Nonhuman Primate Evaluation and Analysis

Final Report

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Final Report – Revised Draft

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Executive Summary

Nonhuman primates (NHPs) are invaluable in biomedical research due to the similarity of physiological systems to those of humans, aiding studies in disease, behavior, and aging. A 2023 National Academies of Sciences, Engineering, and Medicine (NASEM) study highlights their critical role and the need for ongoing support for research using NHPs. The National Institutes of Health (NIH) plays a pivotal role by providing resources for NHP research through the Office of Research Infrastructure Programs (ORIP) within the Office of the Director, as well as through other NIH institutes, centers, and offices (ICOs).

Maintaining an adequate NHP supply for research presents ongoing challenges, such as balancing researcher needs with breeding efforts. This NHP Evaluation and Analysis, initiated by NIH ORIP and the Office of AIDS Research, builds on a similar study conducted in 2018 to understand NHP demand and supply in the United States, spanning research fields, species, services, and future needs. The findings will inform NIH strategies to benefit the greater biomedical research community. This study utilized qualitative and quantitative methods to forecast future demand and supply, ensuring reliability through data redundancy and source validation. It comprises four distinct components:

- An identification of major NHP service providers in the United States and their capabilities.
- An analysis of historical NHP usage trends from NIH awardees and others.
- An assessment of the current NHP landscape and forecast of future demands for NHP use reported by major NHP service providers.
- A survey of NIH-supported intramural and extramural NHP users to characterize consumer demand.

The study reports on NHP trends from fiscal years (FYs) 2018 to 2022 and forecasts usage from calendar years 2024 to 2028. Longitudinal trends covering 10 years are presented when data were available from the 2018 study report. Additionally, a list of acronyms and abbreviations used in this report is provided in Appendix J.

Identification of Major NHP Service Providers in the United States and Their Capabilities

The capabilities of 26 identified NHP service providers were examined in detail. These facilities together provide the majority of NHPs available in the United States to NIH-supported investigators (Table 1). Within these facilities, 12 NHP species were identified as being bred and used in biomedical research. The rhesus macaque continues to be the most commonly bred species. In examining research capabilities, National Primate Research Centers (NPRCs) continue to offer a much more diverse portfolio of services compared to the other academic institutions, contract research organizations (CROs), and other private suppliers. Although capabilities overlap, many of the veterinary and research support procedures available at NPRCs still are unique to them and not available at other organizations included in the study.

Analysis of Historical Trends of NHP Use

Overall Conclusion from Historical Trend Analysis

By using similar approaches to the previous NHP Evaluation and Analysis published on the ORIP website in 2018, this current evaluation allowed for comparisons across two consecutive

5-year intervals of NIH extramural and intramural use, as well as the ability to obtain national trends for FY18 to FY22 from the United States Department of Agriculture. The planned number of NHPs to be used in extramural-awarded grant and cooperative agreement applications increased by 18% over the two 5-year periods, with a total of 30,174 animals across the different species for FY13 to FY17 and a total of 35,802 animals for FY18 to FY22 (Table 4 and Figure 12). In contrast, intramural use remained relatively constant across the 5-year interval, with totals of 4,137 NHPs across species for FY13 to FY17 compared to 4,099 animals from FY18 to FY22 (Figure 14). National trends also showed an increase of approximately 12% in NHP usage from FY18 to FY22 (Figure 16) across the NHP facilities included in this report (Table 1). Despite substantial year-to-year variability, these data collectively reveal a long-term increase of 10–20% in the use of NHPs in biomedical research over the 10-year interval. Remarkably, this closely matches the predicted 10–25% expansion recommended for rhesus macaques in the previous 2018 report.

Detailed Summary of Historical Trend Analysis

Focusing on the more recent 5-year interval from FY18 to FY22, a total of 35,802 NHPs were planned to be used in research projects, with rhesus macaques dominating usage at 55%, followed by baboons (9%), cynomolgus macaques (9%), and marmosets (6%). Notably, rhesus macaques continue to be the primary model for HIV/AIDS and behavioral and systems neuroscience studies. However, a decline in the planned number of NHPs to be used was observed in FY19 and FY22, which is potentially influenced by such factors as previously reported limited animal availability[2] or reduced animal and investigator availability due to the COVID-19 pandemic. Despite the necessary use of NHPs in SARS-CoV-2 research, extramural COVID-19 research projects did not substantially increase overall NHP usage, as existing resources were reallocated to the COVID-19 studies. HIV/AIDS research, viral infectious disease research, and behavioral and systems neuroscience research collectively comprise more than 50% of the total planned number of NHPs to be used, primarily supported by such ICOs as the National Institute of Allergy and Infectious Diseases (NIAID), National Institute on Aging, and National Institute of Mental Health.

The distribution of the planned number of NHPs to be used by research phases (defined in Appendix E) revealed that more than half of the planned number of NHPs to be used between FY18 and FY22 was allocated to basic research, with similar distributions for other phases of applied, testing/developmental, and translational research. Certain characteristics of proposed NHP usage in research, such as sex and age categorization, frequently were absent or insufficiently specified in awarded applications, posing challenges for data interpretation. Despite these limitations, it is evident that most investigators preferred adult NHPs for research, and the overall use of males and females appeared to be similar, except for a few research areas in which a preference for one sex over the other is apparent. These findings underscore the complexity and dynamic nature of NHP research and highlight the importance of continued monitoring and analysis to inform resource allocation and research strategies effectively.

The analysis of NHP acquisition for intramural NIH use from FY18 to FY22 reveals consistent trends in species distribution and funding sources. Rhesus macaques constitute the majority of animals acquired, comprising three-fourths of the total, followed by cynomolgus macaques at around 13%. These species remained steady in usage over the 5-year period, aligning closely with awarded application data for extramural projects. NIAID emerges as the primary funder of NHP research in both extramural and intramural projects, with a focus on infectious disease research. NIH intramural colonies became the primary source of NHPs for their intramural researchers from FY18 to FY22, accounting for 55% of acquisitions, reflecting a shift away from commercial vendors, possibly due to reduced availability and higher costs of commercial NHPs.

National trends from major NHP facilities identified for this study (Table 1) reveal a consistent increase in biomedical research utilization from FY18 to FY22, followed by a slight decline in FY22, which was still greater than usage in FY18 (Figures 16 and 17). CROs and private organizations drove this growth, while usage by pharmaceutical companies remained relatively stable. However, NPRCs and NIH-supported research showed slight declines in usage, possibly caused by annual variability or animal availability. Importation trends indicated stability in the numbers of NHPs imported from FY18 to FY22, with a sharp decrease in FY23. From FY20 onward, the source of NHPs dramatically shifted with China's export ban on NHPs. Cynomolgus macaques dominated imports, with shifts observed in importation sources for cynomolgus macaques, rhesus macaques, and African green (vervet) monkeys. The dramatic decline in U.S. NHP imports in FY23 likely reflects the shift in China's role from primary exporter to importer of NHPs.

Assessment of Current NHP Landscape and Forecast of Future NHP Demands

An in-depth analysis of responses obtained through interviews with NHP service providers detected both commonalities and diverse perspectives among participants. NPRCs and academic institutions predominantly provide NHPs and NHP services to NIH-supported investigators and to a lesser extent to nonprofit organizations and some private industry entities. In contrast, privately owned organizations primarily supply NHPs to pharmaceutical and biotechnology companies. Since 2018, numerous organizations have made upgrades to their facilities and acquired new capabilities, especially with the assistance of funding from the Coronavirus Aid, Relief, and Economic Security (CARES) Act during the COVID-19 pandemic. Nonetheless, persistent challenges, such as infrastructure limitations, staff retention issues, and the struggle to meet increased demand, continue to pose challenges to NHP facilities. Transportation barriers, China's export ban, and stringent quarantine regulations add complications to NHP procurement. Looking ahead, many suppliers anticipate that rhesus macaques and cynomolgus macaques will remain in high demand for infectious disease and pharmaceutical research. Marmosets and rhesus macaques are also in high demand for neuroscience and aging studies. Concerns were expressed that the lack of available domestic NHPs would result in more studies being undertaken in China. Data confidentiality, the handling of proprietary information, the standard of NHP care, and insufficient control of the research study in foreign countries were all cited as issues. These collective concerns underscore the importance of continued monitoring and assessment of NHP colonies to effectively address future demands in biomedical research.

Survey of NHP Users to Characterize Consumer Demand

A survey administered to principal investigators (PIs) who utilize NHPs in their research provided additional insights into the current needs of NHP users. The distribution of survey respondents (total of 490) was similar to that observed in 2018, such that nearly all (89.7%) NHP users worked for a university or other academic institution and nearly half of respondents worked for an NHP-capable facility that did not have an NIH-supported NHP colony. Respondents' current and planned research also followed similar patterns to those in the 2018 study, with behavioral neuroscience, HIV/AIDS, and visual system function and disorders remaining the top three research areas of PIs.

Examining the respondents' preference for their current and future usage of NHPs yielded data on species, sex, age, and pathogen status, as well as the likelihood that they would obtain their preferred animals from the source that they initially identified in their project applications. Of the 459 respondents who indicated their preferred NHP species, rhesus macaques emerged as the most utilized species, followed by African green (vervet) monkeys and cynomolgus macaques. Estimated species usage during the 2024–2028 period remained consistent, albeit with some slight variations for certain species. Sex preferences of both male and females, if available, generally were similar for most major species. Regarding age categories, adult NHPs were preferred across all species, followed by juveniles overall. Pathogen status preferences were fairly even across categories, with simian immunodeficiency virus–free NHPs being the most selected. Additionally, across the major species currently used or planned to be used in the future, the majority of respondents (63%) indicated that they were extremely likely or likely to obtain their NHPs from the source identified in their application or proposal.

Among survey respondents, more than half indicated NIH-supported facilities as the planned location for their studies, with the NPRCs being a frequent choice. Among respondents who had an NHP facility within their organization, most planned to use their own organization to conduct their studies. For respondents who did not have NHP-capable facilities, nearly two-thirds indicated that they planned to use an NPRC for their studies. Regardless of the number of NHPs requested by a study, external investigators who have an NHP facility at their own organizations were more likely to use their own facilities compared to respondents with no NHP facility available. For respondents who did not have an NHP facility available, small and medium users were more likely to utilize an NPRC, whereas large users had a somewhat even distribution among utilizing an NPRC, another NIH-supported center, or a non-NIH-supported center.

A large number of critical research capabilities were identified by survey respondents, with the most frequently cited capabilities pertaining to imaging, behavioral testing and training, general veterinary support, veterinary surgical capabilities, and biological containment. The study also evaluated factors influencing investigators' choice of NHP facilities for research. Basic animal availability emerged as the most crucial factor, highlighting the importance of timely access to required species, age, and sex. Genetically characterized animals were deemed less critical. Access to specialized equipment or facilities, NHP-related expertise, and local access were crucial, but their importance varied based on the investigators' preferred study site. For those using their own organizations, local access to animals was paramount. In contrast, users of separate NPRCs, other NIH-supported facilities, and non-NIH-supported facilities located offsite prioritized basic animal availability and access to relevant expertise and techniques. In open-ended comments, respondents also highlighted the importance of quality collaboration and knowledgeable staff for NHP care, suggesting additional critical factors beyond those specifically surveyed.

The survey results highlight serious challenges faced by researchers in obtaining NHPs and related services during the past 5 years. Most respondents reported increased costs for NHPs, with more than half experiencing a two-fold cost increase and many having to reduce the scope of their research projects or decrease the number of NHPs assigned to their studies as a result. Issues with NHP availability, compounded by the impact of the COVID-19 pandemic, were widespread, affecting the initiation and execution of studies and requiring changes in research strategy or experimental design for many respondents. Survey respondents in the present study (51%) noted problems in which limited NHP availability delayed their studies or necessitated changes to their research plans; this was comparable to a similar survey conducted in 2018

(50%). Additionally, respondents to the more recent survey highlighted the challenges of insufficient NHP housing and facility staffing, budget constraints, and budget cuts.

Conclusion

This study underscores the indispensable role of NHPs in biomedical research. Utilizing diverse methodologies to ensure informed decision-making for resource allocation and research strategies, results from all methods indicated an increase of 10–20% in demand for NHPs in biomedical research across research fields and phases. In particular, demand for rhesus macaques, cynomolgus macaques, and marmosets was high across the biomedical research enterprise. Ongoing support of NHP research and expansion of domestic colonies are critical needs, especially with NIH playing a pivotal role in providing resources through NPRCs and other NIH-supported facilities.

NPRCs and other NIH-supported facilities continue to serve as a major resource for many investigators. However, such challenges as limited funding, outdated infrastructure, and personnel shortages constrain their ability to meet increasing demand. The need for NHPs in biomedical research will remain for years to come. The COVID-19 pandemic was a recent example of the critical importance of NHP models, which were used to advance treatments and vaccines. Although a small percentage of NHPs were diverted to COVID-19 research, the effects on current research (e.g., delayed study starts, extended grant awards, limited animal availability) are indicative of the impacts of increased demand for a limited resource. Hence, it is imperative to address these various challenges through collaborative efforts and expertise to ensure sustainability and appropriate support of NHP resources for future biomedical progress.

Introduction

Nonhuman primates (NHPs) play a crucial role as animal models in biomedical research across various research areas. Their close physiological similarity to humans allows them to serve as models for human disease, cognitive and behavioral studies, aging, reproductive medicine, and more. A recent study from the National Academies of Sciences, Engineering, and Medicine (NASEM) extensively characterized biomedical research using NHP models that have contributed to several health advances, demonstrating a track record of predictive relevance of the NHP model and the need for continued support for basic and translational research using NHPs.[1] Much of the research performed on NHPs is facilitated by the resources provided by the National Institutes of Health (NIH). NIH supports NHP facilities, breeding colonies, and other NHP research resources that are utilized by both NIH awardees and intramural scientists. These NHP resources are supported by grants, cooperative agreements, or contracts managed by the Office of Research Infrastructure Programs (ORIP) within the NIH Office of the Director (OD) or by other NIH institutes, centers, or offices (ICOs).

This NHP Evaluation and Analysis, initiated at the request of NIH ORIP and the Office of AIDS Research (OAR), aims to enhance the understanding of the demand for and supply of NHPs in the United States. It provides an extension of the NHP Evaluation and Analysis report published in 2018 by ORIP,[2] which yielded insights into NHP supply and demand from fiscal years (FYs) 2013 to 2017. The study also is intended to provide the NHP community with a longitudinal view of the research fields utilizing NHPs, the quantities and species involved, NHP-related services, and facilities available to investigators, as well as the forecast for future needs in the next 5 years. The findings of this study will assist NIH in devising the best management strategies for the NIH-supported NHP research resources, which are essential to the pursuit of some of NIH's high-priority research programs. Additionally, this study will benefit the biomedical research community in planning and making decisions that will meet their research needs.

Maintaining an ample supply of NHPs to sustain current and future research has been an ongoing challenge. It requires a delicate balance, ensuring that there are enough animals to meet the needs of researchers without creating unutilized animals. Overseeing and managing a breeding colony is a complex process. Most NHPs require years to reach sexual maturity/adulthood to be considered suitable for research. The need to continue breeding removes a subset of adult NHPs from the available research pool. To properly evaluate these challenges, the current study was structured to utilize various methodologies, requiring the integration of both qualitative and quantitative data, in assessing future demand and supply. The overlapping nature of the data sources used for this study serves to augment the validity and reliability of the study's findings.

The analysis comprises four components:

- An identification of major NHP service providers in the United States and their capabilities.
- An analysis of historical NHP usage trends from NIH awardees and others.
- An assessment of the current NHP landscape and forecast of future demands for NHP use reported by major NHP service providers.
- A survey of NIH-supported extramural and intramural NHP users to characterize consumer demand.

The first component involved an initial identification of major NHP service providers in the United States and their capabilities, aimed at establishing a foundational understanding of the primary sources of NHPs and the type of related services and resources that are accessible to investigators.

The second component focused on analyzing the planned number of NHPs to be used from new and renewal NIH grants and cooperative agreements that were awarded in the 5 FYs after the conclusion of the previous NHP Evaluation and Analysis, spanning from FY18 to FY22. The purpose was to determine any discernible trends in NHP usage that could potentially indicate future demand. NIH awardees typically drive the demand for NHPs and NHP-related services provided by NIH-supported NHP centers. Therefore, the study is primarily focused on this segment of the research enterprise, examining both extramural and intramural usage trends. Nonetheless, insights into NHP usage by other entities, such as pharmaceutical companies and federal laboratories, should also provide a broader perspective on national demand. Hence, additional information was collected on national NHP importation trends and the annual report database maintained by the Animal and Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture (USDA).

The third component centered on gathering qualitative data through interviews concerning the supply of and anticipated demand for NHPs in biomedical research for both NIH-supported projects and the overall NHP community, with a focus on identifying emerging trends. In addition, this component explored operational similarities and differences between the NIH-supported NHP centers and colonies with other comparable NHP service providers in the United States and examined the different challenges they face. These included challenges related to animal resources, human resources, and facility infrastructure. Taken together, the insights gathered along these lines contribute to a better understanding of the needs of NHP facilities.

The final component of this study centered on gathering information that can better characterize the needs of investigators who rely on NHPs for their research programs. A survey was administered to investigators who are currently using or are planning to use NHPs in their research during the next 5 calendar years (2024–2028). The survey aimed to group users into different categories based on their needs, determine the research capabilities they find crucial, understand the reason behind their choice of NIH-supported NHP resources over other options, and determine the challenges they face when trying to obtain NHPs or related research resources.

This study report mainly covers usage trends from FY18 to FY22 and provides a forecast of NHP usage from calendar years 2024 to 2028. Longitudinal trends covering 10 years are presented when data were available from the previous report.[2] The survey aimed to define distinct subpopulations of users, identify important research capabilities desired by them, identify factors that may affect their decision to use NIH-supported NHP resources for their studies (as opposed to alternatives that they may have), and identify the extent and nature of problems that may exist in obtaining NHPs or related research capabilities. Although data on research fields using NHPs are captured in this analysis, this report does not cover the impact of research using NHPs or the need for NHPs in biomedical research, as those topics were expertly covered in the NASEM report. The NASEM report concluded that given the current state of science, no alternatives to the use of NHP models exist to address complex multiorgan interactions and integrated physiology.[1]

Methods

Identification of Major NHP Service Providers in the United States and Their Capabilities

Major suppliers of NHP and research facilities providing NHP-related services were identified initially through ORIP's previous NHP Evaluation and Analysis report[2] and the NASEM report, *Nonhuman Primate Models in Biomedical Research: State of the Science and Future Needs*.[1] The list of major suppliers and research facilities from these two reports were then cross-checked with the data provided from USDA's annual APHIS report database.[3] The facilities in this report include those reporting 400 or more NHPs held and used each FY between FY18 and FY22. Facilities that met this criterion only once in the 5-year period are not included in the report to ensure consistency from one year to another. Additional investigations using Google were conducted to confirm whether the facilities are still in operation, have ceased operations, or were acquired by other organizations.

Table 1 lists the 31 facilities that were identified for further assessment after applying the inclusion parameters. Organizations are grouped by the type of facility, with the total number of NHPs at these facilities provided for each FY (animals held and animals used for research). These organizations in aggregate make up at least 85% of all NHPs that are housed in the United States. The specific USDA annual report holding and use data from the 31 identified facilities for FY18 to FY22 are available in Appendix A. The four pharmaceutical companies and one of the federal research institutes listed below were excluded from the study, as they are assumed to be using NHPs exclusively to support their own research and generally do not provide animals or resources externally. The remaining 26 facilities underwent further analysis of their capabilities.

Table 1. Major NHP Facilities with Total Number of NHPs from Each FY Between FY18 and FY22

Organization	2018	2019	2020	2021	2022	Included in Study?
National Primate Research Centers (NPRCs)						
California NPRC	4,843	4,993	5,035	5,009	5,190	Yes
Emory NPRC	4,047	3,681	3,755	3,941	4,020	Yes
Oregon NPRC	6,267	6,435	6,120	5,660	5,496	Yes
Southwest NPRC	2,973	2,920	2,789	2,960	3,261	Yes
Tulane NPRC	5,591	5,746	5,820	5,826	5,953	Yes
Washington NPRC	1,116	1,053	1,338	1,264	1,194	Yes
Wisconsin NPRC	2,426	2,395	2,368	2,407	2,360	Yes
Academic Institutions with an NIH-Supported Breeding Colony						
Johns Hopkins University	908	1,003	1,014	418	672	Yes

The University of Texas MD Anderson Cancer Center (Keeling Center for Comparative Medicine and Research)	2,351	2,475	2,506	2,619	2,666	Yes
University of Puerto Rico (Caribbean Primate Research Center)	4,426	4,473	4,298	4,172	4,186	Yes
Wake Forest University	835	889	936	903	868	Yes
Other Academic Institutions						
University of Louisiana at Lafayette (New Iberia Research Center)	7,666	9,104	10,242	10,440	11,322	Yes
University of Pittsburgh	694	751	812	813	613	Yes
The University of Texas Medical Branch	363	389	474	562	528	Yes
Contract Research Organizations (CROs) and Other Private NHP Suppliers						
Alpha Genesis Inc.	390	394	370	572	743	Yes
Altasciences Preclinical	n/a	3,828	3,986	4,485	4,031	Yes
Battelle Memorial Institute	448	342	531	622	272	Yes
BIOQUAL Inc.	2,969	3,060	3,764	3,657	2,917	Yes
Charles River Laboratories	15,435	17,060	17,830	19,363	18,931	Yes
Inotiv*	160	356	702	1,021	1,038	Yes
JOINN-Biomere	807	995	836	1,284	1,119	Yes
Lovelace Biomedical Research Institute	190	339	685	923	959	Yes
The Mannheimer Foundation Inc.	4,439	4,560	813	4,608	5,019	Yes
Northern Biomedical Research Inc.	n/a	439	504	661	866	Yes
Primate Products LLC	n/a	78	658	887	1,207	Yes

Pharmaceutical Companies						
Bristol Myers Squibb	670	716	551	569	540	No
Labcorp Early Development Laboratories Inc.	9,199	9,024	7,041	8,604	8,158	No
Merck Sharp & Dohme Corp.	1,339	1,227	1,050	984	919	No
Pfizer Global Research & Development	906	757	812	815	636	No
Federal Research Institutes						
NIH	3,788	5,711	3,884	3,819	3,799	Yes
U.S. Army Medical Research Institute of Infectious Diseases	522	693	478	1,088	577	No

**Envigo was acquired by Inotiv.*
Data source: USDA. Details can be found in Appendix A.

Information regarding the capabilities of the 26 organizations included in the study was gathered through a review of each organization's website. The National Primate Research Centers (NPRCs) maintain a central website that outlines their primary and secondary capabilities, which were confirmed by the center directors through their responses to requested information and interviews. For all organizations, contact information for their center directors, marketing staff, or veterinary staff were identified. These individuals were then contacted via email to request information about how they serve the NHP biomedical research community. Specifically, all identified organizations were asked to provide information on the species of NHPs they breed or maintain, their approximate holding capacity, and the specialized equipment in their facility. Service catalogs and other resources containing the detailed description of their capabilities not found on the website also were requested. For organizations that did not provide a response to the outreach request, NHP holding capacity was assumed based on the average total number of animals held from FY18 to FY22 provided through the organization's annual Animal Welfare Act report to USDA.

For organizations that responded to the query, all reported capabilities and species information received were summarized in an Excel spreadsheet. This allowed for comparisons among facilities and identification of characteristics common and unique across the NIH-supported centers and other NHP service providers. The capabilities of organizations that did not respond to the query were recorded based on the information provided on their websites.

To expand on data collection efforts, a request for information (RFI), "Infrastructure for Research in Nonhuman Primates" (notice number: NOT-OD-23-150), was published on July 11, 2023, in the *NIH Guide for Grants and Contracts*. A tweet regarding this RFI was published to ORIP's account on X, formerly known as Twitter, to raise awareness of this opportunity to the greater biomedical research community. This RFI was targeted for organizations that have a typical usage of 400 or more animals per year. This threshold in the RFI was established on the assumption that organizations with lower use levels primarily served the internal investigators and would not serve as significant sources of NHPs and related services for the larger research community. Only one response was received from the RFI, with no indication of the organization’s name or location. Therefore, the data were not included in the final list of facilities with species and/or research capabilities.

Analysis of Historical Trends of NHP Use from NIH Awardees and Others

Extramural Awards Analysis

The extramural awards analysis was conducted to identify and describe the use of NHPs in NIH-supported extramural research, discerning any potential trends that may be useful in understanding and preparing for future demands of NHPs. For the extramural awards funded by the different ICOs within NIH, this review involved several steps. Initially, the set of keywords previously used in identifying awarded grants and cooperative agreements was updated to include NHP species that are commonly used in biomedical research, listed in Figure 1, as well as more general terms such as “nonhuman primate” and “monkey.” The list of all keywords used is provided in Appendix B. The keywords were then used to search the NIH Information for Management Planning Analysis and Coordination (IMPAC) II database of awarded applications for FY18 through FY22 to identify grant and cooperative agreement awards potentially using NHPs in their research.

Figure 1. NHPs Commonly Used in Biomedical Research

African Green (Vervet) Monkeys
Baboons
Cynomolgus Macaques
Dusky Titi Monkeys
Japanese Macaques
Mangabeys
Marmosets
Owl Monkeys
Pigtail Macaques
Rhesus Macaques
Squirrel Monkeys
Tamarins

A total of 3,258 awarded applications were extracted from the database, with administrative data on each award and the abstracts provided in an Excel spreadsheet. These administrative data included FY of the award, activity code, award number, award title, principal investigator (PI), performing organization, and sponsoring NIH ICO. These awarded applications are also limited to award mechanisms that are research-oriented, listed in Figure 2, and further limited to new or renewal applications (Application Types 1 and 2) and awards that involve a change to the awarding NIH ICOs for the renewal to ensure inclusion of the Vertebrate Animals Section (VAS). Awarded applications that did not include the use of NHPs were excluded. Contracts also were excluded, as the IMPAC II database has incomplete data on contracts. The remaining 1,257 awarded applications with indication of NHP usage underwent further analysis.

Figure 2. Award Mechanisms (Activity Categories) Included in Analysis

Director Program Projects (D Series)
Fellowship Programs (F Series)
Research Career Programs (K Series)
Research Program Projects and Centers (P Series)
Research Projects (R Series)
Research-Related Programs (S Series)
Cooperative Agreements (U Series)

The contractors examined the VAS and the full awarded application, when necessary, to identify projects using NHPs and extract projected animal usage details, such as species, sex, and age of the animals. The planned number of NHPs to be used for the duration of the award were assigned to the first year of the project, as it was not possible to determine the number of NHPs assigned for each specific year because these details are rarely present in the application. Age ranges were grouped into one of four categories: infant, juvenile, adult, or geriatric. Age categories were based on the species and are defined in Appendix C.

Additionally, abstracts were reviewed to identify the primary research area, listed in Figure 3, and research phase of each project, listed in Figure 4. The contractors utilized updated taxonomies from the previous report to cover new areas, such as SARS-CoV-2 research. Each project was assigned a single (primary) scientific area and research phase to ensure that NHP use associated with the award was only counted once. The lists of the primary research areas and research phases are provided in Appendix D and E, respectively. A total of 82 awarded applications classified under the research phase as NHP infrastructure or resource grants or cooperative agreements were excluded from the analysis. After the exclusion of infrastructure/resource awards, 1,175 awarded applications were included in the final analysis.

Figure 3. Primary Research Areas

Auditory System	Molecular Immunology (General)
Blood Disorder	Musculoskeletal Disorders
Cancer	Neuroscience – Behavioral and Systems
Cardiovascular Disease	Neuroscience – Molecular
Dental/Oral Disease	Nutritional and Metabolic Disorders (Non-Diabetes)
Diabetes	Regenerative Medicine and Transplantation
Fetal Development	Reproductive Health
HIV/AIDS	Respiratory System
Infectious Disease – Bacterial	SARS-CoV-2 (COVID-19)
Infectious Disease – Fungal	Urologic Diseases
Infectious Disease – Parasitic	Visual System
Infectious Disease – Viral (Non-HIV/AIDS)	Other

Figure 4. Research Phases

Basic Research
Applied Research – Medical Products
Applied Research – Surgical Techniques
Translational Research
Biologics Development/Testing
Drug Development/Testing
Medical Device Development/Testing
NHP Infrastructure/Resource
Other

Finally, the performance site was also noted for NHP studies not conducted in the same animal facility as the awarded organization. The study sites were characterized as follows:

- NPRCs or other NIH-supported NHP facilities (with specific facility identified)
- Other universities (academic centers other than ORIP-supported facilities)
- Commercial organizations
- NIH laboratories (laboratories within/sponsored by NIH ICOs)
- Other federal laboratories

NIH Intramural Usage Analysis

The NIH Division of Veterinary Resources, Office of Research Services, supplied information on the species and number of NHPs obtained from external suppliers and vendors within NIH for intramural usage by NIH investigators. Data were provided from FY18 to FY22, with each animal purchased categorized by the supplier and the end user. Additionally, limited details were provided for each purchase on the intended research area of the acquired animals (e.g., infectious disease research).

National NHP Trends

To inform national NHP trends, the number of NHPs used in research each FY were extracted from annual reports of research facilities in the USDA APHIS database.[3] The research facilities included are those identified in Table 1. Additionally, data on the species and number of NHPs imported to the United States were provided by the Travel Risk Assessment and Mitigation Branch, Division of Global Migration Health, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention (CDC).[4] Data were provided for each FY from FY18 to FY23.

Assessment of Current NHP Landscape and Forecast of Future NHP Demands

To obtain more in-depth insights into each organization's expectations for future NHP demands, the contractors interviewed organizations that breed or maintain NHPs or provide services for researchers using NHPs. Participation in interviews was voluntary, and a few organizations declined the request or never responded to the inquiry. The 20 organizations recruited for interviews were derived from the organizations selected for further analysis after the identification of major suppliers listed in Table 1. Seven participants were NPRCs, four were academic institutions with NIH-supported breeding colonies, three were academic institutions that do not house an ORIP-supported NHP colony, and six were privately owned companies. All interviews were between 30 to 60 minutes in duration and conducted via a video-conferencing platform. The interviews were mainly conducted with the center's director; however, many invited additional staff in their organization with specific knowledge about certain aspects of the operations.

The contractors developed an interview protocol with input from ORIP and OAR staff to ensure that the discussion was targeted and covered the relevant topics. The interviews began with several context questions for organizations that did not provide written answers to the initial outreach request. These questions were adapted from the solicitation email, seeking information about their customers, their ability to meet demands, the animals they breed or maintain, their capacity to reassign NHPs previously used in research, and the impact of the COVID-19 pandemic on their supply of NHPs or ability to provide services. For those that responded to the outreach email, the interviews started with some clarification questions in response to their answers.

Once context or clarification questions had been asked, the interview proceeded with questions that focused on future forecasting and factors that were crucial in the continued ability for centers to meet demand. Questions were asked about how these facilities track demands and usage, whether customer demand and behavior have changed, factors that affected researchers' preferences for certain animals, challenges that they face currently in meeting demand, and constraints that they foresee in meeting future demand. Follow-up questions were conveyed through email or an additional limited interview, as needed, for clarification or additional information as data were being analyzed. The final interview protocol is provided in Appendix F.

Survey of NHP Users to Characterize Consumer Demand

A 34-question survey was developed to better understand the current and future NHP landscape and learn how to best serve the biomedical research community. Some of the questions were adapted from the survey that was previously administered for the 2018 NHP Evaluation and Analysis report[2]; however, new questions were added to provide additional insights. The survey obtained information on the types of NHP facilities being utilized by respondents, the species and number of animals that researchers are planning to use from calendar years 2024 to 2028, the characteristics of the animals (sex, age categories, pathogen status), the location of planned study, the factors that influence which NHP facilities to use, challenges in obtaining NHPs, and the impact of these issues. Because the study included issues that investigators had encountered between FY18 and FY22, a question about the impact of SARS-CoV-2 was also included to determine the extent of the COVID-19 pandemic's impact on research using NHPs. The final survey questions are available in Appendix G.

The survey was intended for investigators who utilize NHPs in their research; therefore, the survey participants were first identified through awarded grants and cooperative agreements that included a proposed use of NHPs. NIH staff obtained the email addresses for the PIs of these awards and created a survey distribution list. The contractors developed a survey administration plan that included the language for the survey distribution email. Because several investigators may have used NHPs in their past research but currently do not expect to use them in their research from 2024 to 2028, or some may have received the invitation in error because they have not used and do not plan to use NHPs in their research, a screening question was included at the beginning of the survey that opted them out of the survey if they met those criteria. The survey was configured to allow anonymous responses and only record a single response from a single device. Participants were given a link that they could save so that they could return to the survey if they were unable to complete it in one sitting.

NIH staff sent the email invitation containing the link to the survey to 1,246 unique PIs using a generic NIH email address (NHPAnalysis@od.nih.gov). Because the survey distribution list was limited to PIs listed in the NHP grants, invitees were encouraged to forward the survey link to other colleagues working with NHPs regardless of whether they were supported by NIH or not. The link to the survey also was made available on the home page carousel of ORIP's website to increase its reach. The survey was administered for 5 weeks, starting in early December 2023 and ending in early January 2024. Reminder emails were sent to all invitees halfway through the administration period and a week before the survey closed.

Response data were downloaded from the survey platform in Excel file format. Quantitative data were analyzed in Excel using pivot tables and formulas to calculate counts, sums, percentages, and means. Chi-square analyses were conducted to examine (1) the relationship between NHP facility and location of NHP studies and (2) the relationship between user type (small, medium, large) and location of NHP studies for external investigators. User type is defined as small users estimated using 10 or fewer NHP animals per year on average during the 5-year period covered in the survey, including all species used; medium users, whose estimated average use was 11 to 30 animals per year; and large users, whose estimated average use was 31 or more animals per year. A one-way analysis of variance (ANOVA) and Welch's procedure was conducted using Statistical Package for Social Sciences (SPSS®) software for items rating the importance of different factors that influence investigator's choice when deciding on organizations to perform NHP studies. A p value of < 0.05 was considered significantly different; Tukey-Kramer and Games-Howell tests were used to conduct post-hoc analyses. Qualitative data were analyzed in Excel. When appropriate, new variables were created in the data set to assign descriptive codes to the open-ended comments to quantify some of the qualitative responses. Comments were summarized based on themes and patterns found.

Findings

Identification of Major NHP Service Providers in the United States and Their Capabilities

Examination of the annual report data available in the USDA APHIS database[3] assisted in identifying the 31 major NHP service providers identified in Table 1. As previously mentioned, only 26 organizations are included in the study after the exclusion of four pharmaceutical companies and one of the federal research institutes. The excluded organizations are assumed to be using NHPs exclusively to support their own research and generally do not provide animals or resources externally.

Responses to the emailed outreach request were received from 13 organizations included in the study. More information about NHP species and capabilities were obtained from organizations that did not initially respond to the outreach email during the interview phase. Table 2 summarizes major areas of commonality between NPRCs and other NHP facilities, as well as the more unique capabilities of the NPRCs compared to other NHP service providers. Overall, the NPRCs provide a very extensive portfolio of services, some of which are unique to them and not available at other universities or private organizations. It is important to consider that overlapping capabilities in Table 2 do not indicate capabilities that are universally shared by all NPRCs and all other NHP facilities, but rather capabilities that are available in at least one of the NPRCs that are also found in one or multiple organizations.

Table 2. Capabilities of NPRCs and Other NHP Facilities

Overlapping Capabilities	Unique Capabilities of NPRCs	Unique Capabilities of Other NHP Facilities
• Animal resource management • Behavioral assessment • Biomarkers • Genetics • High-containment facilities for research use at biosafety levels 2 and 3, both laboratories (BSL-2, -3) and animal (ABSL-2, -3) • Imaging (conventional) • Immunology techniques • Juvenile and developmental toxicology [California NPRC; Charles River Laboratories] • Molecular biology • Pathology • Pharmacokinetics and pharmacodynamics • Preclinical studies • SARS-CoV-2/COVID-19 research support • Toxicology • Veterinary medical research support procedures, including— o Conventional surgical procedures (not specified) o Fluid collection o Minimally invasive videoendoscopic surgery o Physical examinations • Virology	• Assisted reproductive technologies • Bioengineering, bioinformatics, and biotelemetry • BSL-4/ABSL-4* • Cognitive studies • Gene editing • Major histocompatibility complex (MHC) allele discovery • Metabolic phenotyping • Neuroscience o Advanced imaging o Neurohistology o Cognitive, motor, and vision testing apparatus • Stem cells • Transgenesis • Transplantation biology • Veterinary medical research support procedures, including— o Experimental surgical procedures o Gastrointestinal biopsy and endoscopic exams o Colposcopy, rhinoscopy, and thoracoscopy o Ultrasound guided techniques • Viral vectors	• Laboratory of Primate Morphology (skeletal collection) [University of Puerto Rico] • Large animal radiation and radiobiology—Radiation Survivor Core [Wake Forest University] • Behavioral studies of free-ranging macaques [University of Puerto Rico] • Safety studies [New Iberia Research Center; Inotiv]

**Capability is available at only one NPRC (Southwest NPRC).*

Across the 26 facilities included in the study, a total of 12 different NHP species were identified as being bred or used in biomedical research:

- African green (vervet) monkey
- Baboon
- Capuchin
- Common marmoset
- Cynomolgus macaque
- Dusky titi monkey
- Japanese macaque
- Owl monkey
- Pigtail macaque
- Rhesus macaque
- Sooty mangabey
- Squirrel monkey

Table 3 provides a list of species currently being bred in the United States and the breeding facilities (limited to the 26 organizations included in this study). Of the 12 species used in research, 11 species are bred in the country. Overall, rhesus macaque is the predominant species bred domestically. These colonies are exclusively Indian-origin rhesus macaques, except for a small colony of Chinese-origin rhesus macaques residing at the Tulane NPRC. Several species, such as dusky titi monkey and Japanese macaque, are only being bred in the United States by NIH-supported centers.

Table 3. NHP Breeders in the United States

Species	NIH Supported Centers	Other NHP Facilities
African Green (Vervet) Monkey	• Wake Forest University	• New Iberia Research Center
Baboon	• Southwest NPRC • The University of Texas MD Anderson Cancer Center (Keeling Center for Comparative Medicine and Research)	• The Mannheimer Foundation Inc.
Common Marmoset	• Johns Hopkins University* • Southwest NPRC* • Wisconsin NPRC*	• University of Pittsburgh**
Cynomolgus Macaque	• Wisconsin NPRC (Mauritian-origin)	• Alpha Genesis Inc. • Inotiv • New Iberia Research Center • Primate Products LLC • The Mannheimer Foundation Inc.
Dusky Titi Monkey	• California NPRC	

Japanese Macaque	• Oregon NPRC	
Owl Monkey		• The University of Texas MD Anderson Cancer Center (Keeling Center for Comparative Medicine and Research)
Pigtail Macaque	• Johns Hopkins University • Washington NPRC	
Rhesus Macaque	• California NPRC • Caribbean Primate Research Center • Emory NPRC • Oregon NPRC • Southwest NPRC • Tulane NPRC • Wisconsin NPRC	• Alpha Genesis Inc. • Inotiv • Johns Hopkins University • New Iberia Research Center • Primate Products LLC • The Mannheimer Foundation Inc. • The University of Texas MD Anderson Cancer Center (Keeling Center for Comparative Medicine and Research)
Sooty Mangabey	• Emory NPRC	
Squirrel Monkey	• The University of Texas MD Anderson Cancer Center (Keeling Center for Comparative Medicine and Research)	

**In addition to marmoset colonies supported by the NPRC base grant, the Southwest NPRC and Wisconsin NPRC maintain NIH-supported colonies for neuroscience research. The Johns Hopkins University in association with the University of California San Diego also support marmoset colonies for neuroscience research. The Oregon NPRC serves as the Marmoset Coordinating Center (MCC), a managing center for this program. Visit the MCC website for a list of marmoset colonies.*

***One investigator within the University of Pittsburgh has a marmoset breeding colony to be used internally for their own research.*

Each of the NPRCs can hold at least 1,200 animals and house more than one type of species. Altogether, they have a combined estimated NHP holding capacity of more than 26,000 animals. Academic centers that have NIH-supported breeding colonies together have an estimated holding capacity of more than 10,000 animals, some of which are used for NIH-supported research and some for other uses. Other academic centers that do not hold NIH-supported breeding colonies indicated a wide range in their estimated holding capacity. New Iberia Research Center (NIRC) at the University of Louisiana at Lafayette appears to operate at a level more closely resembling private suppliers with an estimated holding capacity of 11,000, whereas the other academic institutions grouped together have a much smaller capacity of around 250 to about 1,000 NHPs. The CROs and other private NHP suppliers, when combined, have an estimated combined holding capacity of 58,800 animals, with each supplier holding anywhere from a few hundred to about 20,000 animals. The precise numbers of animals available could not be provided, as census data were not provided, and these numbers are subject to change with time.

Analysis of Historical Trends of NHP Use from NIH Awardees and Others

Extramural Awards Trends

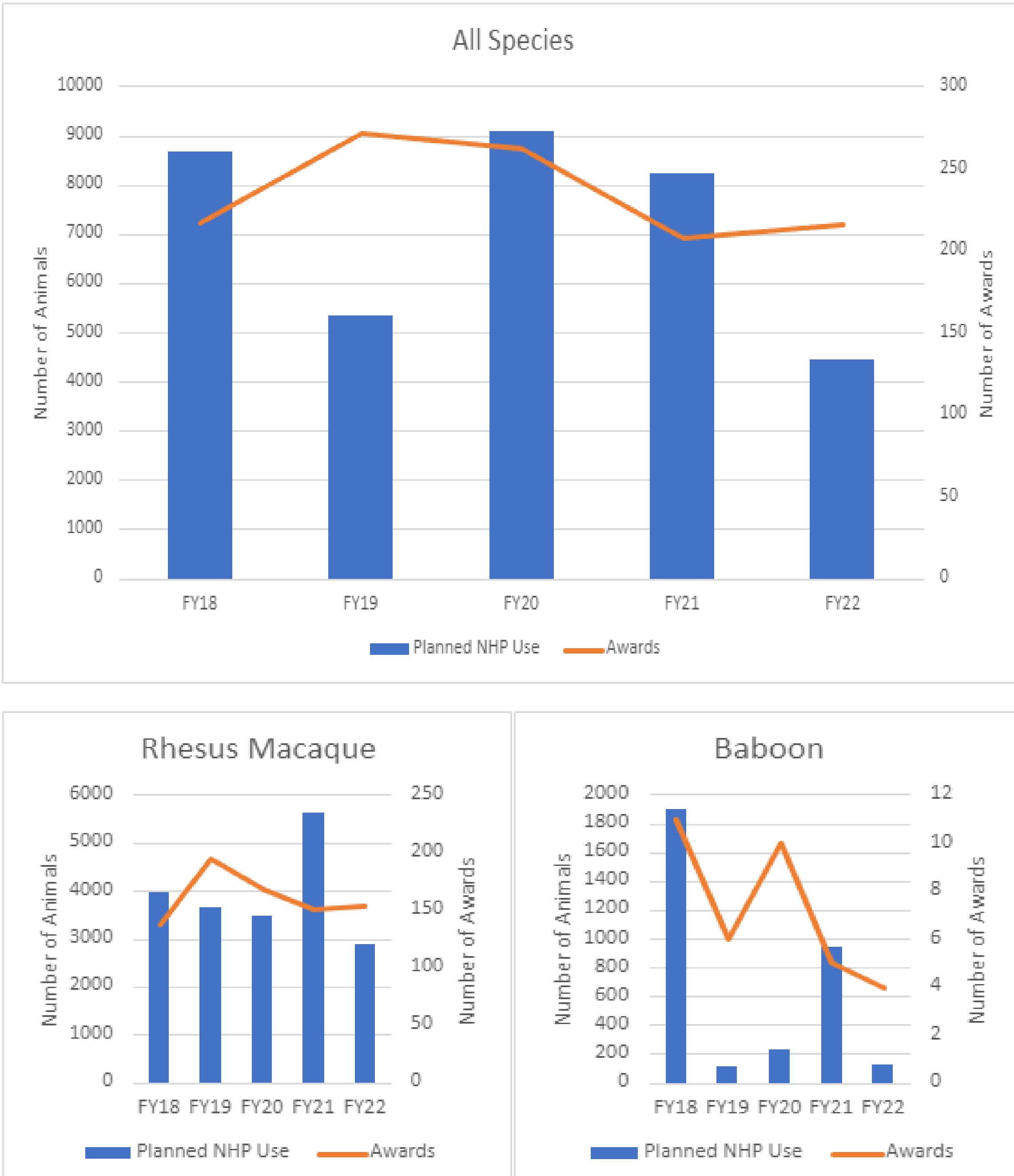
A total of 35,802 NHPs across different species were planned to be used in research based on relevant awards from FY18 to FY22. This excluded NHP infrastructure/resource awards that are focused on supporting the maintenance of breeding colonies or the creation of a specific supply of animals. The overall planned number of NHP species to be used for project-driven research awards and resource-related awards is shown in Table 4. Similar to the results of the previous report, rhesus macaques make up more than half (55%) of planned NHP use for extramural research, followed by baboons (9%), cynomolgus macaques (9%), and marmosets (6%). All planned use of NHPs for research grants and cooperative agreements awarded from FY18 to FY22 and the number of grants and cooperative agreements awarded are shown in Figure 5. All planned use of NHPs reported in the awards were assigned to the FY matching the award's first year. There was no way of determining the exact number of animals projected to be used in a given FY. For most cases, the projected number of animals in each awarded application was for the grant's entire project period (e.g., 5 years for a standard R01 grant).

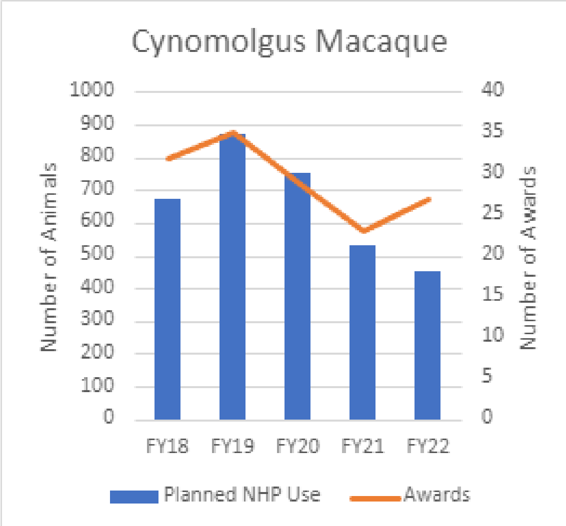
Table 4. Planned NHP Use in Grants and Cooperative Agreements Awarded from FY18 to FY22

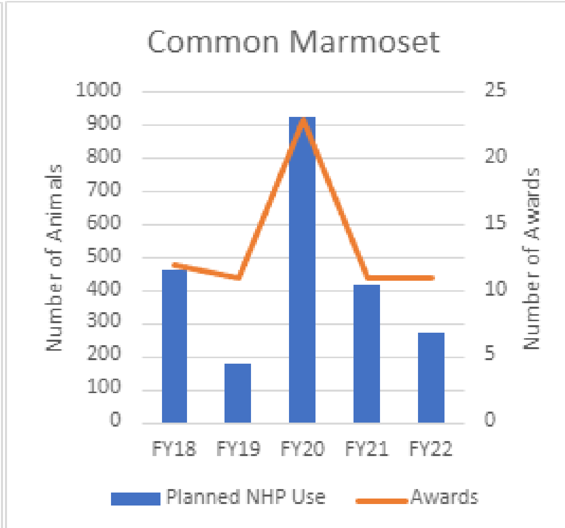
Research Awards Other Than Infrastructure/Resource	
Species	**Number of Animals**
Rhesus Macaque	19,586
Baboon	3,310
Cynomolgus Macaque	3,281
Common Marmoset	2,244
Squirrel Monkey	841
Pigtail Macaque	678
African Green (Vervet) Monkey	549
Owl Monkey	543
Capuchin	135
Dusky Titi Monkey	126
Japanese Macaque	64
Other NHPs or Mixed Species*	4,445
Total Non-Infrastructure/Resource Awards	**35,802**
NHP Infrastructure/Resource Awards	
Species	**Number of Animals**
Rhesus Macaque	30,078
Pigtail Macaque	2,432
Common Marmoset	2,387
Baboon	1,518
Squirrel Monkey	802
Japanese Macaque	368
Cynomolgus Macaque	269
African Green (Vervet) Monkey	251
Tamarin	180
Mangabey	168
Capuchin	98
Owl Monkey	68
Other NHPs or Mixed Species*	258
Total Infrastructure/Resource Awards	**38,877**

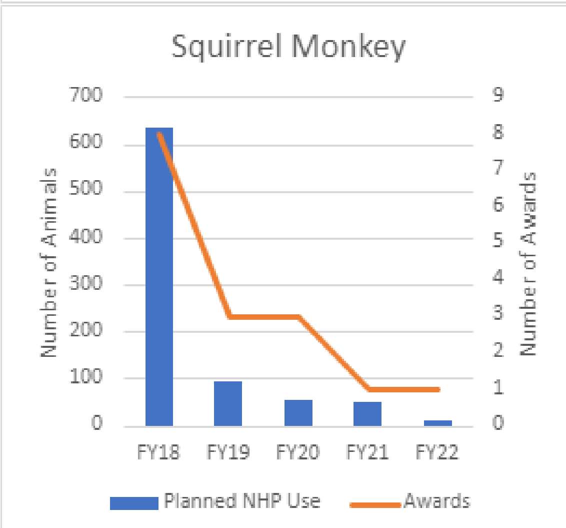
**Awards involving multiple species in which specific numbers for each species were not reported.*

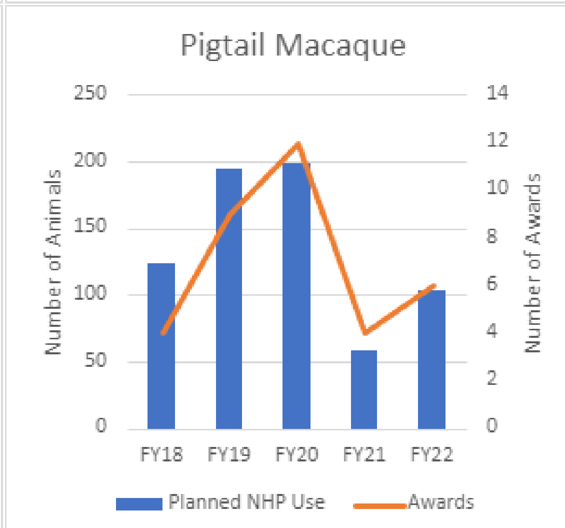
Figure 5. Planned Number of NHP to be Used and Number of Awards with NHPs for FY18 to FY22, Excluding Infrastructure/Resource Awards

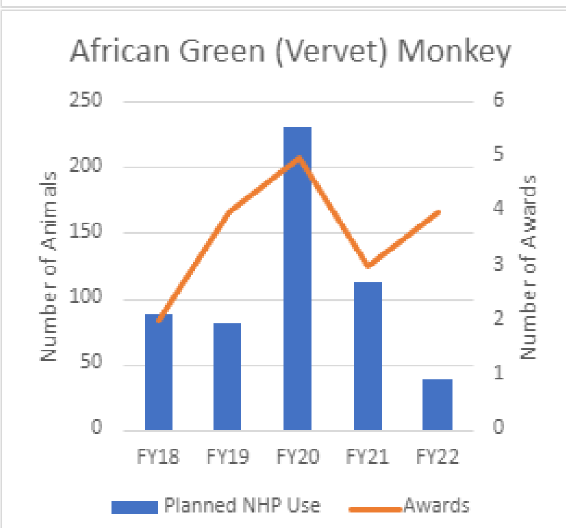


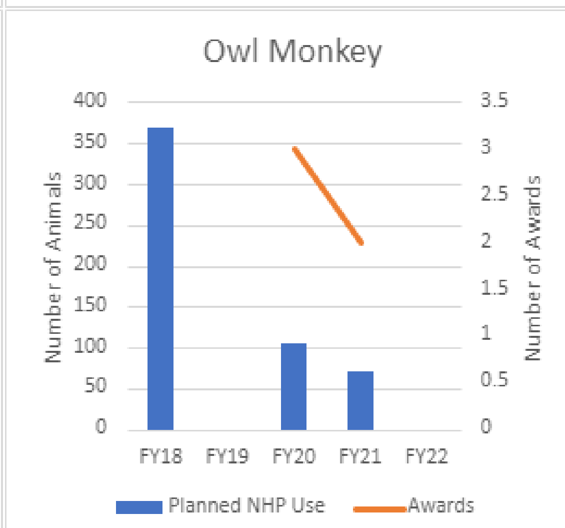

Cynomolgus Macaque
1000
900
800
700
600
500
400
300
200
100
0
Number of Animals
40
35
30
25
20
15
10
5
0
Number of Awards
FY18 FY19 FY20 FY21 FY22
Planned NHP Use
Awards

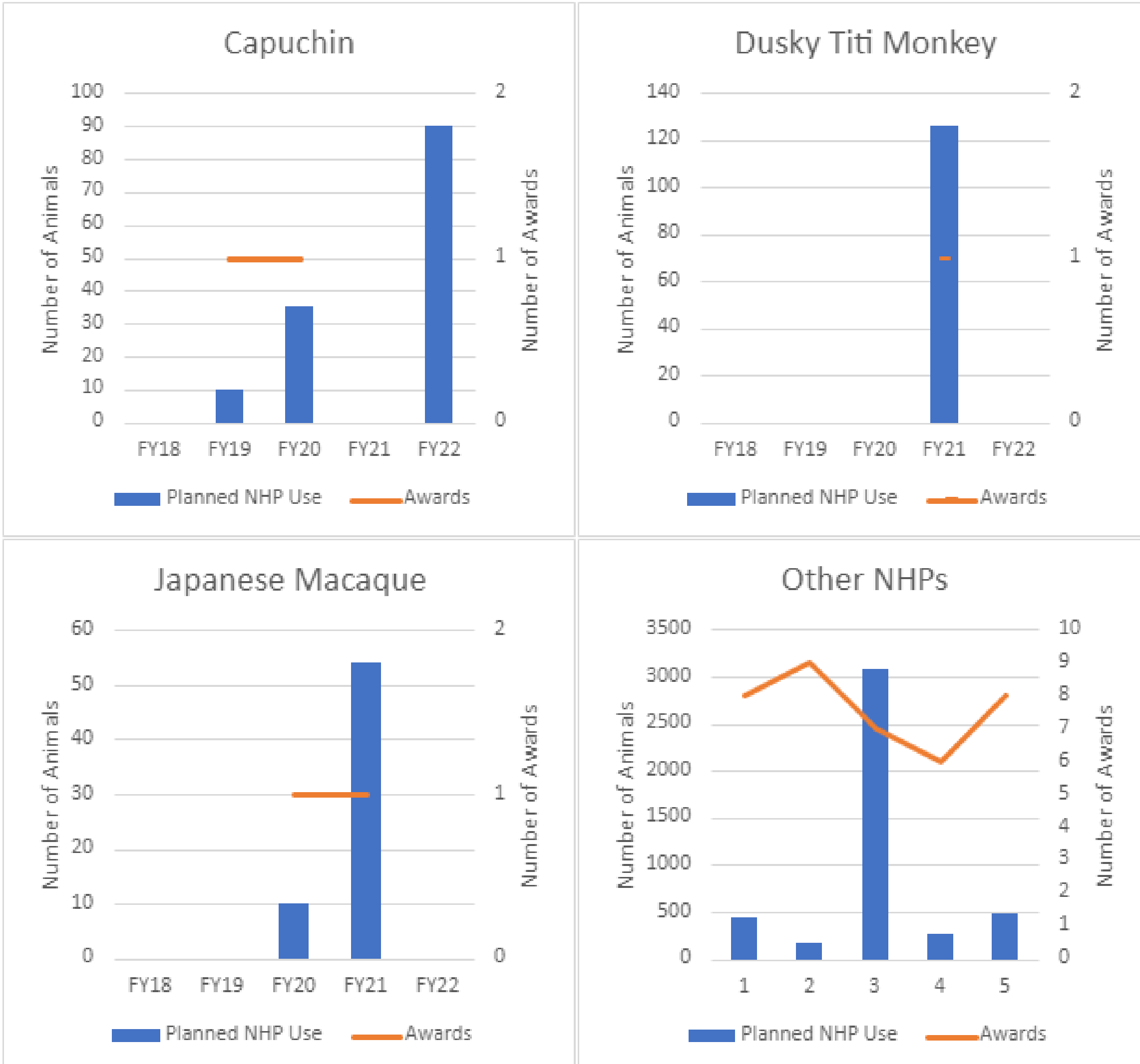

Common Marmoset
1000
900
800
700
600
500
400
300
200
100
0
Number of Animals
25
20
15
10
5
0
Number of Awards
FY18 FY19 FY20 FY21 FY22
Planned NHP Use
Awards


Squirrel Monkey
700
600
500
400
300
200
100
0
Number of Animals
9
8
7
6
5
4
3
2
1
0
Number of Awards
FY18 FY19 FY20 FY21 FY22
Planned NHP Use
Awards


Pigtail Macaque
250
200
150
100
50
0
Number of Animals
14
12
10
8
6
4
2
0
Number of Awards
FY18 FY19 FY20 FY21 FY22
Planned NHP Use
Awards


African Green (Vervet) Monkey
250
200
150
100
50
0
Number of Animals
6
5
4
3
2
1
0
Number of Awards
FY18 FY19 FY20 FY21 FY22
Planned NHP Use
Awards


Owl Monkey
400
350
300
250
200
150
100
50
0
Number of Animals
3.5
3
2.5
2
1.5
1
0.5
0
Number of Awards
FY18 FY19 FY20 FY21 FY22
Planned NHP Use
Awards



The planned number of NHPs to be used fluctuated between FY18 and FY22 when accounting for all species. There appears to be a decrease in the number of planned NHP use from FY18 to FY19, with an increase in FY20 and another downward trend in FY22. The number of awards also fluctuated in this 5-year period, increasing during the years in which there was a decrease in the number of planned NHP usage and decreasing during the years in which planned NHP usage was higher. In observing specific species' trends, there appears to have been a decline in the planned use of rhesus macaque in FY18 to FY20 (12.5% decrease), followed by a steep increase in FY21 (61.4% increase from FY20) before declining again closer to FY18 to FY20 numbers (48.9% decrease from FY21). The planned number of cynomolgus macaque to be used has been decreasing steadily since FY19. The planned number of baboons and squirrel monkeys to be used peaked in FY18 before declining significantly in subsequent years, except FY21, when there was a noticeable increase in planned number of baboons to be used. Common marmosets and African green (vervet) monkeys reached peak planned usage in FY20. The planned number of pigtail macaques to be used was consistent in FY19 and FY20 before a sharp decline in the number of awards and planned usage was observed. For all other species, planned use seems to be more variable and exhibits no discernable trends. Caution in interpretation of these trends in number of planned NHP use and awards is warranted, as some of the variation may be an artifact of assignment of all planned NHP use in an application to the first project year of the award. Other possible limitations include PI availability, as many investigators who use NHPs in their studies had delays in study initiation due to the pandemic or animal availability, resulting in grant extensions, and hence were not submitting new or renewal applications. Other caveats are noted in the discussion.

The rhesus macaque continues to be the primary NHP model used in HIV/AIDS research and behavioral and systems neuroscience studies, making up more than 50% of usage. Of the total planned number of rhesus macaque to be used between FY18 and FY22, HIV/AIDS research, which typically assigns large numbers of animals to studies, makes up 36%, whereas neuroscience studies, which tend to use smaller group sizes, comprise 16%. Figure 6 shows the planned number of animals and number of awards for rhesus macaque for HIV/AIDS research, with a decline in awards and planned number of NHPs to be used in FY22. The notable decline may be related to reduced animal availability or investigator participation in this area of research because several infectious disease researchers pivoted from their current studies to investigate SARS-CoV-2. Figure 7 shows the same phenomenon for behavioral and systems neuroscience studies, which also had a decline in planned number of NHPs to be used in FY22, but the number of awards did not decrease to the extent seen in HIV/AIDS research. The notable increase in planned number of rhesus macaques to be used for neuroscience research in FY21 could be due to a number of factors, including increased interest in dementia research or behavioral studies, which tend to have larger group sizes. Although the COVID-19 pandemic affected the day-to-day operations for researchers working at NHP facilities, the number of NHPs allocated to extramural COVID-19 studies was not substantially increased when compared to uses for other research areas. Less than 1% of NHPs were designated for COVID-19 research out of the total planned number of animals to be used from FY20 to FY22.

Figure 6. Planned Rhesus Macaque Usage and Number of Awards with Rhesus Macaque for HIV/AIDS Research from FY18 to FY22, Excluding Infrastructure/Resource Awards

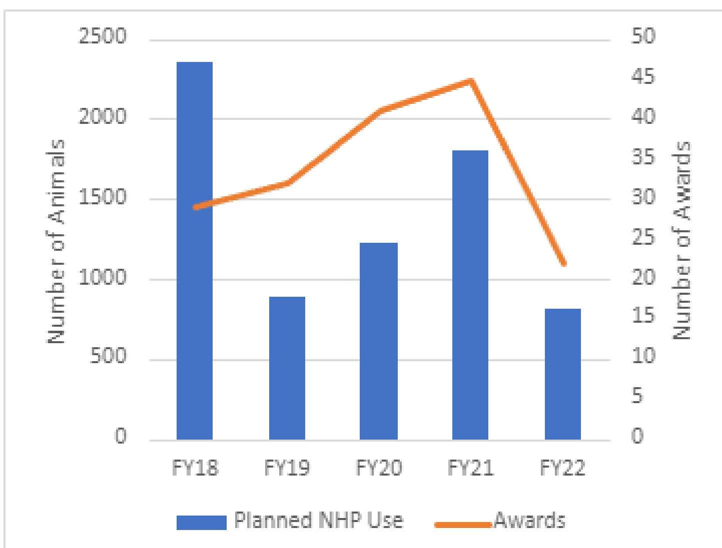
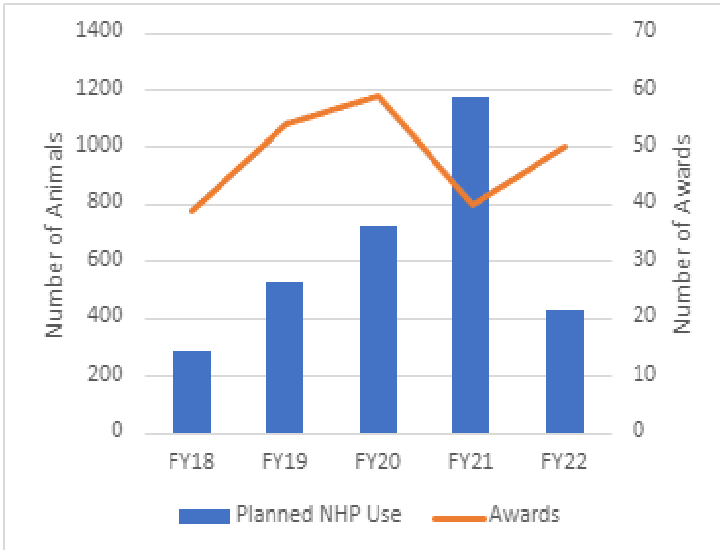
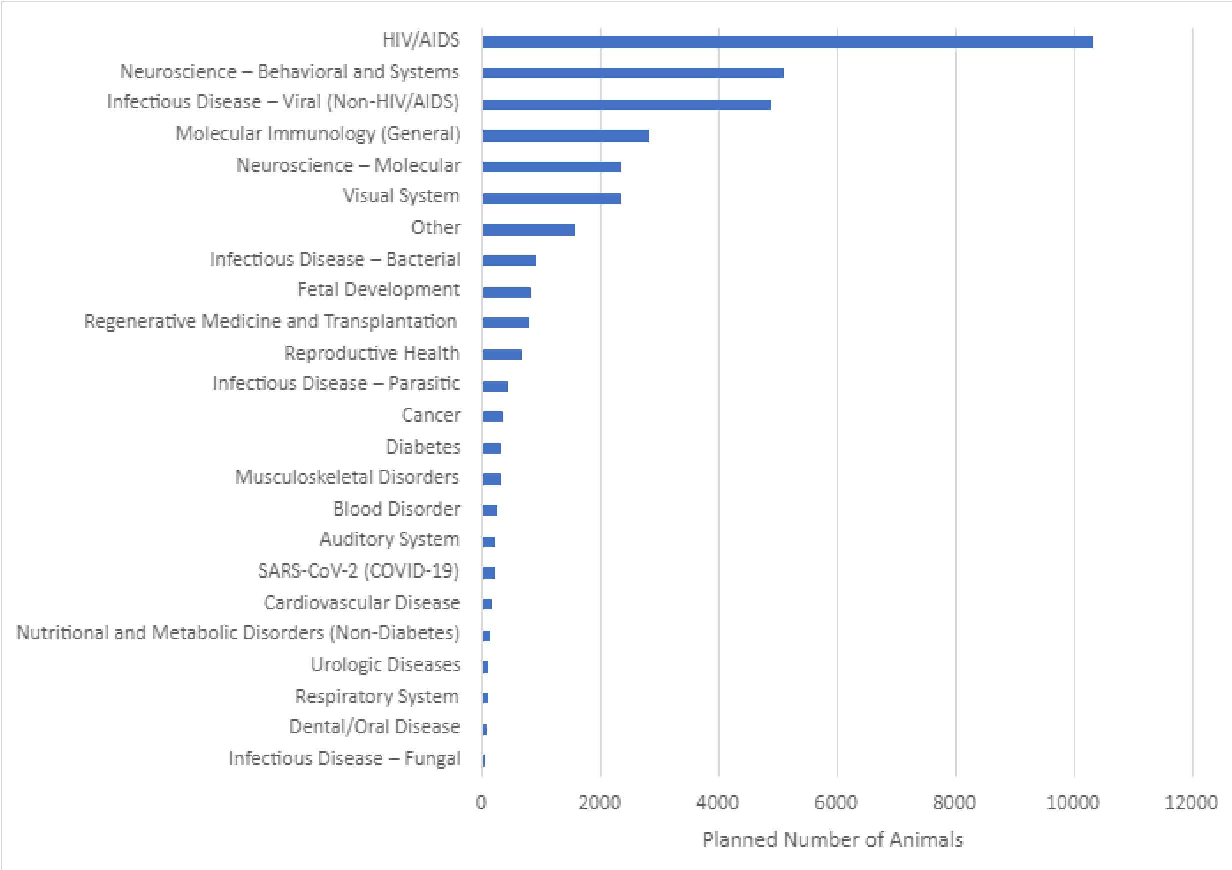


Figure 7. Planned Rhesus Macaque Usage and Number of Awards with Rhesus Macaque for Neuroscience—Behavioral and Systems Research from FY18 to FY22, Excluding Infrastructure/Resource Awards



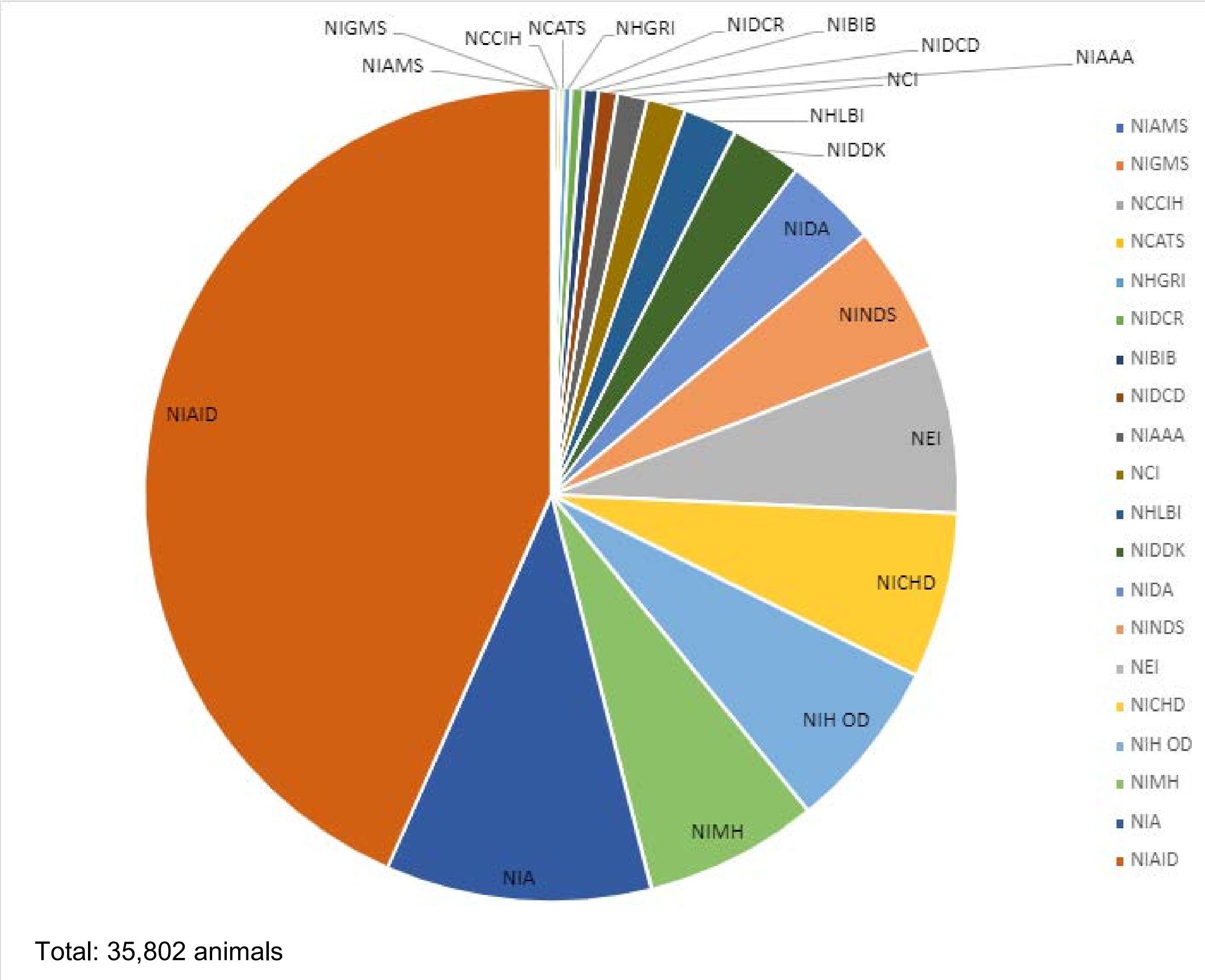
In examining the planned NHP usage by research field, the results are relatively consistent with those data observed for rhesus macaques. HIV/AIDS research comprises about 29% of total planned number of NHPs to be used across all species, followed by behavioral and systems neuroscience research and viral infectious disease (non-HIV/AIDS) research both at 14% each. Together, the top three research fields comprise more than 50% of total planned usage. Figure 8 shows the distribution of NHP planned usage for each research field for FY18 to FY22. A table providing full details of animal planned use by research area is provided in Appendix H.

Figure 8. Planned NHP Usage Distribution Based on Research Fields for FY18 to FY22, Excluding Infrastructure/Resource Awards



Considering that HIV/AIDS research and viral infectious disease research make up more than 40% of the planned number of NHPs to be used, a large portion of the NHPs are for research projects supported by the National Institute of Allergy and Infectious Diseases (NIAID) at 43%. This is followed by the National Institute on Aging at 11%, National Institute of Mental Health (NIMH) at 7%, OD at 7%, *Eunice Kennedy Shriver* National Institute of Child Health and Human Development at 6%, and National Eye Institute at 6%. The distribution of NHP planned use by NIH ICOs is shown in Figure 9. Tables providing full details of annual planned use of each NHP species by sponsoring ICOs are provided in Appendix I.

Figure 9. Planned NHP Usage Distribution Based on Sponsoring NIH ICOs (Graphic Represents Percent of the Total 35,802 NHPs) for FY18 to FY22, Excluding Infrastructure/Resource Awards



As observed in the previous report,[2] within the award mechanisms and types included in this analysis, awards involving NHP use consistently represented less than 2% of all NIH grants and cooperative agreements awarded each FY. This is shown in Table 5 for FY18 to FY22. Across the 10-year interval (FY13 to FY22), the percentage was consistently between 1.3% and 1.7% (see FY13 to FY17 data in Table 8 in the previous report[2]). Table 6 shows the distribution of planned NHP usage by research phases. More than half of planned number of NHPs to be used between FY18 and FY22 went into basic research, ranging from 43% to 70% of use in a single year. The distribution of planned number of NHPs to be used was approximately equal for biologics development and testing research, applied research on medical products, and translational research between FY18 and FY22.

Table 5. Awards Involving NHP Use Compared to Total Awards, Excluding Infrastructure/Resource Awards, by FY, from FY18 to FY22

	Number of Awards				
	FY18	FY19	FY20	FY21	FY22
NIH Awards Involving NHP Use	217	272	262	208	216
All NIH Awards	15,641	15,707	16,059	16,100	16,077
NHP Awards as Percent of All Awards	1.3%	1.7%	1.6%	1.3%	1.3%

Table 6. Planned NHP Usage Distribution Based on Research Phase, Excluding Infrastructure/Resource Awards, from FY18 to FY22

	Number of Animals by Initial FY of Award						
Research Type	FY18	FY19	FY20	FY21	FY22	FY18 FY22	%
Basic Research	6,132	2,516	5,872	3,723	1,905	20,148	56.3%
Biologics Development/Testing	737	1,128	857	588	573	3,883	10.8%
Applied Research – Medical Products	559	301	913	1,061	926	3,760	10.5%
Translational Research	525	369	414	1,941	408	3,657	10.2%
Drug Development/Testing	531	629	607	619	409	2,795	7.8%
Applied Research – Surgical Techniques	130	230	153	261	159	933	2.6%
Medical Device Development/Testing	54	187	289	38	58	626	1.8%
Total	**8,668**	**5,360**	**9,105**	**8,231**	**4,438**	**35,802**	**100%**

Similar to the previous report, some awarded applications did not specify certain characteristics of the NHPs. Data on sex of the animals was recorded when they were made available. Some awarded applications specified both the numbers of male and female animals to be used in each study, whereas some awarded applications provided only one number that was a combination of both sexes without specifying the number for each sex. In approximately 33% of the awards, the numbers of male and female NHPs to be used were either unstated or not specified (often stated as “either sex”). Table 7 shows the planned usage for each research area by sex that was available in the awarded applications.

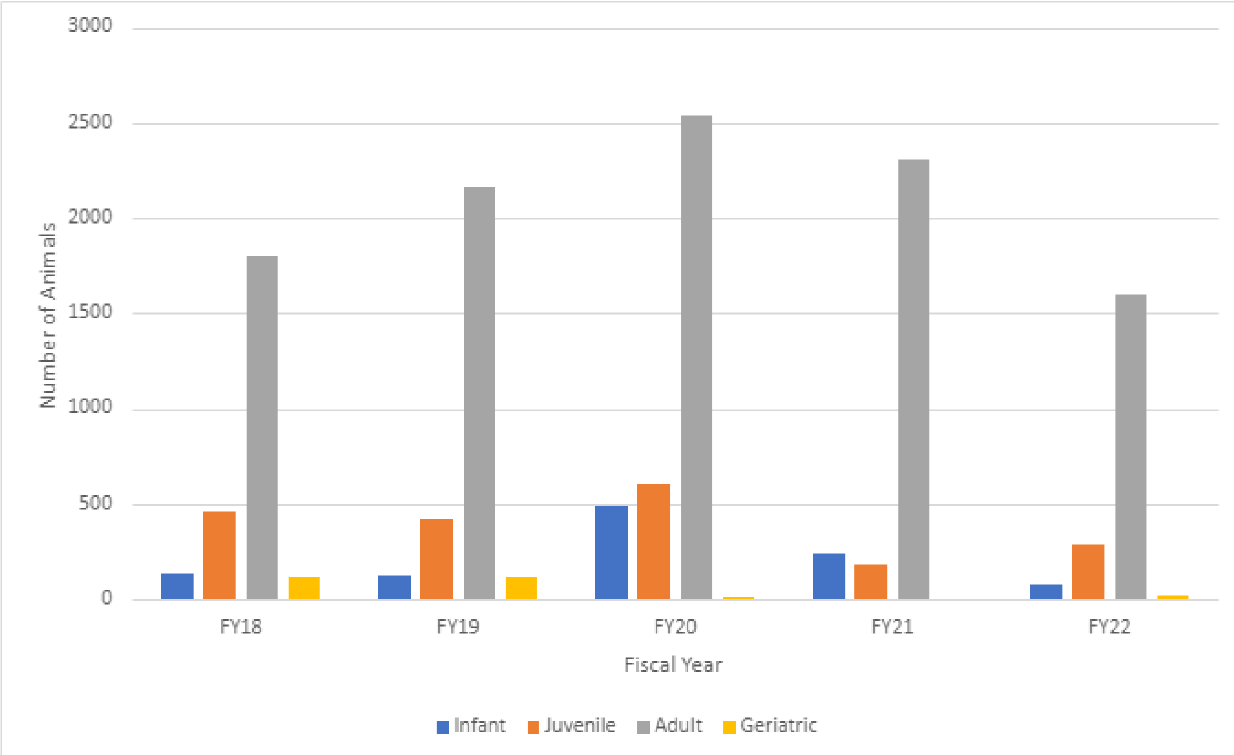
Based on the awards in which the planned NHP usage was specified according to sex, the number of males and females planned to be used are about equal for some research areas, whereas other research areas prefer one sex over the other. Fetal development and reproductive health research, for example, involves predominantly females. Nonetheless, other research areas—such as bacterial and viral infectious diseases, as well as nutritional and metabolic disorders (non-diabetes)—also seem to use more female NHPs.

Table 7. Planned Usage of Male and Female NHPs by Research Area for FY18 to FY22, Excluding Infrastructure/Resource Awards

Research Areas	Male	Female	Both
Auditory System	49	43	117
Blood Disorder	67	50	171
Cancer	133	138	93
Cardiovascular Disease	24	70	64
Dental/Oral Disease	0	0	42
Diabetes	28	52	37
Fetal Development	117	553	94
HIV/AIDS	953	919	2,468
Infectious Disease – Bacterial	62	124	259
Infectious Disease – Parasitic	12	12	230
Infectious Disease – Viral (Non-HIV/AIDS)	282	437	3,757
Molecular Immunology (General)	499	478	1,106
Musculoskeletal Disorders	87	81	107
Neuroscience – Behavioral and Systems	1,482	1,361	2,445
Neuroscience – Molecular	533	537	780
Nutritional and Metabolic Disorders (Non-Diabetes)	33	106	24
Regenerative Medicine and Transplantation	26	309	632
Reproductive Health	84	540	0
Respiratory System	15	14	86
SARS-CoV-2 (COVID-19)	27	3	134
Urologic Diseases	12	52	0
Visual System	235	159	1,067
Other	363	385	364
Total	**5,123**	**6,423**	**14,077**

The ability to analyze patterns regarding planned NHP use by age category was limited by the information provided in the awarded applications. Many applications either left the age groups of the animals unstated or involved multiple age categories, making it difficult to categorize distinct age groups. Approximately 50% of the award applications allowed for identification of age categories, which is shown in Figure 10. Despite the limited data, it is apparent that most investigators use adult animals, with a secondary preference for juvenile animals. The use of infant NHPs in research studies seems to be noticeably higher in FY20 when compared to the 2 previous and following FYs. For geriatric NHPs, the planned use for FY18 to FY19 remained quite stable before dipping in the following 3 FYs.

Figure 10. Planned NHP Usage by Age Group and FY for All Species from FY18 to FY22, Excluding Infrastructure/Resource Awards

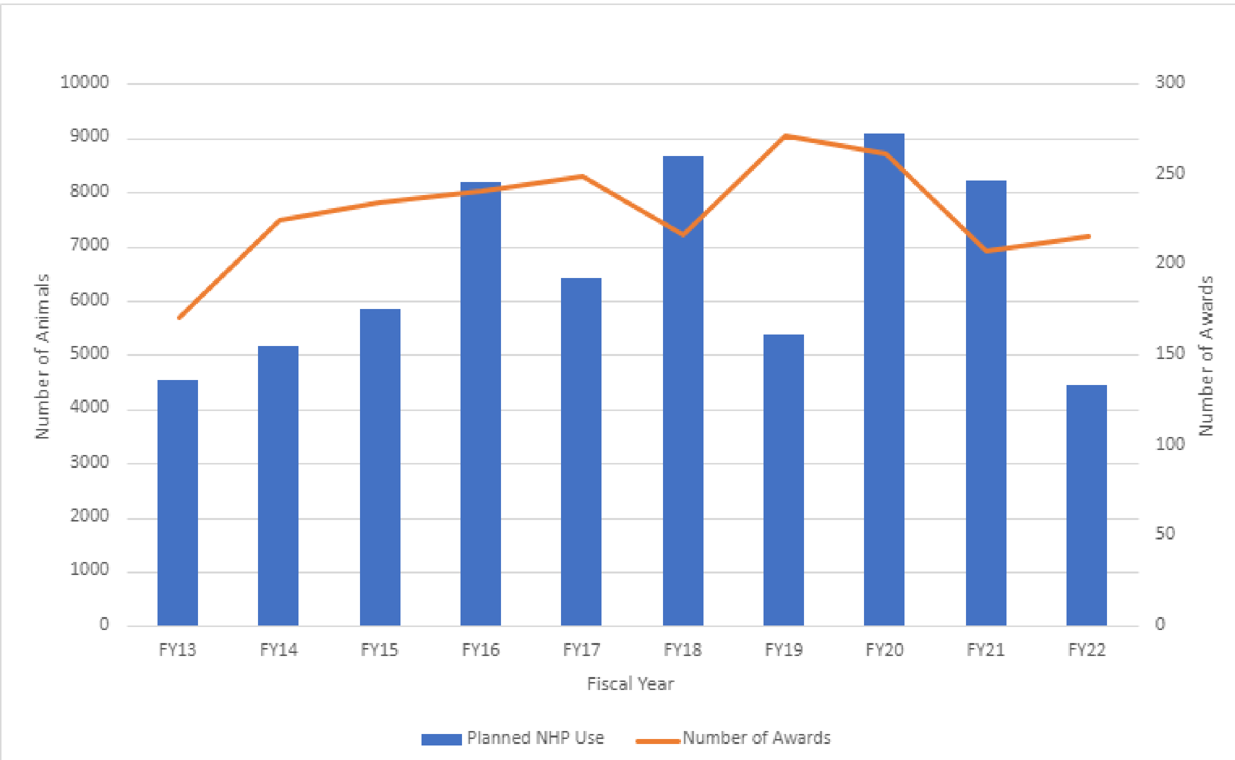


Of the total 1,175 research project awards examined in this study, 236 awarded applications were to the host institutions of the NPRCs or Caribbean Primate Research Center, and 112 awarded applications had their study site being one of the NPRCs or Caribbean Primate Research Center instead of the awarded organization. Thus, approximately 30% of the research project awards were to be performed at an NPRC or the Caribbean Primate Research Center. Given that rhesus macaque is the most used NHP species, Figure 11 displays the planned usage of this species for each NPRC by scientists located at the NPRC's host institution ("Internal PI") versus scientists from an external organization who indicated using the NPRC host institution to perform their research ("External PI"). The planned use for both internal and external PIs at California NPRC and Emory NPRC seem to be aligned with the overall rhesus macaque planned use across all organizations, with similar numbers between FY18 to FY20, rising notably in FY21, and then declining again in FY22. Oregon NPRC is the only center that shows a fairly steady increase in planned number of rhesus macaque to be used. The remaining centers show variability in planned usage when accounting for both types of PIs. These data should be interpreted with caution, as this information is not consistently available in the awarded applications. Some applications may not specify study sites to allow flexibility in where the study is performed. Likewise, PIs may wait until the project is funded to select a site.

Figure 11. Planned Use of Rhesus Macaques at the NPRCs and Caribbean Primate Research Center for FY18 to FY22, Excluding Infrastructure/Resource Awards

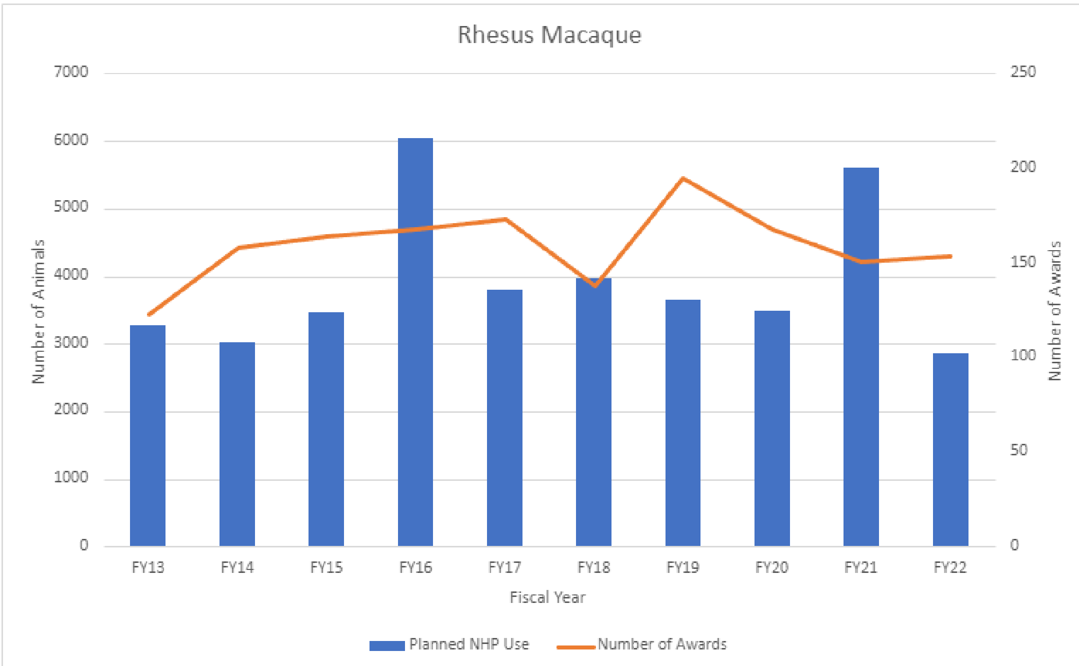
In examining trends from the current and previous 5-year evaluation periods of extramural planned NHP use in research awards other than infrastructure/resource, an 18% increase in planned NHP use occurred, with a total of 30,174 animals (Table 6)[2] across the different species for FY13 to FY17 and a total of 35,802 animals (Table 4) for FY18 to FY22. The numbers of animals used each year fluctuated with planned usage, hovering around 4,000 to 5,000 NHPs in FY13 to FY14, FY19, and FY22; around 6,000 NHPs in FY15 and FY17; and more than 8,000 NHPs for FY16, FY18, and between FY20 and FY21. Figure 12 demonstrates the trends across the 10-year period. Data for FY13 to FY17 were obtained from the previous NHP Evaluation and Analysis report published on the ORIP website in 2018.[2]

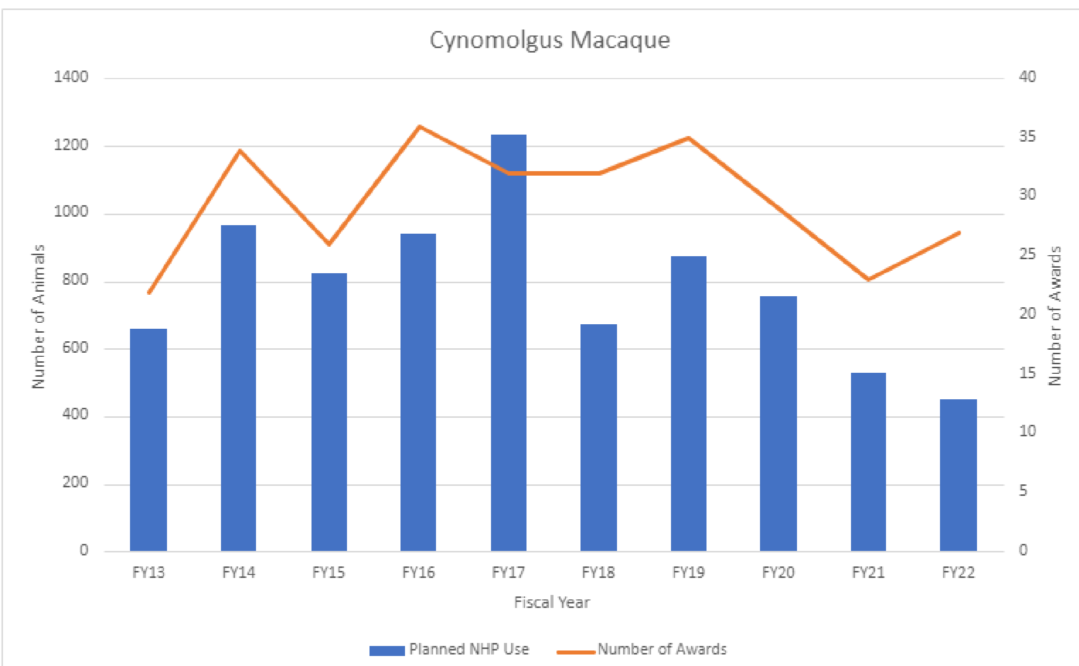
Figure 12. Planned NHP Usage Distribution During the 10-Year Period For Research Awards, Excluding Infrastructure/Resource Awards

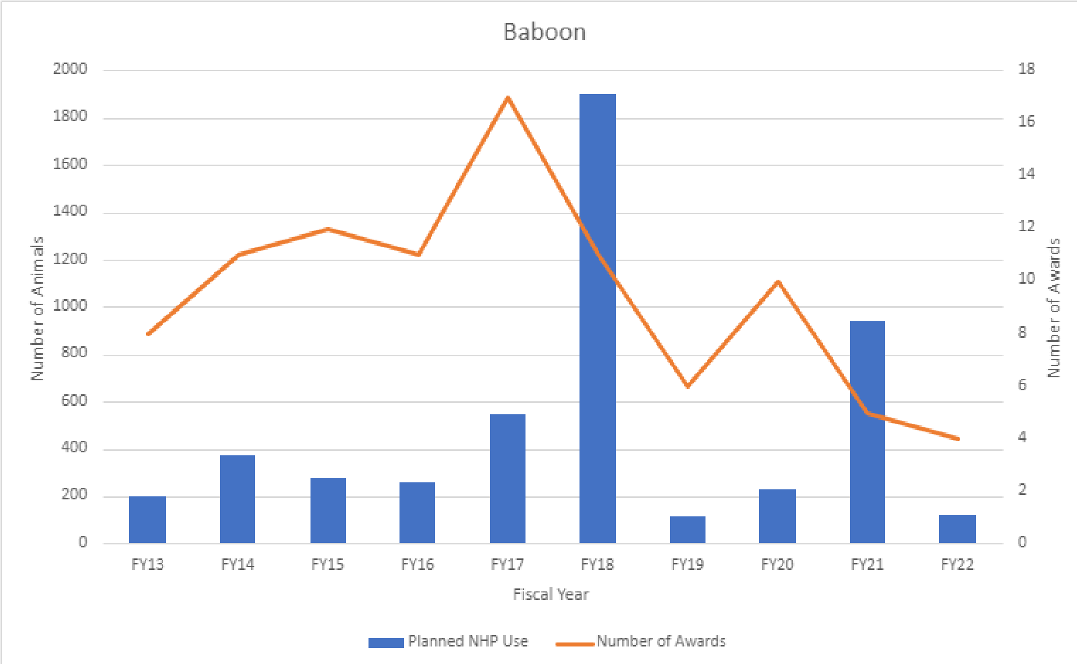


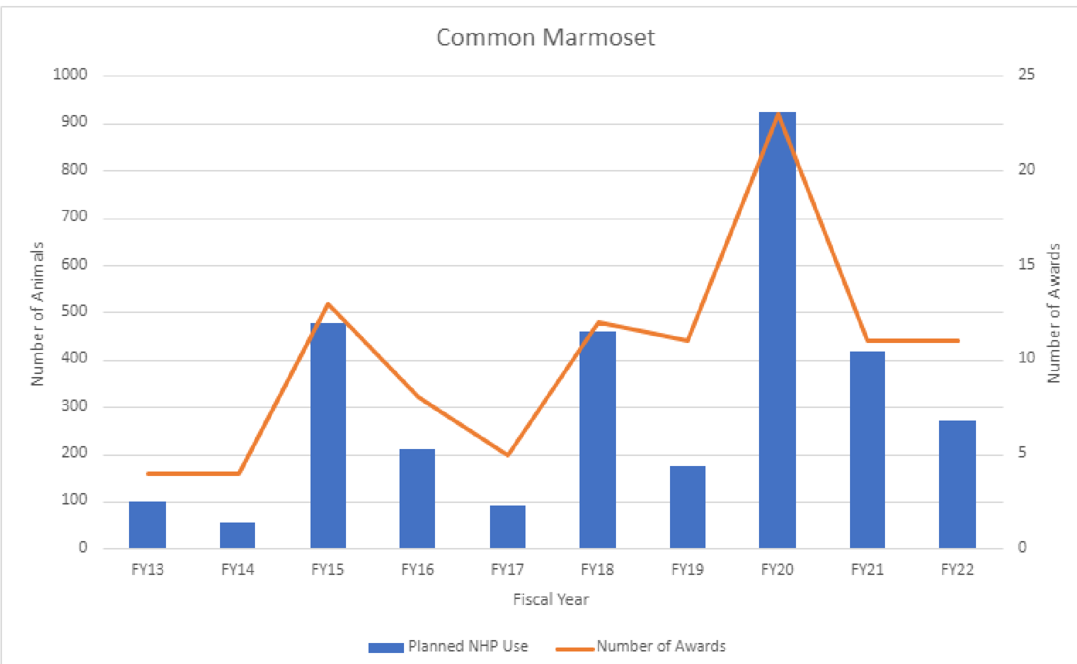
The usage of rhesus macaques shows an interesting trend when analyzed during the two 5-year periods. Although the total usage has remained about the same at 19,000 animals, the planned use in the first 3 years (FY13 to FY15 and FY18 to FY20) remained stable before increasing rapidly in the fourth year (FY16 and FY21) and then again dropping to a similar level as the first 3 years in the fifth year of the time period. Planned number of cynomolgus macaques to be used dropped between the two 5-year evaluation periods, with a drop of approximately two-thirds when comparing FY17 to FY22. Although there seems to be a two-fold increase in the use of baboons when looking at the number from the two 5-year periods, the reason for this increase points to a substantially higher planned use in FY18 and FY21. It is unclear whether the overall increase will continue over time given that the number of awards with baboons decreased in FY21 and FY22. Meanwhile, there seems to be a sizable increase in the usage of marmosets, with only 936 animals planned to be used between FY13 and FY17, which increased to 2,221 animals planned to be used between FY18 and FY22. The shorter life span and smaller size of marmosets tends to appeal to investigators, especially in neuroscience and aging research. Figure 13 displays planned usage and number of awards for the four species in FY13 to FY22.

Figure 13. Planned NHP Usage Distribution During the 10-Year Period for Rhesus Macaque, Cynomolgus Macaque, Baboon, and Common Marmoset, Excluding Infrastructure/Resource Awards









Intramural Usage Trends

Table 8 presents the annual acquisitions of various NHP species for intramural NIH use spanning FY18 to FY22. These numbers exclusively account for animals obtained from external sources and may not encompass all intramural usage. Three-fourths of the animals obtained between FY18 and FY22 were rhesus macaques. Cynomolgus macaques make up around 13% of all animals used. The number of rhesus macaques and cynomolgus macaques have been quite steady across the 5-year period, and these are the predominant species utilized. The overall NHP use remained relatively consistent.

Table 8. Annual Acquisition of NHPs for Intramural NIH Use by Species

Species	Number of Animals by FY				
	FY18	FY19	FY20	FY21	FY22
Rhesus Macaque	555	626	655	581	644
Cynomolgus Macaque	91	105	92	119	131
Marmoset	22	47	93	-	-
African Green (Vervet) Monkey	26	-	50	34	7
Owl Monkey	-	28	48	-	-
Squirrel Monkey	20	-	28	-	22
Pigtail Macaque	18	10	10	20	-
Capuchin	-	-	-	-	17
All Species	**732**	**816**	**976**	**754**	**821**

The data for NIH intramural investigators align quite well with the awarded grant data for extramural projects. NIAID is the main sponsor across grant-funded projects and intramural research initiatives, and most of the animals obtained for intramural use were assigned to infectious disease research. The distribution of animals by the sponsoring NIH institute is displayed in Table 9. NIAID intramural usage accounted for 75% of all animals obtained in the 5-year period, ranging from 67% to 86% of animals acquired in a single year. The National Cancer Institute makes up around 13% of all animals used, followed by NIMH at 6%.

Table 9. Annual Acquisition of NHPs for Intramural NIH Use by Institute

NIH Institute	Number of Animals by FY				
	FY18	FY19	FY20	FY21	FY22
National Institute of Allergy and Infectious Diseases	569	547	704	552	704
National Cancer Institute	86	167	111	132	43
National Institute of Mental Health	41	88	82	26	36
National Heart, Lung, and Blood Institute	16	-	25	44	4
National Institute of Neurological Disorders and Stroke	-	-	50	-	-
National Institute on Drug Abuse	20	-	-	-	12
National Institute on Aging	-	10	-	-	19
National Eye Institute	-	4	4	-	3
All Institutes	**732**	**816**	**976**	**754**	**821**

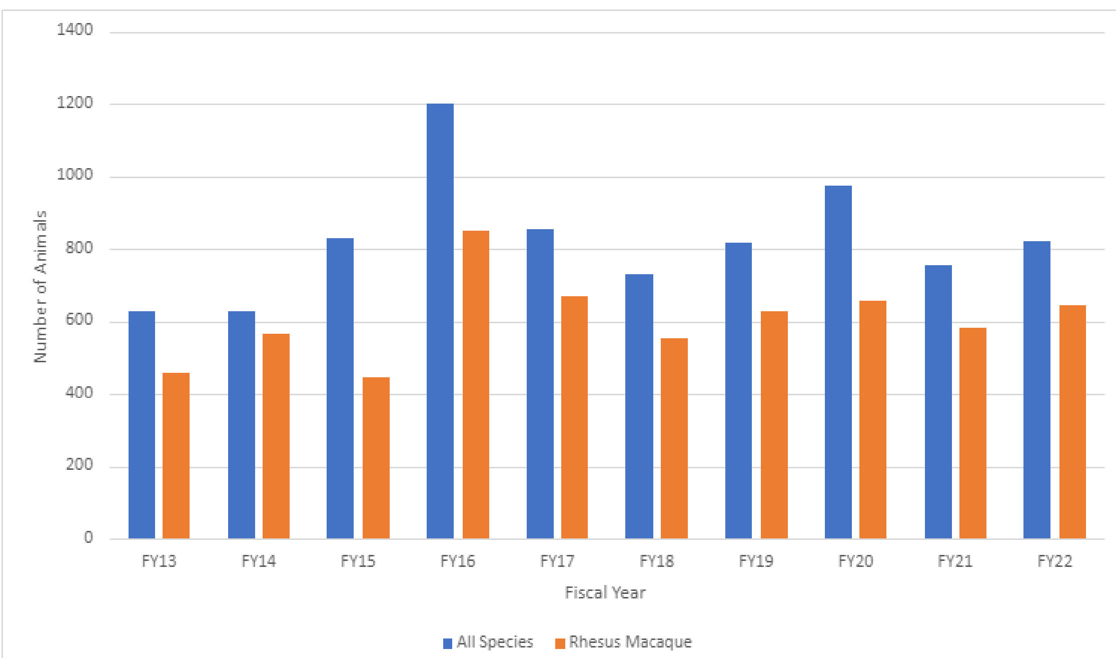
More than half (55%) of the NHPs obtained for intramural use came from NIH intramural colonies, followed by commercial vendors which make up 25% of the number of NHPs acquired in the 5-year period between FY18 and FY22. Table 10 exhibits the distribution of NHP acquisition for intramural use by the type of supplier. All 2,257 animals supplied by NIH intramural colonies were rhesus macaques, whereas all of the cynomolgus macaques were supplied by commercial vendors. Lesser used owl monkeys and squirrel monkeys were supplied only by ORIP-supported colonies, and capuchins were supplied by commercial vendors. All types of vendors supplied rhesus macaques for intramural use, although the quantities vary.

Table 10. Annual Acquisition of NHPs for Intramural NIH Use by Supplier Type

Source	Number of Animals by FY					FY18 22 Total	% of Total
	FY18	FY19	FY20	FY21	FY22		
NIH Intramural Colony	525	340	389	444	559	2,257	55%
Commercial Vendors	145	218	373	129	148	1,013	25%
NPRCs	-	206	113	72	13	404	10%
Other: ORIP-Supported Colony	26	38	86	20	57	227	6%
Other: Federal Laboratory	16	-	10	77	37	140	3%
Other: University Supplier	20	14	5	12	7	58	1%
All Suppliers	**732**	**816**	**976**	**754**	**821**	**4,099**	**100%**

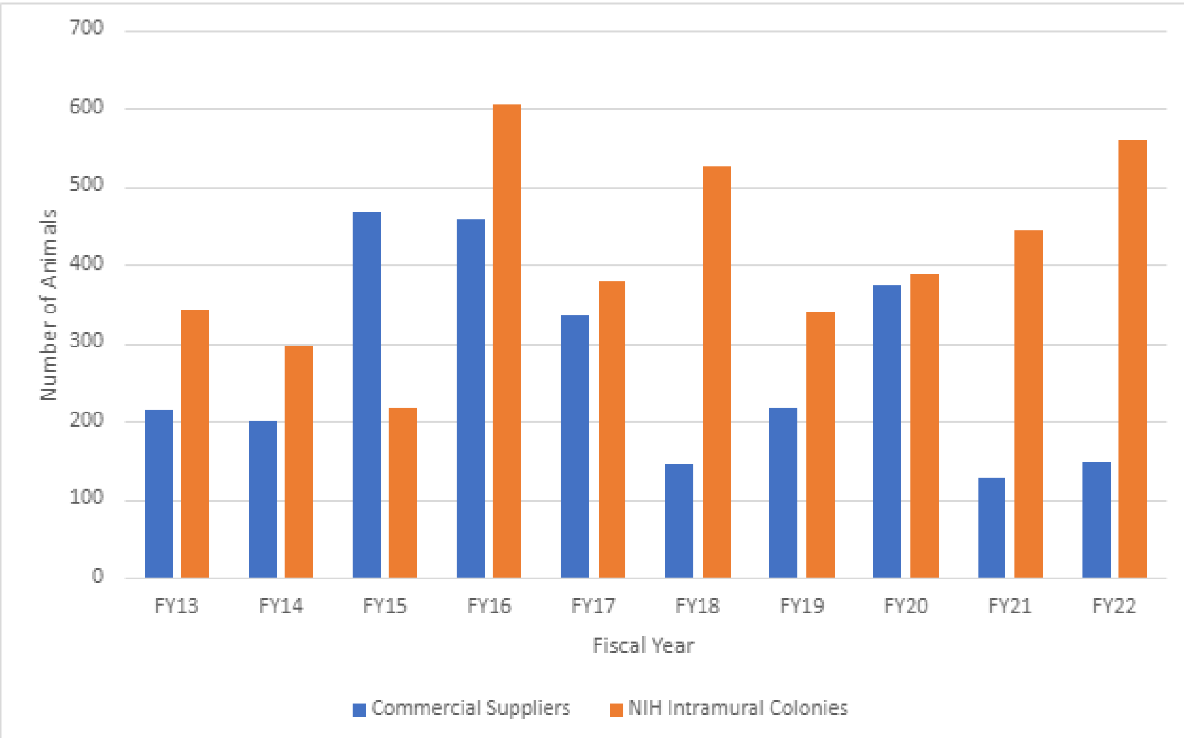
In comparing the current and previous 5-year periods of intramural data, the total NHP usage has not changed dramatically, with 4,137 animals used from FY13 to FY17 and 4,099 animals used between FY18 and FY22. Intramural NHP usage from FY13 to FY22 is shown in Figure 14. Data for FY13 to FY17 were obtained from the previous NHP Evaluation and Analysis report published on the ORIP website in 2018.[2] As noted in the previous evaluation, a large surge in the usage of rhesus macaques occurred in FY16, but this declined slightly the following year and has remained relatively constant through FY22.

Figure 14. Annual Intramural NHP Usage for All Species and Rhesus Macaque from FY13 to FY22



A notable change in the source of the NHPs used in NIH intramural research between the two 5-year periods was apparent. During the FY13–FY17 period, intramural researchers obtained 41% of their NHPs from commercial vendors, whereas during the FY18–FY22 period, only 25% of NHPs were obtained from commercial vendors. NIH intramural colonies provided 55% of the NHPs during the FY18–FY22 period, as opposed to only 44% in the previous FY13–FY17 period. The decreased reliance on commercial providers by intramural researchers reflects the reduced availability of NHPs, the decrease in NHP imports, and the high demand and cost of these animals. NIH intramural colonies are currently compensating for the decreased availability from commercial vendors. Figure 15 shows the number of NHPs obtained from commercial sources and intramural colonies during the past 10 years.

Figure 15. Annual Number of NHPs Obtained for Intramural Studies from Commercial Supplier and NIH Intramural Colonies from FY13 to FY22



National NHP Trends

In examining NHP usage trends from the major NHP facilities listed in Table 1, the USDA data[3] demonstrated a continued increase in the use of NHPs in biomedical research across all research organizations for FY18 to FY21, with a slight decline for FY22. However, the total used in research in FY22 was still roughly 12% greater than the numbers of NHPs used in FY18. Figure 16 presents the aggregate number of animals used in research per FY to identify broader usage trends. Additionally, Figure 17 provides a more nuanced breakdown, categorizing the NHP usage based on the types of organization. CROs and other private organizations make up the majority of the usage each year and appear to be the driving force behind the increase each FY. Usage by pharmaceutical companies appears relatively consistent, whereas NPRC and NIH-supported research use appears to have declined slightly, although this may simply reflect annual variability. Alternatively, the decline may reflect animal availability as production remains static at the NIH-supported colonies.

Figure 16. Number of Animals Used for Research Reported to USDA APHIS by FY from FY18 to FY22

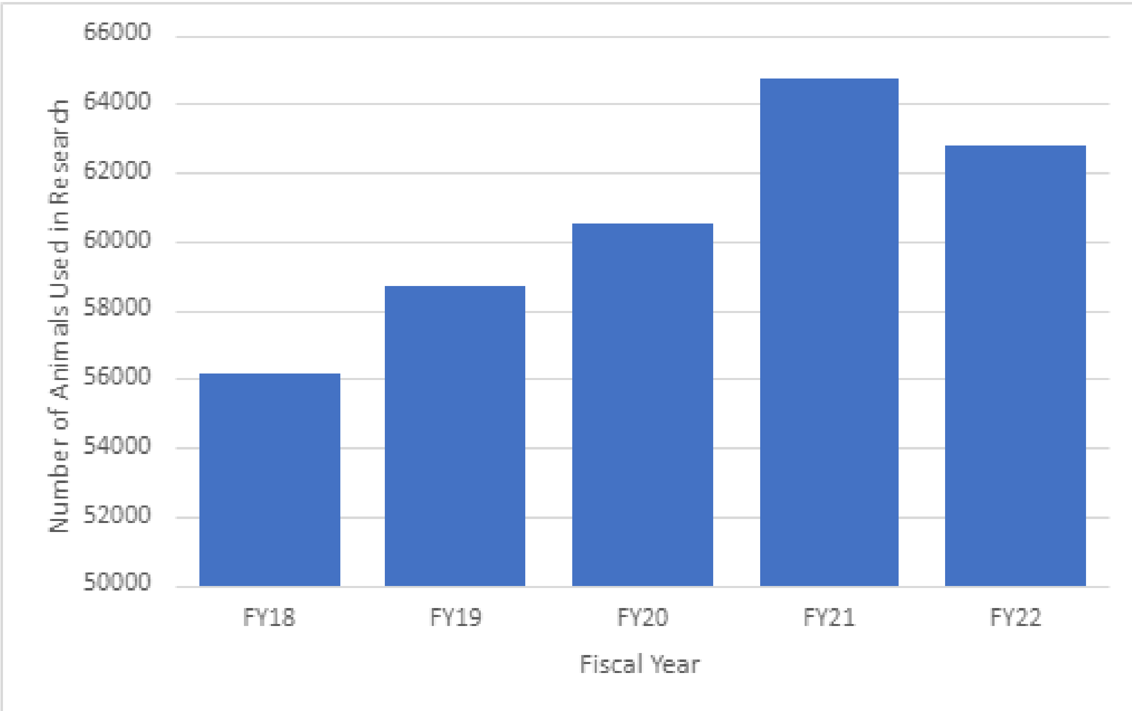
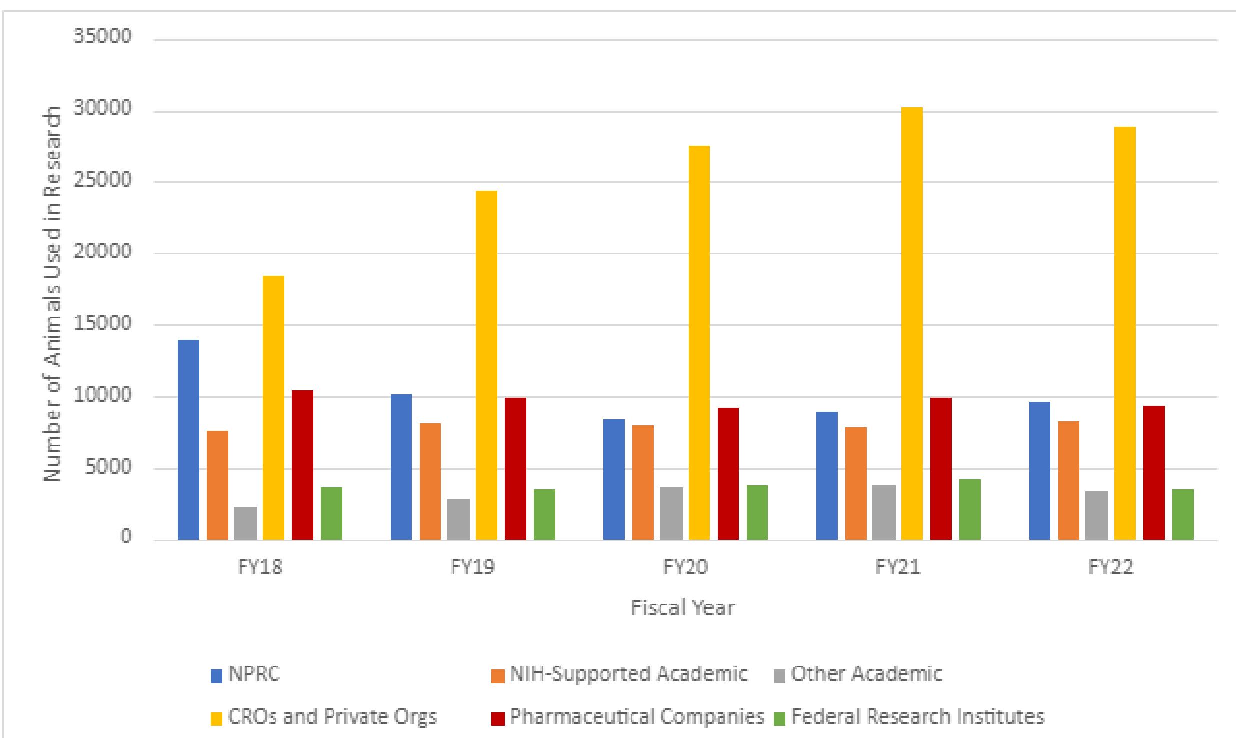


Figure 17. Number of Animals Used for Research Reported to USDA APHIS by FY and Organization Type from FY18 to FY22



In exploring importation trends from data provided by CDC[4] from FY18 to FY23, the number of NHPs imported between FY18 and FY22 appeared to be stable but then decreased by nearly half in FY23. The majority of imports were cynomolgus macaques, making up an average of 94% of the imported animals in terms of NHPs. With China implementing an export ban on NHPs since the beginning of 2020, increases in imported Cambodian-origin cynomolgus macaques between FY20 and FY22 and imported Mauritian-origin cynomolgus macaques from FY20 to FY23 have been observed.

The number of rhesus macaques imported to the United States has also dropped significantly from FY18 to FY23, with no importation taking place in FY23. Almost all of the rhesus macaques imported over the years have been from China. The largest African green (vervet) monkey exporter has been Saint Kitts and Nevis; however, since FY20, the United States has imported this species from Barbados as well. Most importations of marmosets had come from South Africa, whereas squirrel monkeys and capuchins were mainly imported from Guyana. Table 11 shows the importation number for each species from FY18 to FY23.

Table 11. United States Imports of NHPs by FY from FY18 to FY23

Species	FY					
	FY18	FY19	FY20	FY21	FY22	FY23
Cynomolgus Macaque	28,038	31,313	25,637	31,242	28,765	16,290
Rhesus Macaque	1,685	960	317	34	17	0
African Green (Vervet) Monkey	298	192	964	636	639	487
Common Marmoset	201	160	370	252	80	160
Squirrel Monkey	17	30	97	5	85	80
Capuchin	8	15	0	66	30	10
Other NHPs	70	9	44	41	51	15
Total	**30,317**	**32,679**	**27,429**	**32,276**	**29,667**	**17,042**

Assessment of Current NHP Landscape and Forecast of Future NHP Demands

Following a comprehensive analysis of the collected interview responses, it became evident that some commonalities were shared by the interviewees, as well as diverse perspectives. In this section, key findings distilled from these responses are presented, highlighting critical themes and observations. It is important to note that to uphold confidentiality of the participants and safeguard proprietary or commercially sensitive information, the results from individual organizations have been de-identified.

To start, interviewees from NPRCs and a few academic institutions, especially those holding NIH-supported colonies, shared that their primary customers are NIH-supported investigators. In addition to NIH-funded investigators, some academic institutions support nonprofit organizations and private industry entities, such as pharmaceutical companies, and a few serve investigators working under the U.S. Department of Defense and U.S. Food and Drug Administration, as well as through other government contracts. In addition, a small portion of the academic institutions maintain NHPs to be used internally by their own researchers. Privately owned organizations typically provide NHPs for-profit, primarily to pharmaceutical and biotechnology companies, and to a lesser extent to academic investigators. A few private organizations also manage macaque colonies under contracts from NIH. These NHPs are bred and distributed as directed by the relevant NIH contract.

Capabilities and Services

When asked about new capabilities acquired since 2018, several organizations mentioned various improvements and additional resources, including new or upgraded positron emission tomography (PET) and computed tomography (CT) scanners; magnetic resonance imaging (MRI) machines; and microscopy resources, such as microscope facilities and surgical microscopes. NPRCs and several academic and private facilities offer cutting-edge flow cytometry capabilities, whereas other private facilities expanded on the areas of research they support—such as metabolic disease, ophthalmology, and cardiovascular research. Also, some facilities, including a few NPRCs, built and increased their breeding space and improved their current infrastructure for the species they maintain.

A few NPRCs also discussed improvements and new capabilities that they were able to acquire through the Coronavirus Aid, Relief, and Economic Security (CARES) Act, which were made available during the COVID-19 pandemic. Some NPRCs were able to expand specific-pathogen-free (SPF) rhesus colonies; renovate their current facilities (e.g., biosafety level 3 [BSL-3], colony management buildings); and replace outdated equipment or purchase new machines and tools, such as autoclaves, flow cytometers, telemetry equipment, and respirators. The investment in animal biosafety level 3 (ABSL-3) facilities allowed NPRCs to perform critical research in a timely manner to help develop COVID-19 vaccines and treatments. Funds from the CARES Act also were used to establish a COVID-19 Coordinating Center as a task order to an existing contract with the Tulane NPRC. The Coordinating Center worked with the seven NPRCs to establish harmonized master protocols for study procedures used in COVID-19 research. The Coordinating Center developed and harmonized 43 standard operating procedures across the seven NPRCs to support the NHP master protocols and harmonization of the research methods for a comparative series of four long-COVID-19 studies. The Coordinating Center included a data center, which collected diverse types of data incorporating demographics, inoculations and treatments, complete blood count/chemistry, urinalysis, clinical signs, viral load, and mesoscale data, as well as imaging data (radiology, plethysmography, PET-CT), telemetry, pathology, flow cytometry results, and metabolomics. This project allowed coordinated use of NHPs for comparative studies and possible future secondary and meta-analyses.

Although numerous additions and improvements have been made to capabilities and services, infrastructure issues remain a concern for NHP facilities. Several interviewees discussed either the completion of renovations or the need for renovations to their facilities. These needs include constructing new facilities, expanding or updating the existing space (e.g., renovating fencing and field cages), or converting the existing space into breeding or holding space. Almost all NHP facilities are struggling to maintain older infrastructure. In addition to the need for new facilities (e.g., quarantine, biocontainment, housing), additional space for NHPs and staff, new technological systems (e.g., laboratory informatics), and equipment (e.g., PET and CT scanners) are needed. Facilities with an abundance of land are considering developing housing to support organizations that will fund their own breeding colonies.

Human resources are another critical need for NHP facilities. Staff retention and hiring since the COVID-19 pandemic has been a challenge for many facilities, albeit in different forms. Several NPRCs and facilities housed at academic institutions cited that they cannot provide competitive salaries compared to private organizations or industry. Even though some facilities increased staff salary or other compensation and benefits during the COVID-19 pandemic, these increases have not been perceived as sufficiently competitive. Privately owned research facilities and CROs have experienced less difficulty overall with hiring and retaining staff. Nonetheless, they also have encountered problems filling positions that have been difficult to fill, including clinical laboratory animal veterinarians, for which there is an apparent national shortage, as well as animal care and technical staff. Additionally, facilities in rural areas experience additional difficulty in attracting staff. To remedy this, some privately owned research facilities have been working to provide incentives for pursuing careers in laboratory animal medicine.

Current Supply and Demands of NHPs

Generally, most facilities have found it a challenge to keep pace with customer demand for NHPs. Some factors include the size of their colonies or facilities; the increased cost of NHPs (species have different costs due to demand and local operational costs, resulting in some species increasing in cost by almost 10-fold); and lack of supply of high-demand species, such as rhesus macaques and cynomolgus macaques. Marmosets are also in high demand, particularly for studies in neuroscience, aging, and genetic research, for which they are valued for their smaller size and rapid development. Fewer facilities house large marmoset colonies, and recent investments from NIH for expansion are underway. A primary concern for growing these colonies is maintaining genetic diversity, given the limited number of current breeders. A small number of organizations have been able to keep a steady supply of macaques to meet the demands of their established customers, whereas others have relied on purchases from other organizations to meet demand. Nonetheless, opportunities to make these purchases are unpredictable, and this approach to meeting demand is not sustainable. For a few private organizations, clients—particularly pharmaceutical companies or biotechnology firms—are purchasing macaque progeny before they are born and supporting the animals until they reach maturity to fulfill their future research needs. Although some facilities have been able to meet demand, this has required staggered assignments, resulting in a longer research study or modification of specific NHP requirements, such as age, sex, or genetic characteristics. Several facilities reported refusing approximately 30% of clients because of their inability to supply the requested NHPs. It is unclear, however, whether these potential customers were able to obtain the NHPs from another facility.

Although backlogs in technical services have not yet occurred, many facilities, including NPRCs and privately owned organizations, have observed an increase in the use of their specialized services, such as PET scanners and imaging facilities, or have had certain periods during which the facilities were at capacity. Several efforts attempt to mitigate the supply issue by reassigning NHPs previously used for non-terminal studies. Nonetheless, reassignment rate varies among organizations, with some reassigning less than 5% due to most studies being terminal in nature, and other groups reporting that most or nearly all of their NHPs are reassigned to multiple studies depending on research requirements and suitability of the NHP for future studies.

Numerous organizations also reported that demands for other species have increased due to the lack of availability of preferred species. For example, rhesus macaques and cynomolgus macaques are in very high demand, but because that demand has been difficult to fill, other species and models are being requested (e.g., marmosets or baboons instead of rhesus macaques). Baboon colonies have been able to meet demand, and some facilities have reduced breeding, as this species has a relatively high fecundity rate.

Researchers have had to pivot from their original plans and utilize different NHP species that are comparable models. Some facilities cite that external requests have decreased because an increasing number of investigators know that the organization has had to decline requests in the past and have stopped sending requests to those facilities. In particular, the demand for cynomolgus macaques has far outstripped supply, as few domestic breeding colonies have been established. This species is frequently used to determine efficacy and safety of new drugs and biologics before use in humans. Concerns were expressed regarding the lack of available domestic NHPs, resulting in the need to undertake these studies in China. Specifically, researchers expressed concerns about data confidentiality and the handling of proprietary information, as well as the standard of NHP care established in foreign countries and insufficient control of the research study.

High demand and lack of supply of certain species, such as rhesus macaques and cynomolgus macaques, have contributed to longer wait times. The wait time for macaques ranged from a few months to 2 years. Other factors that affect wait time include the specificity of customers' requests regarding the age and sex combination, pathogen status, and genetic or behavioral characteristics, as well as transportation issues. Many facilities noted that customer requests have become more specific over time. These new, more specific demands have significant effects on the breeding and holding patterns (e.g., keeping animals longer for age-related studies, holding back females for breeding). For example, an increased demand exists for geriatric NHPs for aging research, such as Alzheimer's disease studies. The need for mature adult animals can increase wait times due to the lack of availability of select age groups. Some facilities also cited increased demand for infant NHPs or fetal tissue, which then affects wait time for researchers requesting female NHPs.

Regarding transportation issues, several participants cited China's current embargo on exporting NHPs to the United States as a barrier to meeting demand. Some U.S. facilities work with countries in Asia to fulfill their supply needs; however, some of the NHPs being imported from these countries (e.g., Cambodia, Vietnam) were of dubious quality, and some were suspected of being underage or wild-caught animals. Wild-caught NHPs are not well-characterized in terms of age and genetics and typically have health and other infectious disease concerns, such as tuberculosis. Relatedly, issues with upholding quarantine regulations also have affected wait time, particularly the health of the NHPs, as sick animals (e.g., diarrhea-stricken) cannot be assigned to studies. Additionally, because commercial airlines no longer transport NHPs, organizations must charter their own planes. This increases costs, and charter planes are less available compared to commercial planes. NHP facilities utilize trucking companies to ship species domestically with some success. Although some facilities did not cite negative experiences using land transportation, others noted that tracking truckers can be difficult or that availability of qualified truck drivers is quite low. Most facilities have trusted transporters that they use exclusively; this can affect wait times for researchers, as the facility is dependent on these shippers' availability. These challenges regarding wait time have forced researchers to delay their work, work with fewer NHPs, or consider accepting animals that they would not have otherwise considered.

Tracking and Forecasting Future Demands

Tracking NHP usage and forecasting future demand varied by facility. Some facilities track demand and usage via their grant submissions or requests for studies, a census, a staff coordinator or salesperson, a resource allocation committee, or an electronic record system. Forecasting demand was more challenging overall because few organizations have formal mechanisms in place. Some do so by conversing with current or new clients, conducting market analyses or surveys, or reviewing past usage or request history. Several NPRCs cited a desire to collaborate with NIH and other facilities to better understand demands, forecasting, and funding.

To better understand the obstacles in modeling future demand and the ability to produce sufficient NHPs, an additional interview was undertaken with one NPRC that employs a formal computation population model, as well as its own specific prediction model. The population model is based on a stochastic linear equation originally described by Leslie.[5] This computational model provides a robust predictor of production if the variables are updated to reflect current trends. These variables include infrastructure limits, sex ratio, breeding cycle, attrition rates for ages (natural causes or harvesting for research), fecundity, and infant mortality. This NPRC's R and Mathematica-based program pulls data from the center's animal records database. Other NPRCs perform similar analyses without the use of the computer program.

For the NPRC employing the computer program, the prediction model has been in use for the past 12 to 14 years and is based on information obtained from investigators planning to use the NPRC as a resource for obtaining NHPs (offsite research) or investigators who will perform their research at this NPRC using NHPs (onsite research). For research onsite, infrastructure limits need to be considered in the model. Investigators provide information on desired NHP characteristics, such as numbers, age, sex, and specific and genetic traits, and on research needs, such as housing requirements, assignment schedules, and duration of study. This information, as well as the funding success rate (likelihood of an application submission being funded—a variable that is updated based on actual success), are used to predict the demands for the coming 3 years. The model's prediction accuracy is excellent for forecasting the following 3 years but thereafter does not provide reliable estimates. Reasons for this reduced accuracy likely include variability in application submission/resubmissions by PIs, how NHPs are actually assigned during the funded grant period, uncertainty of which investigators are likely to submit grant applications, the changes that occur in the out-years of a grant award due to shifts in data-driven research, NIH's funding rates (which vary based on Congressional appropriations), and potential errors in the interpretation of the researchers' request. These inherent uncertainties, as well as the ongoing need to maintain current colony statistics and updated variables, hamper accurate forecasting.

In looking toward future demands, many interviewees discussed that rhesus macaques and cynomolgus macaques will continue to be the NHP species in highest demand for biomedical research. Rhesus macaques were named most frequently as suitable models for infectious disease research (e.g., HIV, tuberculosis, malaria, Zika) and neuroscience research, and cynomolgus macaques and rhesus macaques are both associated with pharmaceutical research. Some facilities also mentioned marmosets, which were associated with neuroscience and aging studies, and baboons for reproductive studies. African green (vervet) monkeys were cited as models for aging, neuroscience, and infectious disease studies, albeit at a lower demand. Overall, the biomedical fields that were named as making the most extensive use of NHPs were infectious disease, pharmaceutical or drug/vaccine research, neuroscience, and aging/Alzheimer's research. Metabolic research was also cited by some participants, as well as transgenic work, gene therapy, and genetic research. As usage in these areas will continue to require the species mentioned above, having a more reliable tool to forecast and plan for future usage of these species is imperative for the continuation of research and advancement in the biomedical field.

Survey of NHP Users to Characterize Consumer Demand

Characteristics of the Responding Participants

From December 5, 2023, to January 10, 2024, a survey was administered to PIs who utilize NHPs in their research. The survey was distributed to 1,246 unique PIs identified from the NIH awards as NHP users, and 622 respondents (50%) accessed the survey. It is important to note that the response rate was based on the number of invitations that went out, as it was not possible to indicate whether respondents accessed the survey through the invitation or whether the invitation was forwarded to them. Of the 622 respondents, 132 did not complete the survey past the first three questions, and their responses were not included in the analysis. In the remaining 490 responses, PIs stated that they are currently using or expect to use NHPs in their research from calendar years 2024 to 2028.

The distributions of confirmed NHP users by organization type and type of NHP facility at the respondent's organization are shown in Table 12 and Table 13, respectively. As observed in the 2018 report, most respondents (90%) were from universities or other academic institutions, and slightly more than 85% of the respondents were located at organizations that had an animal facility capable of supporting studies with NHPs, with roughly one-third of all respondents being located at an organization that either hosted an NPRC or hosted another NIH-supported NHP breeding colony.

Table 12. Organization Type of NHP Users

Organization Type	Number*	Percent
University or Other Academic Institution	437	89.7%
Nonprofit Organization	27	5.5%
For-profit Organization	14	2.9%
U.S. Federal Government Agency	8	1.6%
Other	1	0.2%
Total	**487**	**100%**

**Three respondents did not provide their organization type.*

Table 13. Type of NHP Facility at NHP User's Organization

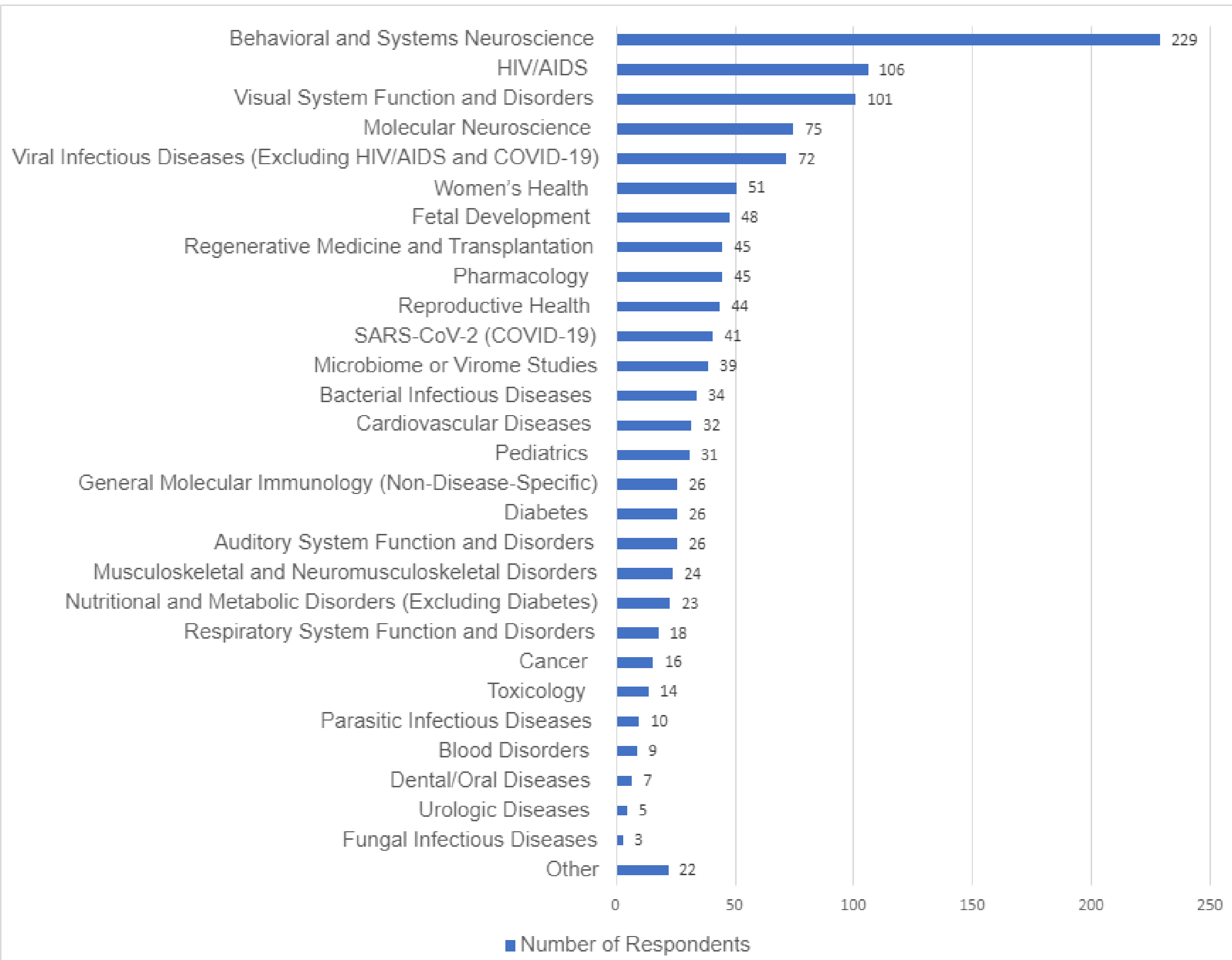
NHP Facility Type	Number*	Percent
NPRC	143	29.4%
NIH-Supported NHP Breeding Colony (Other Than NPRC)	42	8.6%
NHP-Capable Facility (Not Supported by NIH)	231	47.4%
No NHP-Capable Facilities	71	14.6%
Total	**487**	**100%**

**Three respondents did not provide their NHP facility type.*

Respondents were asked to select the areas that best described the focus of their current or planned (calendar years 2024 to 2028) research involving NHPs. Respondents could select all that applied among a list of 28 research areas. The top three research areas selected were behavioral and systems neuroscience (229 respondents), HIV/AIDS (106 respondents), and visual system function and disorders (101 respondents). Figure 18 displays the distribution of all research areas. The top three research areas remained the same as 2018,[2] but shifts in other rank orders occurred. Molecular neuroscience and viral infectious diseases were the fourth and fifth most reported research areas; in 2018, this was reversed. Fetal development, which was the 13th most reported area in 2018, is the seventh most reported in the current report. Pharmacology, which was sixth most reported in 2018, is the ninth most reported in the current report. SARS-CoV-2 and microbiome/virome studies were new research areas; they ranked as the 10th and 11th most reported, respectively, in the current report.

The distribution of research areas reported by respondents seemed to exhibit some differences compared to those observed in the awarded grants and cooperative agreements. Due to variations in the methods used to classify research areas, a direct comparison of each research area between survey respondents and awardees is not feasible. However, similar to the previous report, certain research areas—such as fetal development, cardiovascular disease, diabetes, nutritional and metabolic disorders, and regenerative medicine and transplantation—were notably more prevalent among survey respondents, occurring three to four times more frequently than in the award data. This implies that investigators in these areas may be overrepresented in the survey responses.

Figure 18. Research Areas Involved in NHP Use



Estimated NHP Use

Respondents were asked to indicate up to three NHP species that they currently use or anticipate using in their research during the next 5 years, as shown in Table 14. A total of 459 survey respondents answered this question. Of the 459 respondents, 283 indicated that they plan to use only a single species. Of the respondents, 130 estimated using two species and 44 estimated using three species. Rhesus macaque were the species most investigators planned to use, followed by African green (vervet) monkey, cynomolgus macaque, marmoset, baboon, and squirrel monkey. Estimated use by species was relatively constant across all 5 calendar years (2024 to 2028), except for African green (vervet) monkey, whose estimated usage in 2024 and 2025 was between approximately 3,300 to 4,900, whereas usage from 2026 to 2028 was about 900. Estimated usage of squirrel monkey and owl monkey also slightly differed across the years, such that estimated usage in calendar years 2024, 2025, and 2026 was slightly greater than estimated usage in calendar years 2027 and 2028.

Table 14. Estimated Annual NHP Use, by Species and Location of Studies

Species	NHP Study Site	Estimated NHP Use by Calendar Year**				
		2024	2025	2026	2027	2028
Rhesus Macaque	NPRC	5,887	5,497	5,639	5,321	5,228
	Other NIH-Supported NHP Center	1,068	1,004	1,016	994	980
	Other NHP Center (Not NIH-Supported)*+	1,512	1,535	1,510	1,478	1,443
	Unknown^	4	4	4	4	4
	Total All Sites	8,471	8,040	8,169	7,797	7,655
African Green (Vervet) Monkey	NPRC	49	74	74	69	69
	Other NIH-Supported NHP Center	570	577	571	580	580
	Other NHP Center (Not NIH-Supported)*	2,762	4,262	262	262	262
	Total All Sites	3,381	4,913	907	911	911
Cynomolgus Macaque	NPRC	251	347	306	297	303
	Other NIH-Supported NHP Center	279	251	266	271	271
	Other NHP Center (Not NIH-Supported)*	1,175	1,202	1,215	1,159	1,206
	Total All Sites	1,705	1,800	1,787	1,727	1,780
Marmoset	NPRC	535	388	357	330	237
	Other NIH-Supported NHP Center	247	266	301	301	301
	Other NHP Center (Not NIH-Supported)*	911	1,012	1082	1,118	1,180
	Total All Sites	1,693	1,666	1,740	1,749	1,718
Baboon	NPRC	242	244	225	211	216
	Other NIH-Supported NHP Center	93	98	117	89	82
	Other NHP Center (Not NIH-Supported)*	161	171	136	127	87
	Total All Sites	496	513	478	427	385
Squirrel Monkey	NPRC	203	213	15	15	15
	Other NIH-Supported NHP Center	122	146	146	146	142
	Other NHP Center (Not NIH-Supported)*	91	95	91	91	91
	Total All Sites	416	454	252	252	268
Pigtail Macaque	NPRC	127	79	81	71	71
	Other NIH-Supported NHP Center	16	16	16	20	20
	Other NHP Center (Not NIH-Supported)*	44	42	42	42	42
	Total All Sites	187	137	139	133	133
Japanese Macaque	NPRC	81	93	133	128	125
	Other NIH-Supported NHP Center	-	-	-	-	-
	Other NHP Center (Not NIH-Supported)*	31	31	31	31	31
	Total All Sites	112	124	164	159	156
Patas Monkey	NPRC	-	-	-	-	-
	Other NIH-Supported NHP Center	-	-	-	-	-
	Other NHP Center (Not NIH-Supported)*	72	72	72	72	72
	Total All Sites	72	72	72	72	72
Owl Monkey	NPRC	60	60	60	-	-
	Other NIH-Supported NHP Center	-	-	-	-	-
	Other NHP Center (Not NIH-Supported)*	2	2	2	2	2
	Total All Sites	60	62	62	2	2

Dusky Titi Monkey	NPRC	30	30	30	30	30
	Other NIH-Supported NHP Center	-	-	-	-	-
	Other NHP Center (Not NIH-Supported)*	-	-	-	-	-
	Total All Sites	30	30	30	30	30
Capuchin	NPRC	18	18	18	18	18
	Other NIH-Supported NHP Center	2	2	3	3	3
	Other NHP Center (Not NIH-Supported)*	6	6	6	6	6
	Total All Sites	26	26	27	27	27
Sooty Mangabey	NPRC	-	18	8	12	12
	Other NIH-Supported NHP Center	-	-	-	-	-
	Other NHP Center (Not NIH-Supported)*	-	-	-	-	-
	Total All Sites	-	18	8	12	12
Other Nonhuman Primates	NPRC	-	-	-	-	-
	Other NIH-Supported NHP Center	-	-	-	-	-
	Other NHP Center (Not NIH-Supported)*	4	4	4	4	4
	Total All Sites	4	4	4	4	4
Tamarin	NPRC	-	-	-	-	-
	Other NIH-Supported NHP Center	-	-	-	-	-
	Other NHP Center (Not NIH-Supported)*	-	-	-	-	-
	Total All Sites	-	-	-	-	-

**NHP facilities not directly supported by NIH located in an academic or nonprofit organization, commercial research organization, or federal agency.*

***When indicating species usage, if respondents provided a range (e.g., "50 to 100"), the largest number in the range was used when calculating total usage.*

[+]*One respondent who works for a United States federal government agency stated that NHP studies will be conducted at their organization but did not specify whether their facility supports NHP studies.*

[^]*One respondent who works for a university specified that their organization does not support NHP studies but did not specify where their NHP studies would be conducted. Therefore, their species usage is reported separately.*

In addition to providing an estimated usage of species, respondents also provided the approximate sex ratio, age categories, and pathogen status for their chosen species (across all calendar years, 2024 to 2028). In examining sex ratio preferences within the top six species, most respondents preferred a 50% female/50% male distribution. Squirrel monkey had the same number of respondents preferring a 50/50 distribution and indicating sex as not being too critical when compared to availability. In 2018, use of females for African green (vervet) monkey was more prevalent, but sex distribution in 2022 was more balanced. Table 15 shows the estimated use of males and females for each species. The estimated distribution by sex was only provided by respondents as the approximate percentage of each sex among all animals planned for the 5-year period. A wide range of respondents (3% to 36%, depending on species) were either unable to estimate the distribution of animals by sex in their studies or were indifferent as to the sex of the NHPs.

Table 15. Estimated Sex Distribution for Major NHP Species

Reported Sex Distribution for Animals Used	Number of Respondents by Species: Rhesus Macaque	African Green (Vervet) Monkey	Cynomolgus Macaque	Marmoset	Baboon	Squirrel Monkey
1 = 100% Female	15 (4%)	3 (11%)	6 (6%)	2 (3%)	3 (10%)	0 (0%)
2 = 75% Female/25% Male (Or Mostly Female)	29 (8%)	5 (19%)	5 (5%)	2 (3%)	5 (17%)	1 (7%)
3 = 50% Female/50% Male	189 (51%)	15 (56%)	60 (56%)	51 (80%)	18 (60%)	5 (36%)
4 = 25% Female/75% Male (Or Mostly Male)	41 (11%)	0 (0%)	7 (7%)	1 (2%)	1 (3%)	2 (14%)
5 = 100% Male	28 (8%)	1 (4%)	5 (5%)	0 (0%)	2 (7%)	1 (7%)
6 = Unknown (Or Will Use Either Sex as Available)	71 (19%)	3 (11%)	24 (22%)	8 (13%)	1 (3%)	5 (36%)
Total	**373 (100%)**	**27 (100%)**	**107 (100%)**	**64 (100%)**	**30 (100%)**	**14 (100%)**
	Number of Animals by Species*: Rhesus Macaque	**African Green (Vervet) Monkey**	**Cynomolgus Macaque**	**Marmoset**	**Baboon**	**Squirrel Monkey**
Total Estimated Female Use (Excluding "Unknown")	19,453 (52%)	6,134 (57%)	4,170 (52%)	4,252 (51%)	1,330 (58%)	766 (50%)
Total Estimated Male Use (Excluding "Unknown"")	17,741 (48%)	4,634 (43%)	3,781 (48%)	4,027 (49%)	945 (42%)	752 (50%)

**When calculating the total estimated use by species and sex, if the resulting number was a decimal, it was rounded to the next whole number (e.g., 100.2 ~ 101).*

Regarding planned age categories, 460 respondents provided the age categories that applied within each NHP species that they currently use or plan to use. This question allowed multiple age categories to be selected, and respondents selected age categories for each species that they currently use or propose to use; therefore, 1,202 total selections were received (Table 16). Examining preferred age categories overall, 50% (n = 597) of responses were for adult NHPs, followed by juveniles at 27% (n = 321). In examining results by age and species, most users (50% or more) preferred adult NHPs. Although adults were preferred for African green (vervet) monkey, baboon, capuchin, and common marmoset, each of these were less than 50% of users. For these four species, a higher percentage of infants was preferred in comparison to other species. Researchers also had a somewhat higher preference for geriatric NHPs for these four species; African green (vervet) monkey received a 28% preference for geriatric NHPs, the highest among the listed species. Dusky tiki monkey, due to their low number of respondents, are considered an outlier.

Table 16. Estimated Age Category Distribution for NHP Species

	Number of Responses by Age Categories and Species*				
	Infant	Juvenile	Adult	Geriatric	Total
African Green (Vervet) Monkey	8 (14%)	10 (18%)	23 (40%)	16 (28%)	**57 (100%)**
Baboon	6 (11%)	16 (30%)	25 (47%)	7 (13%)	**54 (100%)**
Capuchin Monkey	1 (11%)	2 (22%)	4 (44%)	2 (22%)	**9 (100%)**
Common Marmoset	27 (18%)	40 (27%)	60 (40%)	23 (15%)	**150 (100%)**
Cynomolgus Macaque	6 (4%)	52 (31%)	95 (56%)	17 (10%)	**170 (100%)**
Dusky Titi Monkey	-	-	1 (50%)	1 (50%)	**2 (100%)**
Japanese Macaque	1 (6%)	5 (29%)	9 (53%)	2 (12%)	**17 (100%)**
Owl Monkey	-	1 (33%)	2 (67%)	-	**3 (100%)**
Patas Monkey	-	1 (50%)	1 (50%)	-	**2 (100%)**
Pigtail Macaque	5 (10%)	15 (30%)	27 (54%)	3 (6%)	**50 (100%)**
Rhesus Macaque	68 (10%)	173 (26%)	332 (50%)	86 (13%)	**659 (100%)**
Sooty Mangabey	-	2 (50%)	2 (50%)	-	**4 (100%)**
Squirrel Monkey	-	3 (14%)	14 (67%)	4 (19%)	**21 (100%)**
Tamarin	-	-	-	-	**-**
Other NHPs	-	1 (25%)	2 (50%)	1 (25%)	**4 (100%)**
Total	122 (10%)	321 (27%)	597 (50%)	162 (13%)	**1,202 (100%)**

**Zero respondents selected tamarins as their currently used/planned species.*

Regarding planned pathogen status, 352 respondents provided the pathogen-status categories that apply within the NHP species that they plan to use. This question, which was new for this 2022 survey, was a select-all-that-apply question, and respondents selected pathogen statuses for each species that they selected; therefore, there were 1,398 total selections (Table 17). Examining preferred pathogen status overall, distribution was fairly even among simian type D retrovirus (SRV)–free, simian immunodeficiency virus (SIV)–free, simian T cell lymphotropic/leukemia virus (STLV)–free, and Cercopithecine herpesvirus 1 (CHV-1)–free statuses. SIV-free NHPs were selected the most (27%) and the least selected was CHV-1-free NHPs (19%). Examining results by pathogen status and species, preferred pathogen status was also fairly even. No particular species appeared to deviate greatly from the overall findings. Respondents could also include other preferred pathogen statuses, which represented 9% of the overall results. Other statuses included adeno-associated viruses (AAV or AAV9), cytomegalovirus (or CMV)–free, lymphocryptovirus-free, *Mycobacterium tuberculosis*–free, SARS-CoV-2 (both free and positive), simian-human immunodeficiency virus (SHIV)–free, and simian varicella virus–free.

Table 17. Estimated Pathogen Status for NHP Species

	Number of Responses by Pathogen Status and Species*					
	SRV free	SIV free	STLV free	CHV 1 free	Other	Total
African Green (Vervet) Monkey	12 (23%)	14 (27%)	11 (21%)	11 (21%)	4 (8%)	**52 (100%)**
Baboon	10 (21%)	11 (23%)	10 (21%)	9 (19%)	7 (15%)	**47 (100%)**
Capuchin	2 (22%)	2 (22%)	2 (22%)	2 (22%)	1 (11%)	**9 (100%)**
Common Marmoset	20 (22%)	22 (25%)	20 (22%)	17 (19%)	10 (11%)	**89 (100%)**
Cynomolgus Macaque	61 (23%)	74 (27%)	56 (21%)	57 (21%)	22 (8%)	**270 (100%)**
Dusky Titi Monkey	1 (25%)	1 (25%)	1 (25%)	1 (25%)	-	**4 (100%)**
Japanese Macaque	6 (26%)	7 (30%)	5 (22%)	4 (17%)	1 (4%)	**23 (100%)**
Owl Monkey	1 (33%)	1 (33%)	1 (33%)	-	-	**3 (100%)**
Patas Monkey	1 (25%)	1 (25%)	1 (25%)	1 (25%)	-	**4 (100%)**
Pigtail Macaque	16 (21%)	21 (28%)	17 (22%)	16 (21%)	6 (8%)	**76 (100%)**
Rhesus Macaque	182 (23%)	219 (28%)	167 (21%)	143 (18%)	72 (9%)	**783 (100%)**
Sooty Mangabey	1 (20%)	2 (40%)	1 (20%)	1 (20%)	-	**5 (100%)**
Squirrel Monkey	5 (28%)	4 (22%)	4 (22%)	3 (17%)	2 (11%)	**18 (100%)**
Tamarin	-	-	-	-	-	**-**
Other NHPs	4 (27%)	4 (27%)	4 (27%)	3 (20%)	-	**15 (100%)**
Total	322 (23%)	383 (27%)	300 (21%)	268 (19%)	123 (9%)	**1,398 (100%)**

**Zero respondents selected tamarins as their currently used/planned species.*

Lastly, respondents indicated the likelihood that they would obtain their chosen species from the source identified in their research project application/proposal (Table 18). Examining results across the six major species (i.e., rhesus macaques, African green (vervet) monkey, cynomolgus macaque, marmoset, baboon, and squirrel monkey), nearly half (41%) of responses indicated that it was extremely likely and that they would prefer to use the identified source; 28% of responses were neutral, and 22% of responses indicated that it was likely that they would use their identified source but would be willing to consider NHPs from another source. Examining results within the six major species, results were relatively similar. The exception was cynomolgus macaque, for which 46% of responses were neutral, 25% were likely, and 16% extremely likely to use the source identified in their project application/proposal.

Table 18. Likelihood of Obtaining Species from Source Identified in Application/Proposal

	Number of Responses by Species					
	Rhesus Macaque	African Green (Vervet) Monkey	Cynomolgus Macaque	Marmoset	Baboon	Squirrel Monkey
Extremely Likely (90–100%)	166 (45%)	15 (56%)	17 (16%)	29 (46%)	16 (53%)	6 (43%)
Likely (50–90%)	78 (21%)	5 (19%)	27 (25%)	13 (21%)	10 (33%)	3 (21%)
Neutral	97 (26%)	7 (26%)	49 (46%)	16 (25%)	3 (10%)	3 (21%)
Unlikely (10–50%)	19 (5%)	0 (0%)	6 (6%)	2 (3%)	1 (3%)	1 (7%)
Extremely Unlikely (0–10%)	12 (3%)	0 (0%)	8 (7%)	3 (5%)	0 (0%)	1 (7%)
Total	**372 (100%)**	**27 (100%)**	**107 (100%)**	**63 (100%)**	**30 (100%)**	**14 (100%)**

Location of Planned NHP Studies

Table 19 compares the local NHP capabilities of the respondents with the location at which they planned to have their NHP studies performed. Regarding the location of planned NHP studies, 255 respondents (52%) indicated that their NHP studies would be performed at an NIH-supported facility, either an NPRC or another center that housed an NIH-supported breeding colony. Among the 416 respondents who had an NHP facility within their own organization, most (86%) planned to use these facilities.

For respondents who indicated a preference to use an external organization to conduct their studies, respondents located at institutions with an NPRC or other NIH-supported NHP breeding colony primarily indicated using another NIH-supported center. Respondents who were not co-located within an NIH-supported NHP facility but had an NHP-capable facility within their own organizations were somewhat more likely to use an external organization to perform their NHP studies than those co-located with an NIH-supported facility, a difference that was not statistically significant.

Of the respondents who did not have an NHP-capable facility within their own organizations, 73% chose to have their studies performed at an NIH-supported site, with nearly two-thirds (59%) having their studies performed at an NPRC. These results aligned well with those obtained and reported previously in the NHP Evaluation and Analysis report (2018).[2]

Table 19. Location of Planned NHP Studies as a Function of NHP Facility Type at the Investigator's Own Organization

	Location of Planned NHP Studies (Number and % of NHP Facility Type)						
NHP Facility Type at Investigator's Organization	**Investigators Own Organization**	**Separate NPRC**	**Separate NIH Supported NHP Facility**	**Separate Academic or Nonprofit NHP Facility**	**Separate Commercial Research Organization**	**Separate Federal Laboratory**	**Total**
NPRC (n = 143)	129 (90%)	13 (9%)	1 (1%)	-	-	-	**143 (100%)**
NIH-Supported NHP Breeding Colony (Other than NPRC) (n = 42)	34 (81%)	5 (12%)	2 (5%)	-	-	1 (2%)	**42 (100%)**
NHP-Capable Facility (Not Supported by NIH) (n = 231)	194 (84%)	16 (7%)	4 (2%)	8 (3%)	8 (3%)	1 (<1%)	**231 (100%)**
No NHP-Capable Facilities (n = 70)	-	41 (59%)	10 (14%)	7 (10%)	11 (16%)	1 (1%)	**70 (100%)**
Total All Facility Types (n = 486)	357 (73%)	75 (15%)	17 (4%)	15 (3%)	19 (4%)	3 (1%)	**486 (100%)**

External investigators (i.e., investigators who are not co-located with an NIH-supported NHP facility) can generate 50% or more of the NHP demand at many of the NIH-supported centers. Thus, factors that may influence their choice of study site are of particular interest, and it was hypothesized that study size may be a contributing factor, as even those organizations that have NHP facilities may not have sufficient space or staff to enable studies involving large numbers of animals. To evaluate the impact of study size on study location, total estimated animal use was used as a surrogate measure of study size. External investigators were separated into two groups: those who had an NHP-capable facility within their organization and those who did not. Each of these groups was then further separated into three groups: small users, who estimated use of 10 or fewer animals per year on average during the 5-year period covered in the survey, including all species used; medium users, whose estimated average use was 11 to 30 animals per year; and large users, whose estimated average use was 31 or more animals per year.

Of the 231 respondents who belong to an NHP-capable facility (not supported by NIH), 210 provided information on the number of species they project to use from calendar years 2024 to 2028. Of those 210, 66% are small users, 19% are medium users, and 15% are large users. Of the 71 respondents who do not have an NHP facility available, 66 provided information on the number of species they project to use from 2024–2028. Of those 66, 58% are small users, 27% are medium users, and 15% are large users.

These two groups were then analyzed with respect to the location at which they planned to have their studies performed (Table 20). External investigators who have an NHP facility at their own organizations were more likely to use their own facilities when compared to respondents with no NHP facility available. This was the case for small, medium, or large users. Examining the group of respondents who have an NHP facility at their own organizations, small users were more likely (91%) than medium (80%) and large (65%) users to use their own facilities. Large users were more likely (23%) to use an external NPRC compared to small (4%) and medium (8%) users, despite the fact that they have NHP facilities at their own organization. In contrast, examining the group of respondents who do not have an NHP facility available, small and medium users were more likely to use an NPRC (61% and 72%, respectively) than large users (30%), and large users were more likely (40%) to use a non-NIH-supported center than small (26%) and medium (17%) users. Overall, these findings are aligned with results from the 2018 report,[2] but differences among groups were not statistically significant.

Table 20. Effect of Estimated Animal Use on Choice of Study Site by Investigators Located External to an NIH-Supported NHP Facility

	Respondents With NHP Facility at Own Organization, by User Type (n 210)			Respondents With No NHP Facility Available, by User Type (n 66)		
NHP Study Site	**Small***	**Medium**	**Large**	**Small**	**Medium**	**Large**
Own Facilities	126 (91%)	32 (80%)	20 (65%)	0 (0%)	0 (0%)	0 (0%)
NPRC	5 (4%)	3 (8%)	7 (23%)	23 (61%)	13 (72%)	3 (30%)
Other NIH-Supported Center	1 (1%)	1 (3%)	0 (0%)	5 (13%)	2 (11%)	3 (30%)
Non-NIH-Supported Center**	7 (5%)	4 (10%)	4 (13%)	10 (26%)	3 (17%)	4 (40%)
Total of User Type	**139 (100%)**	**40 (100%)**	**31 (100%)**	**38 (100%)**	**18 (100%)**	**10 (100%)**

**When categorizing users into "small," "medium," or "large" users, if the average number of species across all 5 years fell between small (≤10 NHPs), medium (11–30 NHPs), or large (≥31 NHPs), the number was rounded down. For example, a respondent who averages 10.6 species will be categorized as "small" and a respondent who averages 30.8 species will be categorized as "medium."*
***Other academic or nonprofit organizations, commercial research organizations, or federal agencies separate from the respondent's own organization.*

Critical Research Capabilities

Survey respondents were able to state up to four research capabilities that were most important for their NHP service provider to possess to successfully support their research, resulting in 1,195 comments. The most frequently cited research capabilities were imaging facilities (e.g., MRI, CT, PET), behavioral testing/training, and general veterinary support. Some comments received more than one code (e.g., PET/CT). These capabilities fell into 14 broad categories, summarized in Table 21 with frequently mentioned specific capabilities. Although this table identifies common themes, several capabilities identified by respondents were highly specific for their studied disease or area of research (e.g., a particular animal model) and were unique to each respondent. Examples of highly specific capabilities included an electronics lab and machine shop for design and fabrication of magnetic resonance–compatible instrumentation, a rhesus pedigree and PRIMe-Seq database of macaques at the Oregon NPRC, regulatory approvals to administer MPTP for Parkinson's disease state induction, endocrine analysis core with rapid and accurate measurement of steroid and peptide hormones, and electrophysiology and optical imaging using genetically encoded reporters.

Table 21. Critical Research Capabilities for NHP Service Providers, All Respondents

Capability Area: Imaging Facilities (n 313, 64.3% of all respondents)	Number of Respondents (% of Capability Area)		
Specific Capabilities Required	All Respondents (n = 487)	NIH-Supported Facility Users (n = 185)	Other Facility Users (n = 302)
Magnetic Resonance Imaging (MRI) (Not Specified)	93 (19.1%)	51 (27.6%)	40 (13.3%)
Positron Emission Tomography	63 (12.9%)	46 (24.9%)	17 (5.6%)
Computed Tomography	47 (9.7%)	30 (16.2%)	17 (5.6%)
Functional MRI	36 (7.4%)	17 (9.2%)	19 (6.3%)
Ultrasound	17 (3.5%)	16 (8.6%)	1 (0.3%)
Structural MRI	14 (2.9%)	4 (2.2%)	10 (3.3%)
Imaging (Not Specified)	11 (2.3%)	7 (3.8%)	4 (1.3%)
Anatomical MRI	5 (1.0%)	5 (2.7%)	-
Neuroimaging	5 (1.0%)	4 (2.2%)	1 (0.3%)
Dual Energy X-ray Absorptiometry	3 (0.6%)	3 (1.6%)	-
In vivo	3 (0.6%)	2 (1.1%)	1 (0.3%)
Ophthalmic Imaging	3 (0.6%)	1 (0.5%)	2 (0.7%)
Live Imaging	2 (0.4%)	2 (1.1%)	-
Three-Photon Imaging	1 (0.2%)	-	1 (0.3%)
Arterial Spin Labeling	1 (0.2%)	1 (0.5%)	-
Angiography	1 (0.2%)	1 (0.5%)	-
Calcium Imaging	1 (0.2%)	-	1 (0.3%)
Diffusion Tensor Imaging	1 (0.2%)	1 (0.5%)	-
Electroencephalogram	1 (0.2%)	1 (0.5%)	-
Fixed Tissue Imaging	1 (0.2%)	1 (0.5%)	-
Near-Infrared Fluorescence Imaging	1 (0.2%)	1 (0.5%)	-
Magnetic Resonance Spectroscopy	1 (0.2%)	1 (0.5%)	-
Ultrastructural	1 (0.2%)	1 (0.5%)	-
Radiography	1 (0.2%)	1 (0.5%)	-
Capability Area: Behavioral Testing/Training (n 139, 28.5% of all respondents)	Number of Respondents (% of Capability Area)		
Specific Capabilities Required	All Respondents (n = 487)	NIH-Supported Facility Users (n = 185)	Other Facility Users (n = 302)
Specialized Behavioral Testing (Not Further Defined)	75 (15.4%)	37 (20.0%)	38 (12.6%)
Motor Performance Testing	26 (5.3%)	19 (10.3%)	7 (2.3%)
Cognitive Testing	13 (2.7%)	5 (2.7%)	7 (2.3%)
Specialized Behavioral Training	11 (2.3%)	2 (1.1%)	9 (3.0%)
General Behavior Studies	7 (1.4%)	4 (2.2%)	3 (1.0%)
Behavior Management	2 (0.4%)	1 (0.5%)	1 (0.3%)
Manipulation Studies	2 (0.4%)	1 (0.5%)	1 (0.3%)
Behavior Tracking	1 (0.2%)	-	1 (0.3%)
Behavior Phenotyping	1 (0.2%)	1 (0.5%)	-
Social Analysis	1 (0.2%)	-	1 (0.3%)

Capability Area: General Veterinary Support (n 114, 23.4% of all respondents)	Number of Respondents (% of Capability Area)		
Specific Capabilities Required	All Respondents (n = 487)	NIH-Supported Facility Users (n = 185)	Other Facility Users (n = 302)
Tissue Sampling/Biopsy	30 (6.2%)	21 (11.4%)	9 (3.0%)
Blood Sampling	20 (4.1%)	12 (6.5%)	8 (2.6%)
General (e.g., Veterinary Care, Support, Services, Staff)	19 (3.9%)	10 (5.4%)	9 (3.0%)
General Animal Health Evaluation	9 (1.8%)	5 (2.7%)	3 (1.0%)
Husbandry	7 (1.4%)	3 (1.6%)	4 (1.3%)
Staff (General)	7 (1.4%)	2 (1.1%)	5 (1.7%)
Food and Diet Studies	6 (1.2%)	5 (2.7%)	1 (0.3%)
Other Sampling	2 (0.4%)	1 (0.5%)	1 (0.3%)
Urology	3 (0.6%)	3 (1.6%)	-
Treatment for Research	3 (0.6%)	2 (1.1%)	1 (0.3%)
Fluid Regulation and Intake	2 (0.4%)	-	2 (0.7%)
Intensive Care Unit	2 (0.4%)	1 (0.5%)	1 (0.3%)
Neonatal Intensive Care	2 (0.4%)	1 (0.5%)	1
Sample Administration	1 (0.2%)	1 (0.5%)	-
General Animal Care	1 (0.2%)	1 (0.5%)	-

Capability Area: Veterinary Surgical Facilities and Services (n 101, 20.7% of all respondents)	Number of Respondents (% of Capability Area)		
Specific Capabilities Required	All Respondents (n = 487)	NIH-Supported Facility Users (n = 185)	Other Facility Users (n = 302)
General Surgical Support and Facilities/Services	61 (12.5%)	30 (16.2%)	31(10.3%)
Neurosurgery	18 (3.7%)	9 (4.9%)	9 (3.0%)
General Surgical Support – Anesthesia	10 (2.1%)	2 (1.1%)	8 (2.7%)
Abdominal Surgery	4 (0.8%)	3 (1.6%)	1 (0.3%)
Survival Surgery	2 (0.4%)	-	2 (0.7%)
Eye Surgery	2 (0.4%)	-	2 (0.7%)
Aseptic Surgery	1 (0.2%)	-	1 (0.3%)
Cardiovascular Surgery	1 (0.2%)	1 (0.5%)	-
Surgical Pathology	1 (0.2%)	1 (0.5%)	-
Surgical Models	1 (0.2%)	-	1 (0.3%)

Capability Area: Housing and Facilities (n 37, 7.6% of all respondents)	Number of Respondents (% of Capability Area)		
Specific Capabilities Required	All Respondents (n = 487)	NIH-Supported Facility Users (n = 185)	Other Facility Users (n = 302)
Social Group Housing	12 (2.5%)	7 (3.8%)	5 (1.7%)
General Housing and Facilities	9 (1.8%)	5 (2.7%)	4 (1.3%)
Neonatal/Infant Nursery	6 (1.2%)	4 (2.2%)	2 (0.7%)
Specialized Housing (e.g., Virus-Free, Prevent Cross Infection)	3 (0.6%)	2 (1.1%)	1 (0.3%)
Primate Enrichment Support	3 (0.6%)	-	3 (1.0%)
Multi-Unit Housing	2 (0.4%)	-	2 (0.7%)
Measurement of Outflow Facility	1 (0.2%)	1 (0.5%)	-
Physiology Behavioral Space	1 (0.2%)	1 (0.5%)	-

Capability Area: Biological Containment (n 89, 18.3% of all respondents)	Number of Respondents (% of Capability Area)		
Specific Capabilities Required	All Respondents (n = 487)	NIH-Supported Facility Users (n = 185)	Other Facility Users (n = 302)
(A)BSL-2	21 (4.3%)	20 (10.8%)	1 (0.3%)
(A)BSL-3	58 (11.9%)	48 (25.9%)	10 (3.3%)
(A)BSL-4	6 (1.2%)	3 (1.6%)	3 (1.0%)
(A)BSL not specified	1 (0.2%)	-	1 (0.3%)
General	3 (0.6%)	2 (1.1%)	1 (0.3%)
Capability Area: Vaccine Development and Immunology (n 41, 8.4% of all respondents)	Number of Respondents (% of Capability Area)		
Specific Capabilities Required	All Respondents (n = 487)	NIH-Supported Facility Users (n = 185)	Other Facility Users (n = 302)
Immunoassays and Immunogenicity Testing	14 (2.9%)	10 (5.4%)	4 (1.3%)
HIV/SHIV studies	7 (1.4%)	4 (2.2%)	3 (1.0%)
General Viral Studies	5 (1.0%)	5 (2.7%)	-
Viral Delivery	4 (0.8%)	1 (0.5%)	3 (1.0%)
Antiretroviral Treatment studies	3 (0.6%)	3 (1.6%)	-
Viral Challenge	2 (0.4%)	2 (1.1%)	-
Infectious Disease Research and Support	2 (0.4%)	2 (1.1%)	-
General (e.g., Immunization, Immunology, Immunobiology)	1 (0.2%)	1 (0.5%)	-
Therapeutic Antibodies	1 (0.2%)	1 (0.5%)	-
Viral Load Assay	1 (0.2%)	1 (0.5%)	-
Viral Stocks Handling	1 (0.2%)	1 (0.5%)	-
Capability Area: Specific Primate Types and Characteristics (n 38, 7.8% of all respondents)	Number of Respondents (% of Capability Area)		
Specific Capabilities Required	All Respondents (n = 487)	NIH-Supported Facility Users (n = 185)	Other Facility Users (n = 302)
Specific-Pathogen-Free Animals	14 (2.9%)	9 (4.9%)	5 (1.7%)
Infant Animals	6 (1.2%)	2 (1.1%)	4 (1.3%)
Geriatric Animals (same as "Aged/Older Animals")	3 (0.6%)	3 (1.6%)	-
Adult Animals	3 (0.6%)	1 (0.5%)	2 (0.7%)
Naïve Animals	3 (0.6%)	2 (1.1%)	1 (0.3%)
Juvenile Animals	2 (0.4%)	-	2 (0.7%)
Major Histocompatibility Complex Type	1 (0.2%)	1 (0.5%)	-
Pregnant Animals	1 (0.2%)	1 (0.5%)	-
Simian Varicella Virus	1 (0.2%)	1 (0.5%)	-
Trypanosoma cruzi	1 (0.2%)	1 (0.5%)	-

Capability Area: Breeding and Reproductive Technologies (n 44, 9.0% of all respondents)	Number of Respondents (% of Capability Area)		
Specific Capabilities Required	All Respondents (n = 487)	NIH-Supported Facility Users (n = 185)	Other Facility Users (n = 302)
Breeding Capability	16 (3.3%)	8 (4.3%)	8 (2.6%)
Assisted Reproductive Technologies	15 (3.1%)	12 (6.5%)	3 (1.0%)
Timed Mating	8 (1.6%)	8 (4.3%)	-
Pregnancy Studies and Management	4 (0.8%)	4 (2.2%)	-
Monitor Cycling Females	1 (0.2%)	1 (0.5%)	-
Capability Area: Biotelemetry and Remote Monitoring (n 27, 5.5% of all respondents)	**Number of Respondents (% of Capability Area)**		
Specific Capabilities Required	All Respondents (n = 487)	NIH-Supported Facility Users (n = 185)	Other Facility Users (n = 302)
Biotelemetry and Remote Monitoring	26 (5.3%)	17 (9.2%)	9 (3.0%)
Video Motion Monitoring	1 (0.2%)	-	-
Capability Area: Pathology Services (n 27, 5.5% of all respondents)	**Number of Respondents (% of Capability Area)**		
Specific Capabilities Required	All Respondents (n = 487)	NIH-Supported Facility Users (n = 185)	Other Facility Users (n = 302)
General Pathology Services	19 (3.9%)	17 (9.2%)	2 (0.7%)
Necropsy	7 (1.4%)	5 (2.7%)	2 (0.7%)
Diverse Fixation Methods	4 (0.8%)	3 (1.6%)	1 (0.3%)
Capability Area: Aerosol Exposure (n 15, 3.1% of all respondents)	**Number of Respondents (% of Capability Area)**		
Specific Capabilities Required	All Respondents (n = 487)	NIH-Supported Facility Users (n = 185)	Other Facility Users (n = 302)
Aerosol Exposure	15 (3.1%)	14 (7.6%)	1 (0.3%)
Capability Area: Drug Testing and Regulated Studies (n 14, 2.9% of all respondents)	**Number of Respondents (% of Capability Area)**		
Specific Capabilities Required	All Respondents (n = 487)	NIH-Supported Facility Users (n = 185)	Other Facility Users (n = 302)
Toxicology/Safety Testing	4 (0.8%)	1 (0.5%)	3 (1.0%)
General Studies	4 (0.8%)	-	3 (1.0%)
Good Laboratory Practices	3 (0.6%)	-	3 (1.0%)
Pharmacokinetics	2 (0.4%)	-	2 (0.7%)
Abuse Liability Testing	1 (0.2%)	-	1 (0.3%)
Capability Area: Other Techniques and Capabilities (n 165, 33.9% of all respondents)	**Number of Respondents (% of Capability Area)**		
Specific Capabilities Required	All Respondents (n = 487)	NIH-Supported Facility Users (n = 185)	Other Facility Users (n = 302)
Molecular Biology and Genetic Techniques (e.g., Genetic Screening or Engineering, Gene Editing or Modeling)	27 (5.5%)	18 (9.7%)	9 (3.0%)
Vision Studies and Testing	19 (3.9%)	5 (2.7%)	14 (4.6%)
Electrophysiology	19 (3.9%)	4 (2.2%)	15 (5.0%)

Neurophysiology	11 (2.3%)	5 (2.7%)	6 (2.0%)
Viral Vector Studies (e.g., Adeno-Associated Viruses, Lentivirus)	11 (2.3%)	-	11 (3.6%)
Drug Administration	9 (1.8%)	5 (2.7%)	4 (1.3%)
Specialized Microscopy (e.g., Confocal, Fluoroscopy)	9 (1.8%)	6 (3.2%)	3 (1.0%)
Optogenetics	9 (1.8%)	4 (2.2%)	5 (1.7%)
Miscellaneous Studies (e.g., Parkinson's Disease, Endocrine, Vestibular)	9 (1.8%)	3 (1.6%)	6 (2.0%)
Flow Cytometry	6 (1.2%)	5 (2.7%)	1 (0.3%)
Metabolic Testing and Assessments	5 (1.0%)	5 (2.7%)	-
Biomarker Analysis	5 (1.0%)	4 (2.2%)	1 (0.3%)
Cerebrospinal Fluid Analysis	3 (0.6%)	3 (1.6%)	-
Pulmonary Function Tests	4 (0.8%)	2 (1.1%)	2 (0.7%)
Cardiovascular System Tests	3 (0.6%)	2 (1.1%)	-
Multiomics	2 (0.4%)	1 (0.5%)	1 (0.3%)
Auditory / Audio Testing	2 (0.4%)	-	2 (0.7%)
Intravenous Injection	2 (0.4%)	1 (0.5%)	1 (0.3%)
Bioengineering	1 (0.2%)	1 (0.5%)	-
Ear Injections	1 (0.2%)	-	1 (0.3%)
High-Performance Liquid Chromatography	1 (0.2%)	-	1 (0.3%)
Immunohistochemistry	1 (0.2%)	-	1 (0.3%)
Neuroradiology	1 (0.2%)	1 (0.5%)	-
Neurotelemetry	1 (0.2%)	-	1 (0.3%)
Specialized Instrument Design and Fabrication	1 (0.2%)	1 (0.5%)	-

Factors Influencing Selection of NHP Facility

Respondents rated a series of factors thought to influence an investigator's choice of a particular organization to house or perform NHP studies. Average importance ratings for these factors are shown in Table 22, along with average ratings within four subgroups: (1) respondents who remained within their own organization, (2) respondents who chose to use an NPRC external to their own organization, (3) respondents who chose to use a facility external to their own organization that is not an NPRC but maintains an NIH-supported breeding colony, and (4) respondents who chose to use a facility external to their own organization that is not supported by NIH. Each factor was rated on a 7-point scale from critically important (1) to no importance (7). The distribution of ratings for each factor are shown in Figure 19. Overall, basic animal availability (i.e., the ability to provide a sufficient number of animals of the required species, age, and sex needed for research in a timely manner) was considered the most critical factor. Genetically characterized animals were considered the least critically important. Significance testing was conducted to assess whether mean ratings were statistically different based on NHP study site. In instances for which the assumption of homogeneity of variances was not violated (prior relationship with performing organization, SPF animal availability, genetically characterized animal availability, cost) a one-way ANOVA was used. There was no statistically significant main effect of prior relationship with performing organization, SPF animal availability, genetically characterized animal availability, or cost.

Table 22. Average Importance Ratings for Factors Potentially Influencing NHP Study Site Selection

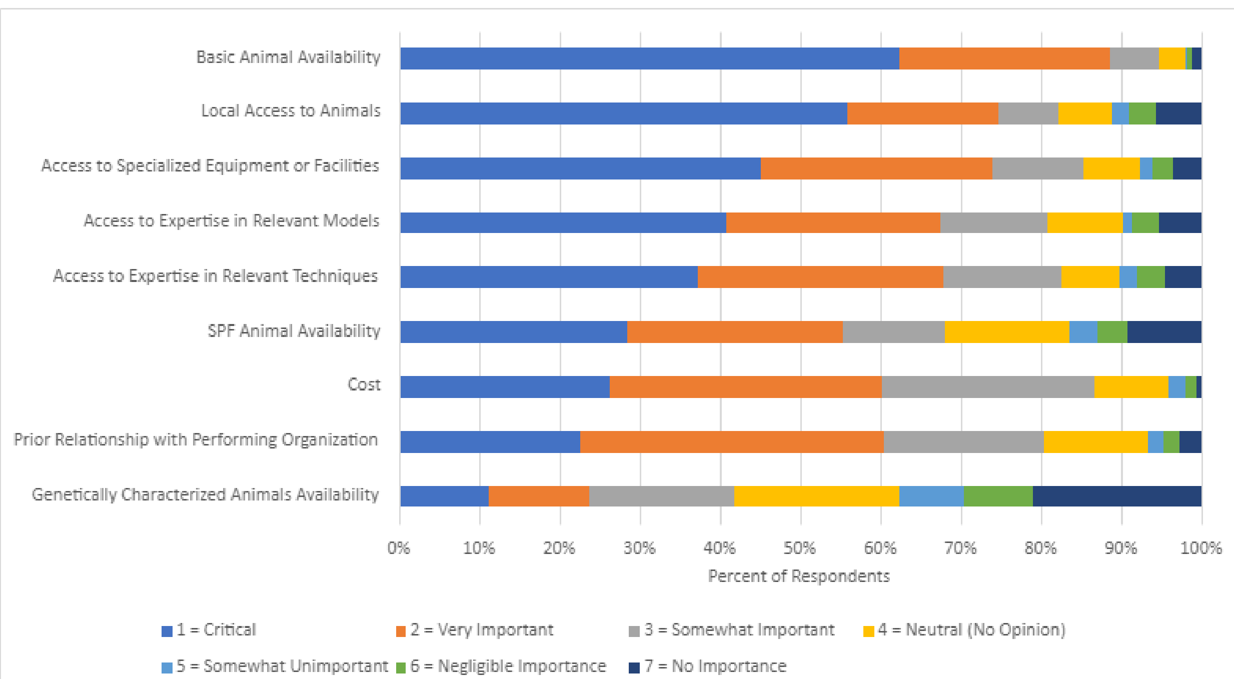
	Average Rating by Respondents Choosing NHP Study Site				
Factor	All Sites (n 490)	Own Organization (n 358)	Separate NPRC (n 75)	Other Separate NIH Supported Facility (n 17)	Other Separate Facility (n 39)
Local Access to Animals	2.13	1.57*	3.62	3.60	3.41
Access to Expertise in Relevant Models	2.35	2.50**	1.97	1.73	2.03
Access to Expertise in Relevant Techniques	2.35	2.54*	1.95	1.54	1.74
Access to Specialized Equipment or Facilities	2.13	2.14	2.08	2.12	2.10
Prior Relationship with Performing Organization	2.51	2.60	2.23	2.14	2.33
Basic Animal Availability	1.59	1.60	1.60	1.20^	1.65
SPF Animal Availability	2.87	2.73	3.14	2.57	3.58
Genetically Characterized Animal Availability	4.12	4.21	3.70	3.53	4.35
Cost	2.33	2.39	2.31	2.07	2.03

**Different from all other subgroups ($p < 0.05$).*

***Different from separate NPRC and other NIH-supported facility ($p < 0.05$).*

^Different from own organization and separate NPRC ($p < 0.05$).

Figure 19. Distribution of Factor Ratings for Factors Potentially Influencing NHP Study Site Selection



In instances in which the assumption of homogeneity of variances was violated (local access to animals, access to expertise in relevant models, access to expertise in relevant techniques, access to specialized equipment or facilities, basic animal availability), Welch's procedure was used. There were statistically significant main effects of local access to animals ($p < 0.001$), access to expertise in relevant models ($p = 0.004$), access to expertise in relevant techniques ($p < 0.001$), and basic animal availability ($p = 0.014$). A Games-Howell post-hoc test found the following statistically significant differences: (1) Local access: The mean rating of respondents who use their own organization were different from all other subgroups. (2) Expertise in relevant models: The mean rating of respondents who use their own organization were different from those who use a separate NPRC and other separate NIH-supported facility. (3) Expertise in relevant techniques: The mean rating of respondents who use their own organization were different from all other subgroups. (4) Basic animal availability: The mean rating of respondents who use a separate NIH-supported facility were different from those who use their own organization and a separate NPRC. These differences are noted in the footnotes of Table 22. Overall, local access to animals was the primary critical factor for those investigators who use their own organization, whereas basic availability and access to relevant expertise and techniques appeared to be driving factors for users of separate NPRCs, NIH-supported facilities, and other separate facilities.

Respondents were also asked whether there were any other factors not mentioned in the survey that are critical or very important for selecting an NHP provider; 129 comments were submitted. Comments varied widely, and many comments were restatements of other factors (e.g., cost, availability), but examples of comments mentioned more than once included the importance of quality collaboration between the provider and the organization requesting NHPs and the importance of staff who know how to treat the NHPs with quality care.

Cost of NHP Species

Because the availability and cost of NHPs have changed during the past 5 years, respondents were asked specific questions related to costs. Most respondents (84.5%) stated that the cost of NHPs increased. Few (2.9%) indicated that costs did not increase, whereas 12.6% did not answer this question.

Of the respondents who stated that cost has increased, 54.5% indicated that the cost increased two-fold for the species they use, and 25.6% indicated a four-fold increase. When asked how the increased cost has impacted their research project (multiple responses were allowed), over half (57%) of the total number of survey respondents decreased the number of NHPs assigned to the study, whereas nearly half (47%) of the total number of survey respondents reduced the scope of the research project. For respondents who selected "other," their written responses included requesting additional funding from other sources, considering abandoning or deferring pursuing NHP studies or funding, using NHPs for a longer amount of time than preferred, spending more funds during the startup of a study than preferred, and considering applying for grants that have a higher or no cap. See Table 23 for more information.

Table 23. How Increased Cost of NHP Species Impacted Respondents' Research Project

I have	Number and Percentage of Responses (n 490)
Had to decrease the number of NHPs assigned to the study.	280 (57%)
Reduced the scope of the research project.	232

	(47%)
Decreased the time commitment of personnel.	160 (33%)
Reduced supply costs.	142 (29%)
Proposed costs that exceed NIH's $500,000 cap with permission from the Institute/Center staff.	89 (18%)
Other.	69 (14%)

Problems Obtaining NHPs or Research Services

Survey respondents were invited to comment on any problems encountered within the past 2 years in either obtaining NHPs or related research services that delayed their study, altered their experimental design, or influenced how they performed their research. The reported problems fell into one of four broad categories that were partially overlapping in their scope (251 comments total, representing 51% of all survey respondents) (Table 24). More substantive comments were coded under multiple factors (e.g., availability and cost).

Table 24. Major Problem Areas Impacting NHP Research

Issues Reported	Number of Respondents (%) (n 490)
Limited Availability of Animals—Inability to obtain NHPs of the required species, sex, and age, or with other specific characteristics in a timely manner	162 (33%)
Increased Cost—Concerns regarding impacts of NHP cost on research	74 (15%)
COVID-19—Concerns regarding impact of COVID-19 on research	39 (8%)
Facility Issues—Problems with insufficient housing to perform required studies or inadequate staffing or staff expertise of the type needed	38 (8%)
Programmatic or Policy Barriers—NIH (or other agency) policies or practices that constrain the conduct of NHP research	23 (5%)

NHP availability was the most frequently cited problem. One-third (33%) of all survey respondents noted problems in obtaining animals that delayed the initiation or execution of their studies, an increase from the 28% reported in 2018.[2] To accommodate the limited availability, 30 respondents (6%) specifically noted that the limited availability of NHPs necessitated changes in their research strategy or experimental design, also an increase from the 1.8% reported in 2018.[2] There were 27 respondents (6%) who specifically mentioned problems with obtaining rhesus macaques (due to availability and/or cost). Of those respondents, four specified that they decided to switch to using cynomolgus macaques due to the lack of rhesus macaques, although eight respondents (overall) mentioned that cynomolgus macaques were also difficult to obtain, due to availability and/or cost. Problems with obtaining marmosets were indicated by seven respondents, representing 1.4% of the total number of survey respondents.

Increased cost was the second highest reported issue, with 15% of the total number of survey respondents reporting it as a barrier in their research. Cost and availability were cited as co-occurring issues by 9% of the total number of survey respondents, such that the lack of availability of NHPs has also increased their cost drastically. Another co-occurring topic with cost was budget cuts or budget limits, with some respondents stating that budget limits are unrealistic. Some respondents also noted the high cost of transporting animals.

Regarding housing and facility issues, lack of or inadequate staffing was cited most often (21 respondents, 4% overall). Respondents discussed staff shortages and the difficulty in finding well-trained veterinary staff. Limited space to house, care for, and conduct research with NHPs was also reported by several respondents.

Regarding programmatic or policy barriers that constrain NHP research, several respondents noted the impact of budget cuts and the need for NHP funding to be increased to account for inflation. Others cited inefficiencies with the processes to request and acquire NHPs, the need for NIH to support project costs incurred prior to the start of the grant award, and concerns about how funding is released. A few respondents also noted that they thought that their research was not prioritized or supported by either their own organization, a collaborating organization, or NIH overall. Lastly, a few respondents cited issues specific to their organization, such as managerial issues.

Lastly, COVID-19 was an intersecting factor across the issues cited. Thirty-nine respondents (8%) mentioned COVID-19 as a factor that affected their research. Half of these comments intersected with comments about availability, such as that COVID-19 led to project delays and/or a project “bottleneck” post-COVID-19. A few respondents mentioned a lack of preferred species due to NHPs being used for COVID-19 studies.

New to the 2023 survey, respondents also provided ratings for three 5-point Likert scale questions regarding the extent to which specified factors affected their research (Table 25). Of those who responded, nearly half (42.6%) indicated that they needed to modify their calendar years 2018 to 2023 research to a “large extent” due to the availability (or lack thereof) of NHPs. Furthermore, nearly half (41%) indicated that they foresee having to change their calendar years 2024 to 2028 research plans to a “large extent” due to the availability (or lack thereof) of NHPs. Lastly, 30.5% and 34.9% of respondents indicated that the SARS-CoV-2 pandemic impacted their ability to use NHPs in their research to “a very large extent” or “a large extent,” respectively.

Table 25. Extent to Which Availability of NHPs and COVID-19 Impacted Respondents

To What Extent	Very Large Extent	Large Extent	Neutral	Little Extent	Very Little Extent
Have you had to modify your research plans from 2018–2023 due to the availability (or lack thereof) of NHPs?	75 (18.6%)	172 (42.6%)	79 19.6%)	54 (13.4%)	24 (5.9%)
Do you foresee having to change your current and future research plans in this next 5 years (2024–2028) due to the availability (or lack thereof) of NHPs?	81 (20.3%)	164 (41.0%)	92 (23.0%)	46 (11.5%)	17 (4.3%)
Did the SARS-CoV-2 pandemic impact your ability to use NHPs in your research?	123 (30.5%)	141 (34.9%)	79 (19.6%)	40 (9.9%)	21 (5.2%)

Discussion

Future Demand for NHPs

This study utilized different approaches to forecast future demand for NHPs during the next 5 years, each with its own limitations and constraints. Capabilities of NHP providers were identified to determine the types of services available in the current landscape. Historical data were gathered and analyzed from NIH awarded grants and cooperative agreements to evaluate trends. Predictions for the future and forecasting methods were qualitatively shared by NHP suppliers and CROs. Finally, a survey of current users of NHPs highlights the challenges encountered by and the needs of NHP researchers. Although each component cannot be treated the same due to the differences in methods and reporting of the results, these components serve as a collective body of evidence to support any assertions regarding the future NHP landscape.

Predicted Changes in Future Demand

Overall, the demand for NHPs in biomedical research across public and private institutions has increased during the past 5 years. This conclusion is supported by data from USDA, which demonstrated a continued increase in the use of NHPs across all research organizations from FY18 to FY22 (Figure 5). Importation of NHPs also showed a steady increase until FY20, when China enacted an export ban (Table 11). The decrease in FY21 and FY22 imports to the United States presumably was driven largely by the Chinese ban and its rippling effects on the international NHP trade, rather than by changes in demand. Despite year-to-year fluctuations in the planned use of NHPs by extramural NIH-supported investigators, the total planned use in research during this 5-year period was 18% greater than that observed in the previous report (35,802 [Table 4] vs. 30,174 [Table 6 in previous report]).[2] NIH intramural research use of NHPs also demonstrated annual fluctuations but remained relatively constant during the 10-year period (Figure 15). Interviews with suppliers, as well as survey results of investigators using NHPs in their research, indicated a high demand for NHPs and limited availability. One commercial vendor indicated that it has been breeding at maximum capacity and has not been able to meet demand during the last 5 years. Another commercial vendor has experienced such high demand that it has already sold future macaque progeny. Collectively, these various sources of data point to continued high demand of this biomedical research resource that is not being met. NASEM reached a similar conclusion, indicating that inadequate NHP resources severely affect the ability of NIH-supported investigators to carry out high-impact research, as well as respond to public health emergencies.[1]

The demand for rhesus macaques in biomedical research continues to be high, with no signs that this trend will decrease. Rhesus macaque is the species being bred most widely across the NPRCs and other NIH-supported facilities to meet demand. Although it is helpful that the NPRCs and the Caribbean Primate Research Center continue to facilitate the breeding of this species, the capacity for the breeding colonies is finite. Rhesus macaque also remains the most widely utilized species in NIH-supported research, with a substantial proportion of both extramural and intramural research projects involving use of this species. Compounding this issue is the export ban imposed by China—a significant source of rhesus macaques in the past—which further constricts the global supply chain. Additionally, the user survey indicates a consistent estimate of approximately 8,000 rhesus macaques being utilized annually across various projects during the next 5 years. This underscores the magnitude of the demand. A legitimate concern exists that the current supply of rhesus macaques will fall short of meeting demand. For many PIs with NIH-awarded grants, the inadequate supply of rhesus macaques may mean having to change their study design, limit the number of NHPs they use for their research, or pay a higher price to obtain animals from private suppliers. Some PIs may change to a different animal model. This change in research focus could negatively impact the ability to translate preclinical research to first-in-human studies because NHPs are the best translational model for many research areas, owing to their anatomical, physiological, and genetic similarity to humans.

The demand for cynomolgus macaques in NIH-supported projects is less clear compared to the demand for rhesus macaques. Across the interviews with suppliers and other NHP service providers, several participants mentioned cynomolgus macaque as being an excellent animal model for many diseases, with a high demand for the species. Nonetheless, between FY18 and FY22, the trends point downward for planned usage of cynomolgus macaques and the number of NIH extramural projects that use this species. In the NIH intramural space, the number of cynomolgus macaques has also remained similar between FY18 and FY22 compared to the numbers from FY13 to FY17. It is not clear to what degree China's export ban and limited availability of this species has contributed to the decline in proposed usage by NIH investigators. Cynomolgus macaques continue to be used extensively in pharmacology, toxicology, and safety studies, which are crucial to support drug development. Hence, pharmaceutical companies and CROs may be the primary users of this species and the demand would not be reflected in NIH-supported extramural research. However, NIH-funded biomedical research using cynomolgus macaques remains critical to improving public health. For a species reported to be high in demand, few domestic cynomolgus macaque colonies exist to support NIH PIs. Only one small breeding colony exists at an NPRC, a colony supported under an NIH contract, and another colony recently established at NIRC. A few private companies have domestic colonies of cynomolgus macaques, which are reserved for their exclusive use (e.g., pharmaceutical companies) or are sold for-profit at higher prices than the NIH-supported colonies. Indeed, one private vendor has sold most of its future cynomolgus macaque progeny to clients, who will support their care until the animals are used in projects. To date, most cynomolgus macaques have been and continue to be imported to the United States, which presents its own problems due to the NHP export ban from China. The importation numbers have decreased by about half in under 2 years, from around 32,000 cynomolgus macaques imported in FY21 to about 16,000 animals in FY23.

Several lines of evidence also point to an increase in the demand for marmosets, which is more extensive compared to the 2018 NHP Analysis and Evaluation Report.[2] In the interviews with suppliers, increased demand for geriatric NHPs for aging research was mentioned; marmosets are a valued model for aging research due to their shorter life span. In addition, marmosets are being used for research involving genetic manipulation, a growing research field. Based on the demand for marmosets in neuroscience research, NIH provided funding for expansion of colonies, as well as for a Marmoset Coordinating Center, to increase availability of marmosets specifically for neuroscience research projects. In evaluating trends from extramural NIH-awarded applications, an increase already is being seen in the number of marmosets being planned for research, although this trend fluctuates to some degree across the years. The increase in marmoset use is one of the important drivers of the increased estimated use of NHPs overall in the next 5 years when compared to the previous report.

The demand for baboons and African green (vervet) monkeys in NIH-supported research is variable. In the previous report, a large increase was seen in planned use of baboons in FY17 awards. The planned use of baboons nearly quadrupled in FY18, before dropping dramatically between FY13 and FY22 (Figure 13). Despite an increase in planned use of baboons for FY21, the overall trends show more sporadic demand in terms of NIH-funded extramural research. The same can be inferred for the use of African green (vervet) monkeys, which seems to show a very large demand based on users' response to the survey, but the planned number of African green (vervet) monkeys to be used has remained relatively steady, except for a steep increase in FY20 (Figure 5). The increase observed in FY20 may be related to their use in SARS-CoV-2 research.

Predicting future demand for other NHP species is challenging due to the absence of discernible patterns across the different data sets, as well as the comparatively lower levels of utilization of these species.

Limitations of the Demand Analysis

Data from planned use of NHPs in awarded NIH grant and cooperative agreement applications provide insights into the utilization of NHPs in NIH research, but it is important to understand the parameters and limitations of these data, which are based on planned NHP usage and not actual numbers. Changes to the number of animals assigned over time may not be captured in this analysis. Additionally, as mentioned previously in the results section, some information was not available in the awarded applications, which limits the depth and accuracy of the analysis. Also, specific schedules for NHP assignment and use during the award period are seldom provided in applications. Such schedules would have provided a more accurate picture of the number of animals investigators plan to use each year. Many of the awards are 3 to 5 years in duration, but NHPs may not be used for all award years. Because this information was not available, all planned NHP use for the study was assigned to the first year of the award, which may contribute to the annual variability observed in the data and mask trends. Observations during longer intervals (e.g., 10 years) should enhance predictability. Lastly, historical data may not fully capture emerging trends or sudden shifts in research priorities, such as the sudden change in research priorities observed during the COVID-19 pandemic. Given the acute need to develop treatments and vaccines to combat the SARS-CoV-2 virus, researchers placed other infectious disease studies on hold and focused on COVID-19 research, resulting in a lack of progress on funded studies and increased grant extensions. Likewise, NHPs were diverted to COVID-19 studies. Although COVID-19 research comprised less than 1% of NHP usage during FY20 to FY22, a notable number of survey respondents indicated that SARS-CoV-2 had a large impact on their research and resulted in decreased availability of animals. Given the limited availability of NHPs prior to the pandemic,[2] a small increase in usage may have had a larger impact on researchers than anticipated.

Interviews with various directors and staff of NHP facilities indicated that the landscape of biomedical research using NHPs is constantly changing. This ever-changing demand has made it difficult for NHP centers and facilities to determine future needs. The size of each NHP colony is constrained by external factors that differ at each facility; these include limited housing or research space, limited funding to cover increasing costs, personnel shortages (e.g., clinical laboratory animal veterinarians, animal care and technical staff), facilities needing renovation, limited genetic diversity of NHP species, increased demand by investigators for SPF and genetic status, and transportation issues. Centers also differ in their method of estimating future demand and are rarely accurate past a certain time frame. Information included in this report is limited to those facilities that agreed to be interviewed, and some organizations indicated that certain information was considered proprietary and could not be shared. One center shared that it has been able to use a prediction model for forecasting its needs for up to 3 years. This requires ongoing collection of detailed information, mostly confidential information to be included in grant applications, from potential users of the center. In addition to the prediction model, the center also uses a population model to predict the production of its various NHP species and has been using it consistently for more than a decade. Whether this prediction model could be applied to other NHP facilities was discussed; however, although some centers share common structures and capabilities, the assumptions entered into the prediction model will differ among centers. A one-size-fits-all approach is not obvious.

Looking into the future of NHP usage, the survey data collected added important insights into short-term demand. A steady demand for various NHPs for biomedical research continues, with select species in higher demand than are currently available. Researchers are requesting NHPs with SPF status, and there is increased demand for select research services, including imaging (e.g., MRI, CT, PET), biocontainment (e.g., ABSL-2, -3, -4), behavioral testing, and surgical support. Although these results are useful, a few limitations to the predictive value of the estimated NHP usage provided by the respondents exist. As with all survey data, the validity of results depends on respondents adequately representing the overall population of interest. Although requests were sent to previous NIH-supported investigators who used NHPs in their research, only 50% of them accessed the survey and not all of those completed the survey. Second, if respondents provided a range for their estimated use, the largest number in the range was the one used in calculating total usage. Relatedly, it cannot be easily determined whether the number of NHPs used from one year to another equates to the researcher using the same animals from one year to the next or whether the researcher is planning to obtain the same number of unique animals each year in addition to those previously obtained.

Continued data collection on the current and future needs of NHP users is necessary, as cumulative findings would allow for the development of a more nuanced and adaptable forecast for future NHP research needs. Such information could offer valuable guidance for NIH and the biomedical research community on how to continue navigating the NHP landscape to meet needs.

Supply of NHPs and Related Services and Ability to Meet Future Demand

In reviewing the suppliers and their capabilities, many continue to rely on NPRCs and other NIH-supported centers to supply animals and provide NHP-related services, even though the number of external PIs utilizing the NPRCs as their study site has decreased from the previous evaluation. About one-third of the NIH grants and cooperative agreements awarded between

FY18 to FY22 were proposed to be conducted at one of the NPRCs and other NIH-supported centers, as opposed to half in the previous study report.[2] NPRCs continue to offer the most diverse range of services compared to other facilities. They have continued to meticulously describe their capabilities from one year to another, specifying up to five available procedures under a listed service for some. NPRCs remain leaders in providing veterinary and research support procedures, offering various services, and having major areas of emphasis for most of their service categories. Some of the other facilities are quite specific in detailing their capabilities in their responses to the outreach request and on their websites, but many of them are generic, making it difficult to determine whether they have overlapping capabilities with the NPRCs for the subcategories of services. In general, considering their services, the NPRCs will continue to be the primary resource centers for many NHP-related studies.

The characteristics of the major domestic NHP providers described in Table 1 has not changed much regarding the species of NHPs bred in the United States in comparison to the previous study report. A few changes have occurred in the facilities breeding NHPs, as some colonies have new ownership, but most colonies have remained the same throughout the 10-year period from FY13 to FY22. Private suppliers and academic institutions continue to provide more commonly used species, such as rhesus macaque, aside from the NIH-supported centers. Nonetheless, certain species of NHPs—such as Japanese macaque, pigtail macaque, and squirrel monkey—are only being bred by NIH-supported centers. Cynomolgus macaques, on the other hand, are mainly supplied by other academic institutions and private suppliers. Only one NPRC currently has a small colony of Mauritian-origin cynomolgus macaques; another colony is supported by an NIH-contract to a commercial vendor, whereas the remaining cynomolgus macaque colonies are maintained by private or academic suppliers.

Overall, consumers and suppliers of NHPs agreed that the limited availability of animals is a major issue. With restrictions on importation and continued usage of NHPs for biomedical research, domestic colonies of NHP species that are mainly used in studies (e.g., rhesus macaques, cynomolgus macaques, marmosets) need to be expanded. The limited availability of domestic NHPs will drive researchers to consider performing their research in China, which has been expanding its NHP research capabilities. Concerns regarding adequate animal care and protection, sharing of proprietary information, and protection of data when working with a foreign company were expressed. Similarly, NASEM concluded that reliance on non-domestic NHPs was unsustainable and threatens the security of the U.S. biomedical research enterprise.[1] However, many NIH-supported centers are limited in increasing colony size by aging infrastructure and inability to expand their personnel because of limited funds. At least one of the interviewees mentioned that they have not been able to increase breeding of their NHP species to meet the demand because their funding is capped at a certain limit each year. When accounting for inflation, especially in recent years, the amount of funding that they receive no longer adequately covers costs. Some NIH-supported centers have had to rely more on their parent university to cover some of the expenses. Some customers have also reported a steep increase in the price of NHPs, which limits their ability to obtain the number of NHPs needed for their research.

Even with additional funding and updated infrastructure, there are challenges in increasing the number of NHP species that are commonly used in biomedical research. It will take a few years to increase the number of rhesus macaques, given the species' seasonal breeding cycle, time to maturity (4 years), and the continued use of female rhesus macaques in studies. Despite the increased interest in marmosets as a well-suited animal model for many types of research, it will also take a few years to increase their number due to their monogamous mating practices and family rearing. Even with their shorter life span, marmosets require 1.5 years to reach adulthood. A large effort at the national level would need to focus on breeding NHP species for biomedical research while maintaining genetic diversity of the colonies. The COVID-19 pandemic highlighted the challenges and risks of an inadequate supply of NHPs; a finite number of NHPs had to be prioritized appropriately for allocation to COVID-19 studies while not adversely affecting other ongoing or future critical research areas. For this reason, NIH made the unprecedented decision to establish a COVID-19 Expert Panel to provide programmatic priority recommendations on COVID-19 research projects proposing to use NHPs to minimize the impact of the NHP shortage (see rescinded *Notice of Limited Availability of Research Non-Human Primates*, NOT-OD-20-173; rescinded *Updated Notice of Limited Availability of Research Non-Human Primates*, NOT-OD-21-080; and *Notice to Rescind NOT-OD-21-080 Updated Notice of Limited Availability of Research Non-Human Primates,* NOT-OD-24-080 published in the *NIH Guide for Grants and Contracts*). Although the necessary research was able to be completed for this public health emergency, it is not clear whether sufficient resources, both NHPs and researchers, are available to handle a future public health emergency of similar or greater magnitude. Because NHPs were allocated to COVID-19 studies while the overall size of the NIH-owned and -supported breeding colonies did not change appreciably, more than 50% of survey respondents mentioned being affected in terms of their ability to use NHPs in their research.

In navigating the complexities of future NHP usage, recognizing these challenges and collaboratively working to provide solutions among customers, suppliers, and sponsors can help shape a more sustainable path toward continued advances in biomedical research. The COVID-19 Coordinating Center at Tulane NPRC worked across all seven NPRCs to establish harmonized protocols for study procedures used in COVID-19 research. The Coordinating Center included a data center, which collected diverse types of data to allow coordinated use of NHPs for comparative studies and possible future secondary analyses and meta-analyses. This project serves as an example of coordination of NHP research projects and enhanced data sharing for efficient use of NHPs. Increased collaboration and data sharing among researchers using NHPs has been proposed over the years as a way to mitigate the limited availability of NHP.[6] NASEM also emphasized the need for both increased coordination and enhanced data sharing in its report.[1] One NPRC that has developed its own method of forecasting future needs is also working individually with other NPRCs to implement similar methods. Together, these types of programs can strengthen the NPRCs' positions as major NHP service providers in the United States in support of NIH-funded research.

Factors Driving Demand for Services by NIH-Supported NHP Facilities

Based on survey results, most investigators who did not have NHP facilities available and were small or medium users favored utilizing an NPRC to conduct their studies. Large users shared an equal preference for using an NPRC or other NIH-supported center. This may be due to the NPRCs and other NIH-supported centers being able to obtain NHPs more easily for smaller studies, but this is speculative. For some capability areas, investigators reported that they choose an NIH-supported facility because these offered a wider range of capabilities than those offered at non-NIH-supported facilities, particularly for imaging, vaccine development, and immunology. Indeed, this likely reflects the wider range and higher quality of services offered by NIH-supported NHP facilities, which makes selecting them more appealing. It should be noted, though, that the majority of survey respondents do *not* belong to an organization with an NIH-supported NHP colony, and most of these respondents conduct their NHP studies in their own organization. Thus, the discussion about capability areas should be interpreted with the understanding that most respondents who *are* using NIH-supported NHP facilities already belong to such organizations.

Conclusion

This study employed diverse methodologies to project the future demand for NHPs for the next 5 years, each with its limitations. Despite these constraints, it is evident that the demand for NHPs in biomedical research is rising consistently, as evidenced by historical data trends and qualitative insights from stakeholders in the NHP community. Increased demand for rhesus macaques, cynomolgus macaques, and marmosets was apparent across the biomedical research enterprise. Demand for other NHP species, such as African green (vervet) monkeys and baboons, remains but demonstrated more variability. The reliance on external sources of NHPs is not sustainable. The persistent high demand for NHPs will continue to outstrip availability, and if this is not addressed by expanding the domestic NHP colonies, it will limit the pace of biomedical research innovation and advancement for years.

Although NPRCs have continued to offer a wide range of services, such challenges as limited funding, aging infrastructure, and personnel shortages constrain their ability to meet increasing demand. Colony expansion requires additional support, as well as expertise, to maintain genetic diversity and health of the colonies. Addressing these challenges requires collaborative efforts, such as data sharing and efficient resource allocation, which are essential to most effectively navigate the evolving NHP landscape. By prioritizing investments and leveraging collective expertise, the NHP biomedical research community can facilitate a more sustainable future of NHP resources for NIH-supported research.

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Appendix A: USDA Annual Report Holding and Use Data

Table 26. USDA Annual Report Holding and Use Data for FY18

Organization	Total NHPs Held for Research in FY18	Total NHPs Used for Research in FY18	Total NHPs
National Primate Research Centers (NPRCs)			
California NPRC	2,122	2,721	4,843
Emory NPRC	2,262	1,785	4,047
Oregon NPRC	1,357	4,910	6,267
Southwest NPRC	1,466	1,507	2,973
Tulane NPRC	4,869	722	5,591
Washington NPRC	519	597	1,116
Wisconsin NPRC	714	1,712	2,426
Academic Institutions with an NIH-Supported Breeding Colony			
Johns Hopkins University	633	275	908
The University of Texas MD Anderson Cancer Center (Keeling Center for Comparative Medicine and Research)	57	2,294	2,351
University of Puerto Rico (Caribbean Primate Research Center)	200	4,226	4,426
Wake Forest University	0	835	835
Other Academic Institutions			
University of Louisiana at Lafayette (New Iberia Research Center)	6,396	1,270	7,666
University of Pittsburgh	0	694	694
The University of Texas Medical Branch	50	313	363
CROs and Other Private NHP Suppliers			
Alpha Genesis Inc.	0	390	390
Altasciences Preclinical	n/a	n/a	0
Battelle Memorial Institute	13	435	448
BIOQUAL Inc.	0	2,969	2,969

Charles River Laboratories	2,413	13,022	15,435
Inotiv*	48	112	160
JOINN-Biomere	0	807	807
Lovelace Biomedical Research Institute	2	188	190
The Mannheimer Foundation Inc.	4,014	425	4,439
Northern Biomedical Research Inc.	n/a	n/a	0
Primate Products LLC	n/a	n/a	0
Pharmaceutical Companies			
Bristol Myers Squibb	0	670	670
Labcorp Early Development Laboratories Inc.	1,643	7,556	9,199
Merck Sharp & Dohme Corp.	101	1,238	1,339
Pfizer Global Research & Development	6	900	906
Federal Research Institutes			
NIH	479	3,309	3,788
U.S. Army Medical Research Institute of Infectious Diseases	256	266	522
Total Number of NHPs Across All Organization Types			
Total	29,620	56,148	85,768

**Envigo was acquired by Inotiv.*

Table 27. USDA Annual Report Holding and Use Data for FY19

Organization	Total NHPs Held for Research in FY19	Total NHPs Used for Research in FY19	Total NHPs
National Primate Research Centers (NPRCs)			
California NPRC	1,596	3,397	4,993
Emory NPRC	2,490	1,191	3,681
Oregon NPRC	4,225	2,210	6,435
Southwest NPRC	2,257	663	2,920
Tulane NPRC	5,083	663	5,746
Washington NPRC	513	540	1053
Wisconsin NPRC	900	1,495	2,395
Academic Institutions with an NIH-Supported Breeding Colony			
Johns Hopkins University	726	277	1,003
The University of Texas MD Anderson Cancer Center (Keeling Center for Comparative Medicine and Research)	55	2,420	2475
University of Puerto Rico (Caribbean Primate Research Center)	0	4,473	4,473
Wake Forest University	0	889	889
Other Academic Institutions			
University of Louisiana at Lafayette (New Iberia Research Center)	7,333	1,771	9,104
University of Pittsburgh	32	719	751
The University of Texas Medical Branch	66	323	389
CROs and Other Private NHP Suppliers			
Alpha Genesis Inc.	0	394	394
Altasciences Preclinical	714	3,114	3,828
Battelle Memorial Institute	0	342	342
BIOQUAL Inc.	0	3,060	3,060
Charles River Laboratories	2,161	14,899	17,060

Inotiv*	117	239	356
JOINN-Biomere	0	955	955
Lovelace Biomedical Research Institute	0	339	339
The Mannheimer Foundation Inc.	4,067	493	4,560
Northern Biomedical Research Inc.	39	400	439
Primate Products LLC	0	78	78
Pharmaceutical Companies			
Bristol Myers Squibb	40	676	716
Labcorp Early Development Laboratories Inc.	1,737	7,287	9,024
Merck Sharp & Dohme Corp.	75	1,152	1,227
Pfizer Global Research & Development	0	757	757
Federal Research Institutes			
NIH	2,439	3,272	5,711
U.S. Army Medical Research Institute of Infectious Diseases	460	233	693
Total Number of NHPs Across All Organization Types			
Total	37,125	58,721	95,846

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Table 28. USDA Annual Report Holding and Use Data for FY20

Organization	Total NHPs Held for Research in FY20	Total NHPs Used for Research in FY20	Total NHPs
National Primate Research Centers (NPRCs)			
California NPRC	3,607	1,428	5,035
Emory NPRC	2,270	1,485	3,755
Oregon NPRC	4,439	1,681	6,120
Southwest NPRC	1,939	850	2,789
Tulane NPRC	4,968	852	5,820
Washington NPRC	767	571	1,338
Wisconsin NPRC	843	1,525	2,368
Academic Institutions with an NIH-Supported Breeding Colony			
Johns Hopkins University	787	227	1,014
The University of Texas MD Anderson Cancer Center (Keeling Center for Comparative Medicine and Research)	32	2,474	2,506
University of Puerto Rico (Caribbean Primate Research Center)	0	4,298	4,298
Wake Forest University	0	936	936
Other Academic Institutions			
University of Louisiana at Lafayette (New Iberia Research Center)	7,775	2,467	10,242
University of Pittsburgh	11	801	812
The University of Texas Medical Branch	123	351	474
CROs and Other Private NHP Suppliers			
Alpha Genesis Inc.	0	370	370
Altasciences Preclinical	619	3,367	3,986
Battelle Memorial Institute	188	343	531
BIOQUAL Inc.	0	3,764	3,764
Charles River Laboratories	2,061	15,769	17,830

Inotiv*	243	459	702
JOINN-Biomere	0	836	836
Lovelace Biomedical Research Institute	0	685	685
The Mannheimer Foundation Inc.	0	813	813
Northern Biomedical Research Inc.	21	483	504
Primate Products LLC	0	658	658
Pharmaceutical Companies			
Bristol Myers Squibb	45	506	551
Labcorp Early Development Laboratories Inc.	0	7,041	7,041
Merck Sharp & Dohme Corp.	133	917	1,050
Pfizer Global Research & Development	33	779	812
Federal Research Institutes			
NIH	531	3,353	3,884
U.S. Army Medical Research Institute of Infectious Diseases	41	437	478
Total Number of NHPs Across All Organization Types			
Total	31,476	60,526	92,002

**Envigo was acquired by Inotiv.*

Table 29. USDA Annual Report Holding and Use Data for FY21

Organization	Total NHPs Held for Research in FY21	Total NHPs Used for Research in FY21	Total NHPs
National Primate Research Centers (NPRCs)			
California NPRC	2,652	2,357	5,009
Emory NPRC	2,798	1,143	3,941
Oregon NPRC	4,278	1,382	5,660
Southwest NPRC	1,841	1,119	2,960
Tulane NPRC	4,945	881	5,826
Washington NPRC	762	502	1,264
Wisconsin NPRC	896	1,511	2,407
Academic Institutions with an NIH-Supported Breeding Colony			
Johns Hopkins University	191	227	418
The University of Texas MD Anderson Cancer Center (Keeling Center for Comparative Medicine and Research)	24	2,595	2,619
University of Puerto Rico (Caribbean Primate Research Center)	0	4,172	4,172
Wake Forest University	0	903	903
Other Academic Institutions			
University of Louisiana at Lafayette (New Iberia Research Center)	7,997	2,443	10,440
University of Pittsburgh	9	804	813
The University of Texas Medical Branch	61	501	562
CROs and Other Private NHP Suppliers			
Alpha Genesis Inc.	0	572	572
Altasciences Preclinical	1,114	3,371	4,485
Battelle Memorial Institute	0	622	622
BIOQUAL Inc.	0	3,657	3,657
Charles River Laboratories	2,258	17,105	19,363

Inotiv*	271	750	1,021
JOINN-Biomere	0	1,284	1,284
Lovelace Biomedical Research Institute	0	923	923
The Mannheimer Foundation Inc.	4,285	323	4,608
Northern Biomedical Research Inc.	0	661	661
Primate Products LLC	0	887	887
Pharmaceutical Companies			
Bristol Myers Squibb	25	544	569
Labcorp Early Development Laboratories Inc.	1,016	7,588	8,604
Merck Sharp & Dohme Corp.	106	878	984
Pfizer Global Research & Development	0	815	815
Federal Research Institutes			
NIH	692	3,127	3,819
U.S. Army Medical Research Institute of Infectious Diseases	14	1,074	1,088
Total Number of NHPs Across All Organization Types			
Total	36,235	64,721	100,956

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Table 30. USDA Annual Report Holding and Use Data for FY22

Organization	Total NHPs Held for Research in FY22	Total NHPs Used for Research in FY22	Total NHPs
National Primate Research Centers (NPRCs)			
California NPRC	2,766	2,424	5,190
Emory NPRC	2,636	1,384	4,020
Oregon NPRC	4,196	1,300	5,496
Southwest NPRC	1,469	1,792	3,261
Tulane NPRC	5,019	934	5,953
Washington NPRC	690	504	1,194
Wisconsin NPRC	1,090	1,270	2,360
Academic Institutions with an NIH-Supported Breeding Colony			
Johns Hopkins University	90	582	672
The University of Texas MD Anderson Cancer Center (Keeling Center for Comparative Medicine and Research)	85	2,581	2,666
University of Puerto Rico (Caribbean Primate Research Center)	0	4,186	4,186
Wake Forest University	0	868	868
Other Academic Institutions			
University of Louisiana at Lafayette (New Iberia Research Center)	8,979	2,343	11,322
University of Pittsburgh	6	607	613
The University of Texas Medical Branch	113	415	528
CROs and Other Private NHP Suppliers			
Alpha Genesis Inc.	299	444	743
Altasciences Preclinical	728	3,303	4,031
Battelle Memorial Institute	65	207	272
BIOQUAL Inc.	0	2,917	2,917
Charles River Laboratories	2,471	16,460	18,931

Inotiv*	245	793	1,038
JOINN-Biomere	0	1,119	1,119
Lovelace Biomedical Research Institute	0	959	959
The Mannheimer Foundation Inc.	4,480	539	5,019
Northern Biomedical Research Inc.	0	866	866
Primate Products LLC	0	1,207	1,207
Pharmaceutical Companies			
Bristol Myers Squibb	1	539	540
Labcorp Early Development Laboratories Inc.	761	7,397	8,158
Merck Sharp & Dohme Corp.	115	804	919
Pfizer Global Research & Development	21	615	636
Federal Research Institutes			
NIH	905	2,894	3,799
U.S. Army Medical Research Institute of Infectious Diseases	11	566	577
Total Number of NHPs Across All Organization Types			
Total	37,241	62,819	100,600

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Appendix B: Keywords for Grant Searches

General Keywords

- Nonhuman primate
- Non-human primate
- Primate
- Monkey

Keywords for Genus: *Aotus*

- *Aotus*
- Owl monkey

Keywords for Genus: *Callitrix*

- *Callithrix*
- *Callithrix jacchus*
- Marmoset

Keywords for Genus: *Cebus*

- *Cebus*
- Capuchin

Keywords for Genus: *Callicebus*

- *Callicebus*
- *Callicebus cupreus*
- Dusky titi monkey
- Coppery titi monkey

Keywords for Genus: *Cercocebus*

- *Cercocebus*
- Mangabey

Keywords for Genus: *Chlorocebus*

- *Chlorocebus sabaeus*
- *C. sabaeus*
- African green monkey
- Sabaeus monkey
- *Chlorocebus pygerythrus*
- *C. pygerythrus*
- Vervet

Keywords for Genus: *Erythropatas*

- *Erythrocebus patas*
- *E. patas*
- Patas monkey

Keywords for Genus: *Macaca*

- *Macaca*
- *Macaca mulatta*
- *M. mulatta*
- *Macaca fascicularis*
- *M. fascicularis*
- *Macaca nemestrina*
- *M. nemestrina*
- *Macaca fuscata*
- *M. fuscata*
- *Macaca arctoides*
- *M. arctoides*
- Macaque
- Rhesus
- Rhesus macaque
- Cynomolgus macaque
- Pigtail macaque
- Japanese macaque
- Stump-tailed macaque

Keywords for Genus: *Papio*

- *Papio*
- *Papio anubis*
- *Papio hamadryas*
- Baboon

Keywords for Genus: *Saguinus*

- *Saguinus*
- Tamarin

Keywords for Genus: *Saimiri*

- *Saimiri*
- *Saimiri boliviensis*
- *S. boliviensis*
- *Saimiri oerstedii*
- *S. oerstedii*
- *Saimiri sciureus*
- *S. sciureus*
- *Saimiri ustus*
- *S. ustus*
- *Saimiri vanzolinii*
- *S. vanzolinii*
- Squirrel monkey

Appendix C: Age Categories

Table 31. Age Categories and Age Ranges for NHP Species

Species	Age Category and Age Ranges			
	Infant	Juvenile	Adult	Geriatric
African Green (Vervet) Monkey	Less than 12 months	1–4 years	4–15 years	Over 15 years
Baboon (all species)	Less than 12 months	1–4 years	4–15 years	Over 15 years
Common Marmoset	Less than 6 months	6–18 months	1.5–8 years	Over 8 years
Cynomolgus Macaque	Less than 12 months	1–4 years	4–17 years	Over 17 years
Japanese Macaque	Less than 12 months	1–4 years	4–15 years	Over 15 years
Pigtail Macaque	Less than 12 months	1–4 years	4–15 years	Over 15 years
Rhesus Macaque	Less than 12 months	1–4 years	4–17 years	Over 17 years
Sooty Mangabey	Less than 12 months	1–4 years	4–15 years	Over 15 years
Squirrel Monkey	Less than 12 months	1–4 years	4–15 years	Over 15 years
Tamarin	Less than 7 months	7–30 months	2.5–10 years	Over 10 years

Appendix D: Areas of Research and Definitions

Table 32. Research Area Category with Inclusion/Exclusion Criteria

Primary Research Area Category	Supplemental Inclusion/Exclusion Criteria
Auditory System	Includes studies of normal auditory processing and disorders/diseases of the auditory system.
Blood Disorder	None.
Cancer	Includes all studies on cancer, except HIV/AIDS-associated cancers (classified separately under "HIV/AIDS").
Cardiovascular Disease	None.
Dental/Oral Disease	None.
Diabetes	None.
Fetal Development	Includes normal fetal development, as well as the effects of disease, alcohol, etc., on fetal development (except HIV/AIDS effects, classified separately under "HIV/AIDS").
HIV/AIDS	Includes all studies of direct effects of AIDS (including effects on fetal development), studies addressing therapy for AIDS, drug and vaccine development, and studies of AIDS comorbidities.
Infectious Disease—Bacterial	Includes all bacterial infectious disease research (to include vaccine development and testing). Excludes general studies of infectious disease not specifically directed toward bacterial diseases (classified separately as "Molecular Immunology [General]").
Infectious Disease—Fungal	Includes all fungal infectious disease research (to include vaccine development and testing). Excludes general studies of infectious disease not specifically directed toward fungal diseases (classified separately as "Molecular Immunology [General]").
Infectious Disease—Parasitic	Includes all parasitic infectious disease research (to include vaccine development and testing). Excludes general studies of infectious disease not specifically directed toward parasitic diseases (classified separately as "Molecular Immunology [General]").

Infectious Disease—Viral (Non-HIV/AIDS)	Includes all viral infectious disease research (to include vaccine development and testing), other than HIV/AIDS (classified separately under “HIV/AIDS”). Excludes general studies of infectious disease not specifically directed toward HIV infection (classified separately as “Molecular Immunology [General]”).
Molecular Immunology (General)	Includes all studies of the function of the immune system not directed toward a specific infectious disease or transplantation immunology (classified separately).
Musculoskeletal Disorders	Includes studies of neuromuscular disease (e.g., Parkinson’s disease).
Neuroscience—Behavioral and Systems	Includes studies of behavior and cognition, including function of neural circuits and systems, effects of disease (e.g., Alzheimer’s disease), and alcohol/substance abuse on these behaviors/systems.
Neuroscience—Molecular	Includes studies of molecular mechanisms underlying neurological function/disorders. These studies will be targeted to the subcellular level (e.g., genetic manipulation).
Nutritional and Metabolic Disorders (Non-Diabetes)	Includes studies on obesity, metabolic disorders (various), and nutrition disorders (various). Does not include diabetes (classified separately).
Regenerative Medicine and Transplantation	Includes studies on general stem cell research, transplantation rejection, preventing rejection, graft versus host disease, etc.
Reproductive Health	Includes studies of effects on reproductive capacity and pregnancy (for effects on fetus, see Fetal Development).
Respiratory System	Includes studies on non-infectious respiratory diseases and insults (e.g., environmental toxicant exposure), as well as asthma or other inflammatory conditions that affect the respiratory tract.

SARS-CoV-2 (COVID-19)	Includes all studies of direct effects of COVID-19 (including effects on fetal development), studies addressing therapy for COVID-19, drug and vaccine development, and studies of COVID-19 comorbidities.
Urologic Diseases	Includes studies on renal function.
Visual System	Includes studies of visual processing and ophthalmic disorders.
Other	Used for studies not fitting within any other category.

Appendix E: Research Phases and Definitions

Table 33. Research Phases Category and Definition

Category	Definition
Basic Research	Basic research is formally defined as "systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind." Basic biomedical research is targeted at understanding the underlying mechanisms of disease, injury, or normal biological function and behavior, as well as the development of novel research tools (e.g., animal models) for mechanistic studies and/or the study of medical countermeasures.
Applied Research—Medical Products	Applied research is formally defined as "systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met." Applied biomedical research for medical products typically explores the use of a defined countermeasure concept or set of concepts against a particular disease or condition, or it evaluates physical or biological characteristics of the countermeasure itself. Applied research can demonstrate proof of concept for a countermeasure and may seek to optimize a countermeasure but falls short of formal preclinical development activities.
Applied Research—Surgical Techniques	Applied research is formally defined as "systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met." Applied biomedical research for surgical techniques typically explores the use of a defined concept or set of concepts for surgical intervention in a particular disease or condition to demonstrate proof of concept and optimize the application of the technique.
Translational Research	Translational research fosters the multidirectional integration of basic research, patient-oriented research, and population-based research, with the long-term aim of improving the health of the public. T1 research expedites the movement between basic research and patient-oriented research that leads to new or improved scientific understanding or standards of care (e.g., drug development; pharmacogenomics; some studies of disease mechanisms and research into such new areas as genetics, genomics, and proteomics). T2 research facilitates the movement between patient-oriented research and population-based research that leads to better patient outcomes, the implementation of best practices, and improved health status in communities (e.g., clinical epidemiology, health services [outcomes] research, community-based participatory research). T3 research promotes interaction between laboratory-based research and population-based research to stimulate a robust scientific understanding of human health and disease (e.g., emerging disciplines, such as molecular and genetic epidemiology).

Biologics Development/Testing	This category includes studies that have as their objective formal preclinical development of a biologic (including vaccines) as a prerequisite to initiation of clinical trials to establish optimal dosing, toxicity, kinetics, etc. Generally involves studies conducted in accordance with Good Laboratory Practice (GLP) (for toxicity testing). For products intended for United States Food and Drug Administration (FDA) approval under the Animal Rule, may also include advanced testing of efficacy under GLP.
Drug Development/Testing	This category includes studies that have as their objective formal preclinical development of a drug as a prerequisite to initiation of clinical trials to establish optimal dosing range, toxicity, kinetics, etc. Generally involves studies conducted in accordance with GLP (for toxicity testing). For products intended for FDA approval under the Animal Rule, may also include advanced testing of efficacy under GLP.
Medical Device Development/Testing	This category includes studies that have as their objective formal preclinical development of a medical device as a prerequisite to initiation of clinical trials or (when applicable) as direct evidence supporting approval of a device under the Premarket Notification (510(k)) process to establish usability, safety, performance, etc. Generally involves studies conducted in accordance with GLP (for toxicity testing).
NHP Infrastructure/ Resource	This category is reserved for development and maintenance of NHP breeding colonies and closely related activities, including development of NHP reagents or other research resources that are broadly applicable to studies employing NHPs.
Other	Used for studies not fitting within any other category.

Appendix F: Interview Information Page and Protocol

NHP Evaluation and Analysis Interview

Background

Who is conducting the interviews for this evaluation?

Maggie May of the Human Resources Research Organization (HumRRO) and Sheri Hild, a consultant for The Scientific Consulting Group, Inc. (SCG), will be conducting semi-structured interviews with research suppliers of nonhuman primates (NHPs). HumRRO is an independent nonprofit research organization, and SCG is a science communications company. Other HumRRO and SCG staff may also be on the call for notetaking purposes.

What is this evaluation about?

The Division of Program Coordination, Planning, and Strategic Initiatives (DPCPSI) within the Office of the NIH Director performs critical analysis tasks in support of numerous key areas of emerging scientific opportunities or rising public health challenges and helps to accelerate investments in these areas to make sure new ideas have a chance to develop. Under the umbrella of DPCPSI, the Office of Research Infrastructure Programs (ORIP) and the Office of AIDS Research (OAR) are undertaking a research study to reassess the demand for and use of NHPs in biomedical research. NHPs are critical for biomedical research because of their close physiological similarities to humans, which allows them to serve as models for human disease. ORIP funds a comprehensive grant portfolio of NHP-related centers, resources and projects that enables stages of translational research from discovery to final testing before initiation of human clinical trials. The study being undertaken by ORIP and OAR will provide critical information on current and future NHP needs and how those needs are being met. The study findings and aggregate data will be useful in guiding the NIH and the biomedical research community regarding meeting future national resource needs.

What will I be asked to do?

During the interview, you will be asked questions that assess the capabilities, current status, and future needs of NHPs in biomedical research. You will be asked questions regarding upgrades to your facility, how you track NHP demands and forecast future NHP uses, species preference for research, challenges and constraints in meeting demands, and more. The questions collectively aim to gather comprehensive information about past, current, and future landscape of NHP use.

How long will the interview last?

The interview will last approximately 1 hour.

How will the interview be conducted?

The interview will be conducted virtually via Microsoft Teams. With your consent, the discussion will be recorded for notetaking purposes only. The recording will not be shared or distributed beyond HumRRO and SCG and will be destroyed upon conclusion of the evaluation project.

Interview Questions

Context questions (only asked if response to these questions was not received from RFI email or clarification is needed):

1. Who are your customers and are you able to meet demand?
2. Do you maintain breeding colonies of nonhuman primates (NHPs)? Can you elaborate on the NHPs and NHP-related resources that your organization provides or maintains to support biomedical research needs?
   a) For suppliers: What species do you breed? What is your approximate total holding capacity? What is your annual production rate for each NHP colony (by species)?
   b) For suppliers: How do you maximize production for each of your colonies? What are the limiting factors (e.g., insufficient breeding space, insufficient space for juveniles, not enough genetic diversity, insufficient care/support staff, etc.)?
   c) What specialized facilities, services, or equipment do you provide to NHP investigators?
3. Do you have the capacity to "recycle/reuse" NHPs for more than 1 research study? If so, approximately how many NHPs would fall in this category on an annual basis?
4. How has the COVID-19 pandemic affected your supply of NHPs or your ability to provide NHP-related services, and what challenges did you face in meeting the increased demand or maintaining a steady supply during this period?

Questions for obtaining forecast of capabilities and NHP use:

5. Have you added any capabilities/services to your facility since 2018? If so, what are they?
6. Are there areas you plan to expand upon related to animals/species, services, or research expertise?
7. Are you regularly tracking NHP demands and usage? If yes, how?
8. How do you determine future demand (customer needs for specific NHPs)? Has customer behavior changed, and if so, how? Can you briefly describe your forecasting method for future use of NHP species?
9. Based on your experience and past usage, which specific NHP species are in higher demand for biomedical research, and which biomedical research fields make the most extensive use of NHPs. What factors contribute to researcher preferences?
10. How long is the current wait time for the NHP species/age/sex combination that is in highest demand at your center? What are the key factors affecting wait time?
11. To what extent is NHP transportation an issue/problem? What is its impact on meeting demand?
12. What are some challenges or constraints that you foresee in meeting the growing demands for NHPs in biomedical research?

13. What strategies does your organization employ to ensure a consistent supply of NHPs and related resources to meet the needs of researchers?

14. Is there any additional information you wish to provide us with on your organization’s research capabilities, or on forecasting future demands of NHP usage?

Appendix G: User Survey

Nonhuman Primate Evaluation and Analysis User Survey

Thank you for participating in the National Institutes of Health (NIH) Office of Research Infrastructure Programs (ORIP) Nonhuman Primate Survey! Your responses are being collected by the Human Resources Research Organization (HumRRO), an independent third party. Your feedback will be combined with the opinions of nonhuman primate suppliers to help ORIP, NIH, and the nonhuman primate community better understand the current and future nonhuman primate landscape and how to best serve the biomedical research community. Your responses will be completely voluntary and anonymous. The aggregate results will be published as part of a report on the NIH ORIP website. The survey includes questions that pertain to the areas of research that will require use of nonhuman primates during the next 5 years (2024–2028), species requirements, facility requirements, and the factors that dictate where investigators choose to have their nonhuman primate studies performed. If you do not plan to use nonhuman primates in your research, or received the survey invitation in error, please answer Question 1 to opt out of the survey; otherwise, please answer all questions.

Please click “Next” to begin.

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1. Please select from one of the choices below to confirm whether you expect to use nonhuman primates in your current and/or future research (selecting choice B, choice C, or choice D will opt you out of the survey, concluding your participation).
   A. I am currently using or expect to use nonhuman primates in my research during the period from 2024–2028.
   B. I have used nonhuman primates in my past research but do not currently expect to use them in my research from 2024–2028 due to changes in the scientific focus of my research and associated needs for animal models.
   C. I have used nonhuman primates in my past research but do not currently expect to use them in my research from 2024–2028 for reasons unrelated to the scientific focus of my research.
   D. I received the survey invitation in error; I have not used and do not plan to use nonhuman primates in my research.

Branching: If A, then move forward. If B/C/D, then end the survey.

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2. Please indicate the type of research organization in which you currently work (select one).
   A. University or other academic institution
   B. Nonprofit organization
   C. For-profit organization
   D. United States federal government agency
   E. Other (please specify) ________________

3. Please indicate whether your organization has an animal facility that can support studies in nonhuman primates (select one).
   A. My organization operates an NIH-supported National Primate Research Center.*
   B. My organization maintains an NIH-supported nonhuman primate breeding colony (but is not a National Primate Research Center).
   C. My organization has an animal facility that can support studies in nonhuman primates, but this facility is not supported directly by NIH.
   D. The animal facilities (if any) in my organization cannot support studies in nonhuman primates.

*The National Primate Research Centers are located at Emory University; Oregon Health & Science University; Texas Biomedical Research Institute; Tulane University; University of California, Davis; University of Washington; and University of Wisconsin–Madison.

4. Please select from the following list the statement that best describes the organization which you expect will house the nonhuman primates used in your future research and perform studies on them. If you have not yet planned your future studies in sufficient detail to determine where studies will be performed, select the statement that in your judgment represents the most likely alternative based on where your current studies are performed or other considerations as you deem appropriate (please select one; if you expect to use more than one type of organization, select the choice that describes where most work will be done).
   A. Studies will be performed using the animal facilities of my organization.
   B. Studies will be performed at a NIH-supported National Primate Research Center that is separate from my organization.
   C. Studies will be performed at a NIH-supported nonhuman primate facility that is NOT a National Primate Research Center and is separate from my organization.
   D. Studies will be performed using animal facilities that are not directly supported by NIH and are located at an academic or non-profit institution that is separate from my organization.
   E. Studies will be performed at a commercial research organization that is separate from my organization.
   F. Studies will be performed at a United States Federal Government agency that is separate from my organization.

5. From the following list, please select the area(s) that best describe the focus of your current or future planned (time period 2024–2028) research involving nonhuman primates (please select all that apply).
   A. Auditory system function and disorders
   B. Bacterial infectious diseases
   C. Behavioral and systems neuroscience
   D. Blood disorders
   E. Cancer
   F. Cardiovascular disease
   G. Dental/oral disease
   H. Diabetes
   I. Fetal development
   J. Fungal infectious diseases
   K. General molecular immunology (non-disease-specific)
   L. HIV/AIDS
   M. Microbiome or virome studies
   N. Molecular neuroscience
   O. Musculoskeletal and neuromusculoskeletal disorders
   P. Nutritional and metabolic disorders (excluding diabetes)
   Q. Parasitic infectious diseases
   R. Pediatrics
   S. Pharmacology
   T. Regenerative medicine and transplantation
   U. Reproductive health
   V. Respiratory system function and disorders
   W. SARS-CoV-2 (COVID-19)
   X. Toxicology
   Y. Urologic diseases
   Z. Viral infectious diseases (excluding HIV/AIDS and COVID-19)
   AA. Visual system function and disorders
   BB. Women’s health
   CC. None of the above

This section aims to assist in forecasting nonhuman primate needs in the next 5 years. Question 6 will ask you to provide the nonhuman primate species you are currently using or anticipate using in your research over the next 5 years. Questions 7–11 will ask you to estimate (i) the approximate number of animals of this species that you expect to use in each of the next 5 years, (ii) the approximate mix of sexes within the animals of this species that will be used, (iii) the age categories of the animals of this species, (iv) their pathogen status, and (v) the likelihood that you will obtain NHPs from the source identified in your application/proposal. If you anticipate using more than one species, you may enter data for up to two additional species in Questions 12–23; otherwise, skip to Question 24. Your estimated usage should include both currently funded grants and any new grants that you anticipate receiving during this period. If you are using more than three NHP species, please select only the ones that will be most frequently used. Exact usage data is not required; your “best guess” or estimate is sufficient.

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6. Please use the drop-down menu to select the nonhuman primate species that you currently use or anticipate using in your research over the next 5 years (please select only one species).
   A. African green (vervet) monkey
   B. Baboon
   C. Capuchin
   D. Common marmoset
   E. Cynomolgus macaque
   F. Dusky titi monkey
   G. Japanese macaque
   H. Owl monkey
   I. Patas monkey
   J. Pigtail macaque
   K. Rhesus macaque
   L. Sooty mangabey
   M. Squirrel monkey
   N. Tamarin
   O. Other nonhuman primate

7. Please enter your planned usage of the chosen species above by year.
   A. 2024 _______________
   B. 2025 _______________
   C. 2026 _______________
   D. 2027 _______________
   E. 2028 _______________

8. Please select the approximate sex ratio within the animal you plan to use (across all years listed above).
   A. 100% female
   B. 75% female/25% male (or mostly female)
   C. 50% female/50% male
   D. 25% female/75% male (or mostly male)
   E. 100% male
   F. Unknown (or I’ll use whatever sex is available)

Species	Age Category and Age Ranges			
	Infant	Juvenile	Adult	Geriatric
African Green (Vervet) Monkey	Less than 12 months	1–4 years	4–15 years	Over 15 years
Baboon (all species)	Less than 12 months	1–4 years	4–15 years	Over 15 years
Common Marmoset	Less than 6 months	6–18 months	1.5–8 years	Over 8 years
Cynomolgus Macaque	Less than 12 months	1–4 years	4–17 years	Over 17 years
Japanese Macaque	Less than 12 months	1–4 years	4–15 years	Over 15 years
Pigtail Macaque	Less than 12 months	1–4 years	4–15 years	Over 15 years
Rhesus Macaque	Less than 12 months	1–4 years	4–17 years	Over 17 years
Sooty Mangabey	Less than 12 months	1–4 years	4–15 years	Over 15 years
Squirrel Monkey	Less than 12 months	1–4 years	4–15 years	Over 15 years
Tamarin	Less than 7 months	7–30 months	2.5–10 years	Over 10 years

9. Please select all age categories that apply within the animal you plan to use (across all years listed above).
   A. Infant
   B. Juvenile
   C. Adult
   D. Geriatric

10. Please select all pathogen status that apply within the animal you plan to use (across all years listed above).
    A. Simian type D retrovirus (SRV)–free
    B. Simian immunodeficiency virus (SIV)–free
    C. Simian T cell lymphotropic/leukemia virus (STLV)–free
    D. Cercopithecine herpesvirus 1 (CHV-1)–free
    E. Others _______________

11. Please indicate the likelihood that you will obtain NHPs from the source identified in your research project application/proposal?
    A. Extremely likely (90–100%), I prefer to use the identified source.
    B. Likely (50–90%), the identified supplier usually supports my research, but I will consider NHPs from another source.
    C. Neutral, I will obtain NHPs from any supplier that has them available.
    D. Unlikely (10–50%), the identified source may not have animals available.
    E. Extremely unlikely (0–10%), I do not expect the identified source to have animals available.

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12. Please use the drop-down menu to select the nonhuman primate species that you currently use or anticipate using in your research over the next 5 years (please select only one species).
    A. African green (vervet) monkey
    B. Baboon
    C. Capuchin
    D. Common marmoset
    E. Cynomolgus macaque
    F. Dusky titi monkey
    G. Japanese macaque
    H. Owl monkey
    I. Patas monkey
    J. Pigtail macaque
    K. Rhesus macaque
    L. Sooty mangabey
    M. Squirrel monkey
    N. Tamarin
    O. Other nonhuman primate

13. Please enter your planned usage of the chosen species above by year.
    A. 2024 _______________
    B. 2025 _______________
    C. 2026 _______________
    D. 2027 _______________
    E. 2028 _______________

14. Please select the approximate sex ratio within the animal you plan to use (across all years listed above).
    A. 100% female
    B. 75% female/25% male (or mostly female)
    C. 50% female/50% male
    D. 25% female/75% male (or mostly male)
    E. 100% male
    F. Unknown (or I'll use whatever sex is available)

Species	Age Category and Age Ranges			
	Infant	Juvenile	Adult	Geriatric
African Green (Vervet) Monkey	Less than 12 months	1–4 years	4–15 years	Over 15 years
Baboon (all species)	Less than 12 months	1–4 years	4–15 years	Over 15 years

Common Marmoset	Less than 6 months	6–18 months	1.5–8 years	Over 8 years
Cynomolgus Macaque	Less than 12 months	1–4 years	4–17 years	Over 17 years
Japanese Macaque	Less than 12 months	1–4 years	4–15 years	Over 15 years
Pigtail Macaque	Less than 12 months	1–4 years	4–15 years	Over 15 years
Rhesus Macaque	Less than 12 months	1–4 years	4–17 years	Over 17 years
Sooty Mangabey	Less than 12 months	1–4 years	4–15 years	Over 15 years
Squirrel Monkey	Less than 12 months	1–4 years	4–15 years	Over 15 years
Tamarin	Less than 7 months	7–30 months	2.5–10 years	Over 10 years

15. Please select all age categories that apply within the animal you plan to use (across all years listed above).
    A. Infant
    B. Juvenile
    C. Adult
    D. Geriatric

16. Please select all pathogen status that apply within the animal you plan to use (across all years listed above).
    A. Simian type D retrovirus (SRV)–free
    B. Simian immunodeficiency virus (SIV)–free
    C. Simian T cell lymphotropic/leukemia virus (STLV)–free
    D. Cercopithecine herpesvirus 1 (CHV-1)–free
    E. Others _______________

17. Please indicate the likelihood that you will obtain NHPs from the source identified in your research project application/proposal?
    A. Extremely likely (90–100%), I prefer to use the identified source.
    B. Likely (50–90%), the identified supplier usually supports my research, but I will consider NHPs from another source.
    C. Neutral, I will obtain NHPs from any supplier that has them available.
    D. Unlikely (10–50%), the identified source may not have animals available.
    E. Extremely unlikely (0–10%), I do not expect the identified source to have animals available.

18. Please use the drop-down menu to select the nonhuman primate species that you currently use or anticipate using in your research over the next 5 years (please select only one species).
    A. African green (vervet) monkey
    B. Baboon
    C. Capuchin
    D. Common marmoset
    E. Cynomolgus macaque
    F. Dusky titi monkey
    G. Japanese macaque
    H. Owl monkey
    I. Patas monkey
    J. Pigtail macaque
    K. Rhesus macaque
    L. Sooty mangabey
    M. Squirrel monkey
    N. Tamarin
    O. Other nonhuman primate

19. Please enter your planned usage of the chosen species above by year.
    A. 2024 _______________
    B. 2025 _______________
    C. 2026 _______________
    D. 2027 _______________
    E. 2028 _______________

20. Please select the approximate sex ratio within the animal you plan to use (across all years listed above).
    A. 100% female
    B. 75% female/25% male (or mostly female)
    C. 50% female/50% male
    D. 25% female/75% male (or mostly male)
    E. 100% male
    F. Unknown (or I'll use whatever sex is available)

Species	Age Category and Age Ranges			
	Infant	Juvenile	Adult	Geriatric
African Green (Vervet) Monkey	Less than 12 months	1–4 years	4–15 years	Over 15 years
Baboon (all species)	Less than 12 months	1–4 years	4–15 years	Over 15 years
Common Marmoset	Less than 6 months	6–18 months	1.5–8 years	Over 8 years
Cynomolgus Macaque	Less than 12 months	1–4 years	4–17 years	Over 17 years
Japanese Macaque	Less than 12 months	1–4 years	4–15 years	Over 15 years

Pigtail Macaque	Less than 12 months	1–4 years	4–15 years	Over 15 years
Rhesus Macaque	Less than 12 months	1–4 years	4–17 years	Over 17 years
Sooty Mangabey	Less than 12 months	1–4 years	4–15 years	Over 15 years
Squirrel Monkey	Less than 12 months	1–4 years	4–15 years	Over 15 years
Tamarin	Less than 7 months	7–30 months	2.5–10 years	Over 10 years

21. Please select all age categories that apply within the animal you plan to use (across all years listed above).
    E. Infant
    A. Juvenile
    B. Adult
    C. Geriatric

22. Please select all pathogen status that apply within the animal you plan to use (across all years listed above).
    A. Simian type D retrovirus (SRV)–free
    B. Simian immunodeficiency virus (SIV)–free
    C. Simian T cell lymphotropic/leukemia virus (STLV)–free
    D. Cercopithecine herpesvirus 1 (CHV-1)–free
    E. Others _______________

23. Please indicate the likelihood that you will obtain NHPs from the source identified in your research project application/proposal?
    A. Extremely likely (90–100%), I prefer to use the identified source.
    B. Likely (50–90%), the identified supplier usually supports my research, but I will consider NHPs from another source.
    C. Neutral, I will obtain NHPs from any supplier that has them available.
    D. Unlikely (10–50%), the identified source may not have animals available.
    E. Extremely unlikely (0–10%), I do not expect the identified source to have animals available.

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24. In the boxes provided below, please briefly describe up to 4 research capabilities that are most important for your nonhuman primate service provider to possess in order to successfully support your research. A research capability may be a specialized service or specialized facilities or instruments. Examples include ability to conduct motor performance or specialized behavioral testing, provide biotelemetry support, perform aerosol exposures, perform functional MRI studies, conduct studies requiring high biological containment (e.g., ABSL-3 or ABSL-4), etc. (Each entry is limited to 100 characters.)
    Capability 1 ____
    Capability 2 ____
    Capability 3 ____
    Capability 4 ____

25. The following is a list of factors that might influence an investigator's choice of a particular organization to house or perform nonhuman primate studies. For each of the listed factors, please use the drop-down list to select a number from 1–7 that describes the importance of the factor in your choice of the organization(s) that have supported your nonhuman primate studies in the past, or that you expect to use in the future. (1 = Critical, 2 = Very important, 3 = Somewhat important, 4 = Neutral (no opinion), 5 = Somewhat unimportant, 6 = Negligible importance, 7 = No importance)

    A. Local Access: The performing organization is collocated with or is in close proximity to my laboratory, providing convenient local access to animals and allowing myself and/or my immediate staff to directly participate in the performance of studies that employ the animals, without excessive travel.
        1 = Critical
        2 = Very important
        3 = Somewhat important
        4 = Neutral (no opinion)
        5 = Somewhat unimportant
        6 = Negligible importance
        7 = No importance

    B. Access to Expertise in Relevant Models: The performing organization can provide personnel with specialized expertise (not present within my immediate research team) in nonhuman primate models of the biological systems or diseases that are the focus of my research.
        1 = Critical
        2 = Very important
        3 = Somewhat important
        4 = Neutral (no opinion)
        5 = Somewhat unimportant
        6 = Negligible importance
        7 = No importance

    C. Access to Expertise in Relevant Techniques: The performing organization can provide personnel with specialized expertise (not present within my immediate research team) in research techniques that is necessary for the performance of my research.
        1 = Critical
        2 = Very important
        3 = Somewhat important
        4 = Neutral (no opinion)
        5 = Somewhat unimportant
        6 = Negligible importance
        7 = No importance

    D. Access to Specialized Equipment or Facilities: The performing organization provides access to specialized instruments, equipment or facilities that are not available within my own laboratory and are necessary for the performance of my research.
        1 = Critical
        2 = Very important
        3 = Somewhat important
        4 = Neutral (no opinion)
        5 = Somewhat unimportant
        6 = Negligible importance
        7 = No importance

E. Prior Relationship: I have an established collaboration with the performing organization, or have otherwise used them to support my prior studies, with good results.
    1 = Critical
    2 = Very important
    3 = Somewhat important
    4 = Neutral (no opinion)
    5 = Somewhat unimportant
    6 = Negligible importance
    7 = No importance

F. Basic Animal Availability: The performing organization is able to provide a sufficient number of animals of the required species, age and sex needed for my research in a timely manner.
    1 = Critical
    2 = Very important
    3 = Somewhat important
    4 = Neutral (no opinion)
    5 = Somewhat unimportant
    6 = Negligible importance
    7 = No importance

G. Availability of Specific-Pathogen-Free (SPF) Animals: The performing organization is able to provide a sufficient number of SPF animals in a timely manner.
    1 = Critical
    2 = Very important
    3 = Somewhat important
    4 = Neutral (no opinion)
    5 = Somewhat unimportant
    6 = Negligible importance
    7 = No importance

H. Availability of Genetically Characterized Animals: The performing organization is able to provide a sufficient number of animals with specific genetic characteristics that I need for the performance of my research (e.g., MHC types or other genetic profile).
    1 = Critical
    2 = Very important
    3 = Somewhat important
    4 = Neutral (no opinion)
    5 = Somewhat unimportant
    6 = Negligible importance
    7 = No importance

I. Cost: The performing organization provides the capabilities that I need for my research at the lowest cost, compared to other suitable alternatives.
    1 = Critical
    2 = Very important
    3 = Somewhat important
    4 = Neutral (no opinion)
    5 = Somewhat unimportant
    6 = Negligible importance
    7 = No importance

26. Which species do you use? (select all that apply)
    A. African green (vervet) monkey
    B. Baboon
    C. Capuchin
    D. Common marmoset
    E. Cynomolgus macaque
    F. Dusky titi monkey
    G. Japanese macaque
    H. Owl monkey
    I. Patas monkey
    J. Pigtail macaque
    K. Rhesus macaque
    L. Sooty mangabey
    M. Squirrel monkey
    N. Tamarin
    O. Other nonhuman primate

27. Has the cost of the NHP species used in your research (identified in question 26) increased since 2018?
    A. Yes
    B. No

Branching: If yes, please answer questions 28 and 29. If no, skip to question 30.

28. Approximately how much has the purchase/use cost increased?
    A. 2-fold
    B. 4-fold
    C. 5-fold
    D. 10-fold

29. How has the increased cost impacted your research project? (select all that apply).
    A. I have had to decrease the number of NHPs assigned to the study.
    B. I have decreased the time commitment of personnel.
    C. I have reduced supply costs.
    D. I have had to reduce the scope of the research project.
    E. I have proposed costs that exceed NIH's $500,000 cap with permission from the Institute/Center staff.
    F. Other ___________________________________

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30. Are there any other factors not previously mentioned in this survey that are critical or very important to you in selecting a service provider for your nonhuman primate studies? If so, please briefly describe them.

31. Have you experienced problems within the past 2 years that delayed your research, altered your experimental design, or influenced how you performed your research, because you encountered challenges obtaining or accessing nonhuman primates or related research support capacities? If so, please briefly describe them.

	Very large extent	Large extent	Neutral	Little extent	Very little extent
32. To what extent have you had to modify your research plans from 2018–2023 due to the availability (or lack thereof) of NHPs?					
33. To what extent do you foresee having to change your current and future research plans in this next 5 years (2024–2028) due to the availability (or lack thereof) of NHPs?					
34. To what extent did the SARS-CoV-2 pandemic impact your ability to use NHPs in your research?					

Appendix H: Planned NHP Use by Research Area

Table 34. Planned NHP Use for Research Awards, Excluding Infrastructure/Resource Awards, by Research Area for FY18 to FY22

Research Area and Species		Number of Animals by Initial FY of Award					
		FY18	FY19	FY20	FY21	FY22	FY18 FY22
Auditory System	Common marmoset	56		19			75
	Cynomolgus macaque		14				14
	Rhesus macaque	52	21		55	32	160
	Squirrel monkey	10					10
Blood Disorder	Baboon	30		19		20	69
	Cynomolgus macaque	59					59
	Other NHPs (see notes)						
	Rhesus macaque	88	26	16	28		158
Cancer	Common marmoset				36		36
	Cynomolgus macaque	74	46	54	105	10	289
	Rhesus macaque		24		6	13	43
Cardiovascular Disease	African green (vervet) monkey		24				24
	Baboon					70	70
	Rhesus macaque		96				96
Dental/Oral Disease	Common marmoset	60					60
	Rhesus macaque	4			8	30	42
Diabetes	African green (vervet) monkey	20					20
	Baboon			7	6		13
	Common marmoset		36				36
	Cynomolgus macaque	59	4	50		40	153
	Rhesus macaque		16	94			110
Fetal Development	Baboon	132		112			244
	Common marmoset			10		5	15
	Pigtail macaque		28	22			50
	Rhesus macaque	86	216	26	114	76	518
HIV/AIDS	African green (vervet) monkey				12		12
	Baboon	1406					1406
	Common marmoset	206					206
	Cynomolgus macaque	78	20	43	12	56	209
	Owl monkey	368					368
	Pigtail macaque	121	104	167		92	484
	Rhesus macaque	2356	893	1224	1805	815	7093
	Squirrel monkey	546					546

Infectious Disease – Bacterial	African green (vervet) monkey	68				10	78
	Baboon	24	20				44
	Cynomolgus macaque	35	86	149	46	40	356
	Other NHPs (see notes)		0				0
	Rhesus macaque	115	52	54	90	137	448
Infectious Disease – Fungal	Rhesus macaque			64			64
Infectious Disease – Parasitic	Other NHPs (see notes)				20		20
	Owl monkey			105	70		175
	Rhesus macaque	0	30		146	88	264
Infectious Disease – Viral (Non-HIV/AIDS)	African green (vervet) monkey		41	115	70		226
	Baboon		44				44
	Common marmoset				108		108
	Cynomolgus macaque	25	159	81	42		307
	Other NHPs (see notes)			3020			3020
	Pigtail macaque		35		27	5	67
	Rhesus macaque	269	384	338	86	35	1112
	Squirrel monkey			24			24
Molecular Immunology	Baboon		6	36	800		842
	Common marmoset		4	78			82
	Cynomolgus macaque	70	20	64			154
	Rhesus macaque	16	207	60	1312	178	1773
Musculoskeletal Disorders	Cynomolgus macaque	24	96		50		170
	Rhesus macaque	18	52		36	43	149
Neuroscience – Behavioral and Systems	African green (vervet) monkey			105	30		135
	Baboon		21	4		29	54
	Capuchin		10				10
	Common marmoset	12	36	440	185	20	693
	Cynomolgus macaque	164	194	71	34	81	544
	Dusky titi monkey				126		126
	Japanese macaque			10			10
	Other NHPs (see notes)	45	62	26	98		231
	Pigtail macaque			2			2
	Rhesus macaque	286	528	721	1174	425	3134
	Squirrel monkey	38	92	20		12	162

Neuroscience – Molecular	African green (vervet) monkey			10			10
	Baboon	10		18	100		128
	Capuchin			35			35
	Common marmoset	122	90	3	84	204	503
	Cynomolgus macaque	28	30	11		30	99
	Other NHPs (see notes)			20	90	138	248
	Pigtail macaque		28				28
	Rhesus macaque	263	507	162	140	159	1231
	Squirrel monkey	33		8	50		91
Nutritional and Metabolic Disorders (Non-Diabetes)	Cynomolgus macaque		36				36
	Japanese macaque				54		54
	Other NHPs (see notes)	0					0
	Rhesus macaque		41		16	16	73
Regenerative Medicine and Transplantation	African green (vervet) monkey		16				16
	Baboon	300					300
	Capuchin					90	90
	Common marmoset			80			80
	Cynomolgus macaque		69		51		120
	Other NHPs (see notes)		13			350	363
	Rhesus macaque	92	53	68		403	616
Reproductive Health	Baboon				30		30
	Cynomolgus macaque		30				30
	Pigtail macaque				4	6	10
	Rhesus macaque	122	140	81	139	146	628
Respiratory System	Baboon				6		6
	Cynomolgus macaque	10			6	4	20
	Rhesus macaque	20	36	27		6	89
SARS-CoV-2 (COVID-19)	African green (vervet) monkey					28	28
	Cynomolgus macaque				18	72	90
	Pigtail macaque				24		24
	Rhesus macaque			14	20	64	98
Urologic Disease	Baboon		24				24
	Cynomolgus macaque			40			40
	Rhesus macaque		60				60
Visual System	Common marmoset	3	8	293	4	42	350
	Cynomolgus macaque	47	51	72	53	34	257
	Other NHPs (see notes)	400	93	20	50		563
	Pigtail macaque			8	3		11
	Rhesus macaque	172	233	203	371	202	1181
	Squirrel monkey	8					8

Appendix I: Planned NHP Use by Sponsoring ICO

Table 35. Planned NHP Use for Research Awards, Excluding Infrastructure/Resource Awards, by Sponsoring Institute for FY18 to FY22

Institute/Center and Species		Number of Animals by Initial FY of Award					
		FY18	FY19	FY20	FY21	FY22	FY18 FY22
National Cancer Institute	Common marmoset				108		108
	Cynomolgus macaque	74	46	54	105	10	289
	Rhesus macaque		3	57	6	83	149
National Center for Advancing Translational Sciences	Cynomolgus macaque			31			31
	Rhesus macaque		30				30
National Center for Complementary and Integrative Health	Other NHPs	45	13				58
National Eye Institute	Common marmoset	9	44	47	4	56	160
	Cynomolgus macaque	47	57	120	53	31	308
	Japanese macaque			10			10
	Other NHPs	400	93	40	50		583
	Pigtail macaque			8	3		11
	Rhesus macaque	194	257	239	381	188	1259
	Squirrel monkey	8		20			28
National Heart, Lung, and Blood Institute	African green (vervet) monkey		24	40			64
	Baboon	30		13		20	63
	Cynomolgus macaque	91	6		6	4	107
	Pigtail macaque	108		49		46	203
	Rhesus macaque	42	136	51	96		325
National Human Genome Research Institute	Other NHPs						
	Rhesus macaque					112	112
National Institute of Allergy and Infectious Diseases	African green (vervet) monkey		21	115	70	38	244
	Baboon	1424	40	73	6		1543
	Common marmoset	200	0		36		236
	Cynomolgus macaque	162	290	362	213	236	1263
	Other NHPs		0	3020	20		3040
	Owl monkey	362		105	70		537
	Pigtail macaque	9	165	56	31	57	318
	Rhesus macaque	2459	1391	1368	1621	953	7792

	Squirrel monkey	540		24			564
National Institute of Arthritis and Musculoskeletal and Skin Diseases	Cynomolgus macaque		4		12		16
	Rhesus macaque	8					8
National Institute of Biomedical Imaging and Bioengineering	African green (vervet) monkey		20				20
	Baboon		30				30
	Common marmoset		8	3	8		19
	Cynomolgus macaque	4				3	7
	Other NHPs		6			4	10
	Rhesus macaque	15	99	6		4	124
	Squirrel monkey	3					3
***Eunice Kennedy Shriver* National Institute of Child Health and Human Development**	African green (vervet) monkey		16				16
	Baboon	132	24		36		192
	Common marmoset			10			10
	Cynomolgus macaque		30				30
	Japanese macaque				54		54
	Pigtail macaque			22			22
	Rhesus macaque	266	397	676	495	207	2041
National Institute of Dental and Craniofacial Research	Common marmoset	60					60
	Rhesus macaque	76			8	30	114
National Institute of Diabetes and Digestive and Kidney Diseases	African green (vervet) monkey	88					88
	Baboon			112			112
	Common marmoset					5	5
	Cynomolgus macaque	59	100	90	69	62	380
	Pigtail macaque			18	24		42
	Rhesus macaque	102	120	52	74	37	385
National Institute of General Medical Sciences	Baboon	0		12			12
	Common marmoset	0					0
	Rhesus macaque	14					14
National Institute of Mental Health	Baboon	6					6
	Capuchin		10				10
	Common marmoset		12	609	88	134	843
	Cynomolgus macaque	24		2		32	58
	Dusky titi monkey				126		126
	Other NHPs		8			100	108
	Pigtail macaque			44			44
	Rhesus macaque	176	307	373	139	284	1279

National Institute of Neurological Disorders and Stroke	African green (vervet) monkey			10			10
	Common marmoset	12	10	69		16	107
	Cynomolgus macaque	60	192	25	72	10	359
	Other NHPs		48		90	34	172
	Pigtail macaque		30	2			32
	Rhesus macaque	217	224	180	262	176	1059
	Squirrel monkey	30		8	50	12	100
National Institute on Aging	African green (vervet) monkey			62	30		92
	Baboon	300		22	900	99	1321
	Capuchin					90	90
	Common marmoset		96	166	116		378
	Cynomolgus macaque			50		22	72
	Other NHPs	0		6	98	350	454
	Rhesus macaque	124	429	80	183	559	1375
National Institute on Alcohol Abuse and Alcoholism	African green (vervet) monkey			3			3
	Baboon	4	21				25
	Cynomolgus macaque	24	40	16		12	92
	Rhesus macaque		16	142	88	66	312
National Institute on Deafness and Other Communication Disorders	Common marmoset	50	4	19			73
	Cynomolgus macaque		14			3	17
	Rhesus macaque	59	15	2	52	37	165
	Squirrel monkey	10					10
National Institute on Drug Abuse	Baboon	6					6
	Common marmoset	6			57		63
	Cynomolgus macaque	104	95	5		20	224
	Owl monkey	6					6
	Pigtail macaque	6					6
	Rhesus macaque	125	197	246	188	126	882
	Squirrel monkey	44	92				136
Office of the Director	African green (vervet) monkey				12		12
	Capuchin			35			35
	Common marmoset	122				60	182
	Cynomolgus macaque	24				4	28
	Other NHPs			20			20
	Rhesus macaque	98	30	6	2021	6	2161

Appendix J: List of Acronyms and Abbreviations

AAV	adeno-associated virus
ABSL	animal biosafety level
ANOVA	analysis of variance
APHIS	Animal and Plant Health Inspection Service (USDA)
BSL	biosafety level
CARES Act	Coronavirus Aid, Relief, and Economic Security Act
CDC	Centers for Disease Control and Prevention
CHV-1	cercopithecine herpesvirus 1
CMV	cytomegalovirus
CRO	contract research organization
CT	computed tomography
FY	fiscal year
ICO	[NIH] institutes, centers, and offices
IMPAC	Information for Management Planning Analysis and Coordination
MCC	Marmoset Coordinating Center
MHC	major histocompatibility complex
MRI	magnetic resonance imaging
NASEM	National Academies of Sciences, Engineering, and Medicine
NCATS	National Center for Advancing Translational Sciences
NCCIH	National Center for Complementary and Integrative Health
NCI	National Cancer Institute
NEI	National Eye Institute
NHGRI	National Human Genome Research Institute
NHLBI	National Heart, Lung, and Blood Institute
NHP	nonhuman primate

NIA	National Institute on Aging
NIAAA	National Institute on Alcohol Abuse and Alcoholism
NIAID	National Institute of Allergy and Infectious Diseases
NIAMS	National Institute of Arthritis and Musculoskeletal and Skin Diseases
NIBIB	National Institute of Biomedical Imaging and Bioengineering
NICHD	*Eunice Kennedy Shriver* National Institute of Child Health and Human Development
NIDA	National Institute on Drug Abuse
NIDCD	National Institute on Deafness and Other Communication Disorders
NIDCR	National Institute of Dental and Craniofacial Research
NIDDK	National Institute of Diabetes and Digestive and Kidney Diseases
NIGMS	National Institute of General Medical Sciences
NIH	National Institutes of Health
NINDS	National Institute of Neurological Disorders and Stroke
NIRC	New Iberia Research Center [at the University of Louisiana at Lafayette]
NPRC	National Primate Research Center
OAR	[NIH] Office of AIDS Research
OD	[NIH] Office of the Director
ORIP	[NIH] Office of Research Infrastructure Programs
PET	positron emission tomography
PI	principal investigator
RFI	request for information
SHIV	simian-human immunodeficiency virus
SIV	simian immunodeficiency virus
SPF	specific-pathogen-free [animal]
SPSS®	Statistical Package for Social Sciences
SRV	simian retrovirus
STLV	simian T-cell lymphotropic/leukemia virus

USDA	U.S. Department of Agriculture
VAS	[NIH] Vertebrate Animals Section