop to explore and address these concerns.

Workshop Objectives

Invited experts and speakers from academia, industry, non-profit organizations and government agencies will convene for this two-day public workshop to:

- 1- Examine the availability of marmosets in the United States and abroad;
- 2- Discuss animal welfare and ethical considerations stemming from the use of wildtype and genetically modified marmosets;
- 3- Discuss standards of housing and care, dietary needs and feeding requirements for wildtype as well as genetically modified marmosets in captivity.

The presentations and discussions at the workshop will be captured in a workshop proceedings.

DAY 1, OCTOBER 22

8:00A Welcome and Introduction

Workshop Co-Chairs JAMES FOX, MIT

SAVERIO CAPUANO, Wisconsin National Primate Research Center

Roundtable Director LIDA ANESTIDOU, Institute for Laboratory Animal Research

8:10A Keynote: The Historical Use of Callitrichids in Biomedical Research and Current Trends

SUZETTE TARDIF, Southwest National Primate Research Center

Introduction JAMES FOX

SESSION 1: MARMOSET AVAILABILITY

8:40A Current State of Affairs: Analyzing the Numbers

Objectives:

- Inform on the status of marmoset population in the US
- Present one country's approach to meeting its marmoset-dependent research needs
- Present a perspective on the conflict between conservation, bioprospecting and biomedical research
- In the context of anticipated demand for marmosets, discuss an equitable, sustainable and fair control of and access to marmoset resources (numbers, tissues and genetic material; how supply lines are established and the role of wild caught marmosets) globally.

Session Moderator SAVERIO CAPUANO

Speakers

JON LEVINE, Wisconsin National Primate Research Center

ERIKA SASAKI, Central Institute for Experimental Animals, Japan

MARIA ADELIA BORSTELMANN DE OLIVEIRA, Federal Rural University of Pernambuco - UFRPE, Brazil

SAVERIO CAPUANO

Q&A with the audience

10:10A COFFEE BREAK

10:30A Genetic Diversity in Times of Increased Demand

Objectives:

- Examine the prospect and application of a Species Survival Plan for marmosets, including its role in the exchange of genetic information (+ small colonies)
- Discuss elements of genetic and microbiological characterization of marmosets
 - Do the provenance and genetic background of marmoset colonies play a role in choosing research questions
 - Maintain marmoset colony genetics
- Discuss the genetic diversity in Japan's marmoset colonies
- Analyze the need for and role of genetic diversity in marmosets used in biomedical research (genome sequencing)
- Present a chip-based genomic analysis

Session Moderator JAMES PICKEL, National Institute for Mental Health

Speakers

KENTON KERNS, Smithsonian National Zoo and Conservation Biology Institute

JOANNA MALUKIEWICZ, Arizona State University

YASUHIRO GO, National Institute of Physiology, Japan

JEFFREY ROGERS, Baylor College of Medicine

RICARDO DEL ROSARIO, Broad Institute

11:45A Maintain and Track Genetic Diversity in Marmoset Colonies - Facilitated

Discussion with the Audience

- What is the contribution of genetic diversity to marmoset-based animal models?
- What are some of the most common problems encountered in tracking genetic diversity?
- What are some of the potential solutions in maintaining said diversity?
- It appears likely that the US marmoset research population will include a number of breeding colonies that are each relatively small, raising questions as to how to best maintain the overall population to ensure genetic viability.
 - What are the specific goals of genetic management of the marmoset population – e.g., outbreeding? Definition of founder populations? Enrichment or elimination of certain lineages based on either genotype or phenotype?
 - What can we learn from other institutions that manage numerous, small breeding populations – e.g., zoos?
 - What mechanisms can be used to either encourage or enforce broad population genetic management?
 - What would be the costs and benefits of plans to genotype or sequence every marmoset in research?

Session Leader JAMES PICKEL

12:30P LUNCH

SESSION 2: MARMOSETS AS RESEARCH MODELS

1:30P Using Marmosets in Biomedical Research

Objectives:

In order to showcase the versatility of marmosets as animal models, panelists will use examples of different research questions to discuss:

- Aging research with marmosets
- Marmoset-based infectious disease research under biocontainment conditions
- The development of marmoset-based neuroscience models
- Genomic editing in marmosets
- Using behavioral tests (fMRI) and neuroimaging analysis for model verification

Session Moderator MARINA EMBORG, Wisconsin National Primate Research Center

Speakers

CORINNA ROSS, Texas A&M University - San Antonio

JEAN PATTERSON, Texas Biomedical Research Institute

JAN LANGERMANS, Biomedical Primate Research Center, The Netherlands

ERIKA SASAKI

AFONSO SILVA, National Institute of Neurological Disorder and Stroke

Q&A with the audience

3:30P COFFEE BREAK

3:45P Ethical Considerations Regarding the Use of Marmosets in Research

Objectives:

- Discuss the ethics of genetically modifying the marmoset, a nonhuman primate
- Analyze the ethical imperative of being cognizant of your knowledge before starting research with marmosets (small colonies; transport; stress)

Session Overview ERIC HUTCHINSON, Johns Hopkins University

Speakers

ADAM SHRIVER, Oxford University, United Kingdom

STEVEN NIEMI, Harvard University

4:45P Facilitated Discussion with the Audience

Session Leader ERIC HUTCHINSON

5:30P ADJOURN FOR THE DAY

DAY 2, OCTOBER 23

8:15A Opening of Day 2 and Recap of Day 1

SAVERIO CAPUANO

8:30A Highlights of the workshop on *Transgenic and Chimeric Neuroscience Research: Exploring the Scientific Opportunities Afforded by New Nonhuman Primate Models*

MARINA EMBORG

SESSION 3: MAMMOSET HUSBANDRY

8:45A Select Topics in Marmoset Husbandry

Objectives:

- Highlight marmosets' nutritional needs and daily dietary management
- Provide an overview of Marmoset-specific behavior and enrichment
- Discuss marmosets' reproductive cycle and ways of controlling it
- Present basic elements of Specific Pathogen Free marmoset colonies
- Explore options for harmonization of marmoset husbandry from a global perspective

Session Moderator JACO BAKKER, Biomedical Primate Research Center, The Netherlands

Speakers

MICHAEL POWER, Smithsonian National Zoo and Conservation Biology Institute

NANCY CAINE, California State University-San Marcos

DAVID ABBOTT, Wisconsin National Primate Research Center

TAKASHI INOUE, Central Institute for Experimental Animals, Japan

JACO BAKKER

10:25A Facilitated Discussion with the Audience

There is considerable variation in the husbandry and management of marmosets. Such variation may impede efficient and effective use of this species as a research model and may lead to irreproducible studies.

- What are the areas of management that are most likely to vary and have the potential to affect animal welfare?
- What are the areas of management that are most likely to vary and have the potential to affect study outcomes?
- What mechanisms can we use to gather information on this variation and assess its effects?
- How do we encourage evidence-based decision-making regarding husbandry and management?

- How do we best disseminate such evidence-based management information to the broader community?

Session Leaders SUZETTE TARDIF & JACO BAKKER

12:00P LUNCH

SESSION 4: MARMOSET VETERINARY/CLINICAL CARE

1:00P Select Topics in Marmoset Veterinary Care

Objectives:

- Provide a framework for an overall health management of marmoset colonies
- Discuss common clinical presentations in and treatments for marmosets
- Provide an overview of basic elements of anesthesia and analgesia for marmosets
- Present basic facts and practical aspects of marmoset reproduction
- Discuss key features of marmoset pathology

Session Moderator ERIC HUTCHINSON

Speakers

CASEY FITZ, Wisconsin National Primate Research Center

JESSICA IZZI, Johns Hopkins University

ANNA GOODROE, University of Houston

MONIKA BURNS, MIT

KEITH MANSFIELD, Novartis

2:40P Facilitated Discussion with the Audience

Session Leader ERIC HUTCHINSON

SESSION 5: IMPROVING RESEARCH PRACTICES THAT DEPEND ON THE USE OF MARMOSETS: KEY MESSAGES AND FUTURE ACTIONS

4:00P Closing Session – Improving Research Practices that Depend on the Use of Marmosets: Key Messages and Future Actions

Session Leaders JAMES FOX & SAVERIO CAPUANO

4:30 – 4:45P ADJOURN WORKSHOP