Follow-up Report on the Health Canada Non-Human Primate Colony

An Expert Panel Follow-up Report prepared at the request of The Royal Society of Canada for Health Canada

"studiis eodem diversis nitimur"
"different paths, one vision"
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Follow-up Expert Panel
on the Non-Human Primate Colony

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The Royal Society of Canada
Expert Panel Follow-up Report on the
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I. Introduction and Terms of Reference

In 1997 Health Canada requested that the Royal Society of Canada (RSC) convene an Expert Panel to advise the Department on the future of the cynomolgus macaque monkey colony maintained at its Tunney’s Pasture facilities in Ottawa. This Expert Panel released its Report on November 20, 1997, which contained a series of recommendations for the future of the colony. On February 7, 2003, Health Canada submitted a subsequent request to the RSC that it conduct a follow-up investigation of whether the Department had taken appropriate measures to address these recommendations. The Royal Society of Canada Committee on Expert Panels asked the chair of the original Panel, Dr. Conrad Brunk, to lead this follow-up study together with two other experts, Dr. Albert Clark, a member of the original panel, and Dr. David Fraser, an expert on animal welfare issues.

The Terms of Reference for this follow-up study were agreed upon in a meeting of the follow-up panel with Dr. Karen Dodds, Director General of the Food Directorate and other members of the staff during a site visit to the Tunney’s Pasture facility on June 25, 2003. These Terms of Reference include two general issues:

1. An evaluation of the measures taken by Health Canada to implement the recommendations made by the original Expert Panel in 1997;

2. Evaluation of the appropriateness of re-initiating a breeding program in the colony in order to sustain the colony for new research conducted by Canadian researchers in response to emerging health issues in Canada and the world.

This report details the conclusions of this follow-up investigation.
II. Background: The 1997 Royal Society of Canada Report

In 1997 Health Canada requested that the Royal Society of Canada establish an expert panel to advise it on the future of its non-human primate (NHP) colony. The colony was established in 1983 with the importation of 1000 cynomolgus macaque monkeys from the Philippines, primarily to satisfy the needs of Health Canada for a polio vaccine testing program as required under the Food and Drug Act, but also to provide an ongoing source of research animals in case the supply of off-shore NHP’s ceased or became disrupted. Through an active breeding program the colony reached a high of 1500 animals, but this number had reduced to just over 900 in 1997. As a result of policy changes eliminating the need for duplicate testing of polio vaccines, the department’s requirement for these animals was reduced to zero. Severe budget cuts to the Animal Resources Division (ARD), which was responsible for maintaining the primate colony, placed the whole breeding and research program of ARD in jeopardy. It was in this context that Health Canada requested the Royal Society of Canada Expert Panel to assess the public policy need for a Canadian Non-Human Primate breeding colony. The Terms of Reference asked the Panel to determine:

1. The value of the NHP colony to support Canadian research in universities, the private sector and government organizations on the health effects of disease and disease prevention;

2. The responsibility of the Government of Canada for the maintenance of the colony;

3. The costs and benefits to Canadian research of maintaining the colony;

4. Other options for meeting the research requirements for these animals.

The Expert Panel issued its Report in November 1997. The Report laid out a framework of ethical principles that guided its assessment of the needs for the colony as well as its assessment and recommendations.

PRINCIPLES:

1. Conditional Justification for Animal Research. The Panel recognized the ethical problems raised by the use of highly intelligent and socially/emotionally-developed animals such as the cynomolgus macaques. The Panel concluded that the predominant view in Canadian society is that these animals may be used in research that is scientifically valid and has reasonable
promise of significant health benefits. This implies that it is not ethically acceptable to hold animals of this kind in the restrictive conditions of this kind unless there is demand for, and funding of, the kind of research that justifies their use.

2. Animal Welfare. The Panel accepted that, as a minimum requirement, all animal research should be conducted within the ethical guidelines and standards of care articulated by the Canadian Council on Animal Care (CCAC), and, by implication, no disposition of the NHP colony was acceptable that would remove the animals from the protection of CCAC or a comparable system of animal welfare protection.

3. Responsibility. The Panel invoked the widely recognized principle that the decision to produce or purchase animals for use or enjoyment incurs a serious obligation to provide for the care of these animals. Animals, especially those that are highly developed and intelligent, ought not be bred and then abandoned or euthanized simply because the original interest has waned.

4. Justified Euthanasia. Euthanasia of such animals is normally justifiable under three conditions: When necessary for the prevention of suffering of individual animals, when humane death is necessary to obtain research objectives, and when necessary for population control for example when wild animals overpopulate their natural environments. The Panel felt that euthanasia of NHP’s is not justified merely as a way to “manage away surplus numbers...especially when the overpopulation has resulted in part from a failure to maintain breeding in proportion to reasonable prospects of need.”

5. Non-Displacement. The Panel argued that any option that was likely to have as a consequence the increased level of importation of NHP’S to replace those removed from potential use by elimination of the Health Canada colony was not an advance for animal welfare or for Canadian research.

ASSESSMENT:

The Expert Panel made the following assessment of the research needs and demands for animals of this kind in Canada:

1. The cynomolgus macaque colony constituted a valuable national resource that could play an essential role in meeting new health challenges that could confront the nation, and the removal
of the colony would constitute an irreversible loss of the capacity to respond to these challenges should they arise. Among the challenges identified by the Panel was the likelihood of emerging infectious diseases that would tax the capacity to respond with new drugs and vaccines to counter serious public health threats. The Panel saw the Health Canada NHP colony as uniquely valuable for this kind of research, due to the unusual Specific Pathogen Free (SPF) status of the animals.

2. Despite the clear research value of the NHP colony, if the financial resources to support their use in beneficial research were lacking, the continued maintenance of the breeding colony could not be ethically justified, and the animals should be retired from the restrictive conditions of such a colony into “sanctuary” conditions.

3. There did not exist sufficient public sector funding to support the kind of research in Canada to justify continued existence of the research colony, either by Health Canada or by an independent or jointly funded consortium. Only a major government initiative in support of such research could rationalize the continued existence of the colony at its current size.

4. Health Canada retained an ongoing ethical responsibility for the care of the animals in the breeding colony, and any disposition of the animals should be consistent with this responsibility.

5. Thus, Health Canada retained a financial obligation for either a) placing the entire colony into sanctuary (and the cessation of all breeding), OR b) establishing a health research funding initiative that would rationalize responsible research use of the animals by Canadian researchers.

RECOMMENDATIONS:
On the basis of these conclusions the Expert Panel identified two general options it was prepared to recommend to Health Canada for the disposition of the NHP colony. The first, preferred option assumed the allocation by the Government of Canada of significant research funds for health research that could use these animals. The second, less preferred, option assumed that no such new health research funding would be forthcoming.
Preferred Option: Maintain Canadian health research capacity with reduced-size monkey colony, (justified by government allocation of health research funding)

1. The Government of Canada should allocate funding for a health research grant program in areas of strategic health needs.

2. The Tunney’s Pasture NHP colony should be transformed into a Canadian Primate Research Centre — making the animals available to Canadian health researchers. The Centre could recover some costs by making animals available to external researchers working under the jurisdiction of the CCAC.

3. The population of the colony should be reduced to numbers necessary for actual Canadian research needs via an immediate and complete cessation of all breeding until the colony reaches the minimum number required for research needs. Any future breeding should be resumed strictly in conformity with reasonable demand.

4. All animals in excess of those needed for research should be transferred into permanent sanctuary — in renovated quarters at the Tunney’s Pasture facility. These animals should be available only for non-invasive, observational research.

Secondary Option: Phase out of entire breeding colony and sanctuary of remaining animals (required if Government of Canada does not allocate new health research funding)

1. There should be an immediate end to all breeding.

2. The entire colony should be placed into acceptable sanctuary conditions, to be maintained there for the natural life span of the animals.

3. The colony should be open to observational, non-invasive research, monitored regularly by CCAC and other animal welfare organizations.

4. Animals in sanctuary could be sold to CCAC sanctioned Canadian researchers, if needed, as an alternative to further imports of animals into Canada.
ADDITIONAL CONCERNS ABOUT THE ADEQUACY OF ANIMAL HOUSING CONDITIONS IN THE 1997 FACILITY:

Both options laid out by the 1997 Expert Panel implied the transformation of the then existing Tunney’s Pasture facility into either a Canadian Primate Research Centre or a full sanctuary. Either of these options would have removed certain conditions within the facility that the Expert Panel found unacceptable from the point of view of animal welfare. The Expert Panel had noted that the CCAC had, prior to the Expert Panel’s visit, made “serious recommendations” for changes within the facility to improve a number of these unacceptable practices. These included the need to provide better exercise and cage enrichment for certain animals, more adequately sized cages for single male animals, the pair-housing of single animals in double vertical cages, and expanded use of “harem” social housing, which is a more “normal” social situation of an adult male housed together with a number of females, and when breeding is permitted, babies and juveniles.

The Expert Panel endorsed the opinion of the CCAC, which had been echoed by other informed animal welfare organizations, noting that the continued breeding of animals in the facility had led to “too many animals individually and pair-housed long-term in cages too small to allow for proper exercise and social interaction”. The Expert Panel’s call for an immediate cessation of all breeding, and reduction of the size of the colony was viewed as necessary to end these unacceptable conditions.


The Follow-up Panel members re-visited the Health Canada NHP Colony at Tunney’s Pasture on June 25, 2003. At this time also the members met with Karen Dodds, Director General, Food Directorate and Chair of the HC Animal Care Committee. Also present were Norman Turcotte of Animal Resources, Jocelyn Fournier, Veterinarian responsible for the NHP Colony and other members of the staff and the Animal Care Committee. Dr. Mark Bisby, Vice President for Research of the Canadian Institutes of Health Research also joined the meeting. The Follow-up Panel discussed an Implementation Report prepared by Health Canada, the current state of the NHP colony, and the situation with respect to funding for health research involving the NHP model in Canada.

Following this discussion, members of the Follow-up Panel toured the NHP facility in the company of Mr. Turcotte and members of the staff. Our evaluation of Health Canada’s implementation of the
original RSC Expert Panel Report and of the current state of the colony is based upon these discussions, the tour of the animal facility, and documentation presented to us.

A. Implementation of Expert Panel’s Preferred Option

Finding 1: The Government of Canada has allocated significant new funding for health research in areas of strategic health needs.

Health Canada maintains that it has effectively implemented the “Preferred Option” recommended by the original RSC Expert Panel. This was made possible by a major infusion of funding for health research from the Government of Canada, largely through the creation in June 2000 of the new Canadian Institutes of Health Research. The budget for CIHR was $477 million dollars in 2001-02. The institution of CIHR has rejuvenated the health research agenda of Canadian universities and other partners, and has made it more possible for Canadian researchers to use costly NHP’S in research where these are deemed necessary to achieve research objectives.

The Follow-up Panel agrees with Health Canada’s assessment of the changed health research environment represented by the creation of CIHR by the Government of Canada. The critical value of this new support for health research has been underlined by the emergence of new infectious diseases, such as the West Nile Virus, SARS, and the continued spread of HIV and AIDS in many parts of the world. The Follow-Up Panel salutes the Government of Canada for having responded to the original Expert Panel’s call for renewed funding for research in this area, and Health Canada for recognizing the implications of this innovation for the maintenance of the NHP colony.

Finding 2: Health Canada has moved in the direction of establishing a Canadian Primate Research Centre which makes the animals available to Canadian health researchers.

The recommendation of the original Expert Panel that part of the new health research funding initiative be used for the transformation of the Tunney’s Pasture primate colony into a research centre open to all Canadian researchers to conduct collaborative research requiring NHP’S has been put in motion by several Health Canada initiatives. New funds have been allocated to renovate and upgrade the facilities on the second floor of the Sir Frederick Banting Research Centre (SFBRC), and in 1999 all NHP’S in the Animal Breeding Building were located to SFBRC. As part of the population reduction program, over 500 animals were made available to Canadian researchers under research protocols approved by the HC Animal Care Committee.
The recommendation that Health Canada should recover some costs by making animals available at competitive prices to external researchers has been implemented. Scientists from four universities and three corporate institutions have used this service. Ninety-two animals (four troops) were relocated to a research station of the University of Montreal in Ste. Madeleine, Quebec, for observational research conducted by Dr. Bernard Chapais of the Department of Anthropology. This research was supported by Health Canada under a contract. All but twenty-seven of these were returned to the Tunney’s Pasture facility in 2002. This is the kind of collaboration with Canadian researchers the original Expert Panel envisioned.

In 2001 Health Canada conducted a survey of all Canadian researchers who use NHP’S to determine the actual annual requirement of these animals and to provide data on future requirements. At this time Health Canada also invited scientists to consider the use of the services of the research facilities and animals located at Tunney’s Pasture. In addition, contact was made with CIHR institutional representatives via a teleconference to advise researchers of the availability of the NHP model for approved research proposals. Health Canada has been in communication with CIHR management on possible ways to inform its research community of the availability of this valuable colony, and the opportunity for significant research. The Follow-up Panel encourages Health Canada to continue its efforts to make information on the colony available to Canadian researchers.

Finding 3: Health Canada has implemented the recommendation of the original Expert Panel to cease immediately all breeding and to reduce the size of the colony to the minimum number required for research needs.

Health Canada submitted documentation to the Follow-up Panel, confirmed by the visit to the facility, substantiating that the breeding program in the colony had been suspended soon after the release of the original Expert Panel Report in 1997. New social groups were established with vasectomized males to prevent reproduction. In the intervening years since 1997 Health Canada has radically reduced the size of the breeding colony from 788 animals to its current size of 248 (221 at the SFBRC facility in Tunney’s Pasture and 27 housed at the Anthropology Laboratory of the University of Montreal. Most of this reduction was accomplished through the sale of over 500 animals to Canadian research institutions, and the use of 20 animals in internal Health Canada studies. All research protocols in which these animals were used were reviewed and approved by the Health Canada — Ottawa Animal Care Committee prior to sale or use.

The transfer of the four troops of animals to the University of Montreal observational research project also contributed to the population reduction at Tunney’s Pasture. However, Health Canada approved
a limited breeding program among these troops in order to add infant animals for a “normal” social situation required for the observational research. The fact that the most reproductively valuable females in the HC Colony were aging, and that breeding needed to begin if the colony were to be sustained, lent further support to the approval of this limited breeding program. There have been approximately 20 new births as a result of this new breeding.

It is the opinion of the Follow-up Panel that these actions by Health Canada fully and consistently implemented this recommendation of the original Expert Panel. The colony has been reduced to a size appropriate for the housing facility, and to the level consistent with maintaining the colony. The limited breeding program instituted in the University of Montreal research colony was an essential part of the research project there and was not of the extent to compromise the integrity of the population control recommended by the original Expert Panel. Indeed, we endorse Health Canada’s argument that some breeding was necessary to protect the generational integrity of the colony.

Finding 4: Health Canada’s implementation of population reduction measures, together with the renewed funding for health research, removed the need to transfer “all animals in excess of those needed for research” into a permanent sanctuary.

In the opinion of the Follow-up Panel, the measures taken by Health Canada, outlined above, reduced the size of the NHP colony to the minimum size necessary to maintain it as a support for high priority fundamental health research in Canada. The injection of significant new money into the health research agenda of the nation would have made any further reductions of the colony irresponsible, given the prospects this created for new research using the NHP model. Hence, there were no “excess animals” to be placed into permanent sanctuary.

Health Canada officials claim that the modification and renovation of rooms in the SFBRC facility, together with the institution of group housing in “harem” groups with enhanced enrichment (e.g., deep litter, swings, branches and other enrichment articles), has “simulated” sanctuary conditions. Though such indoor (and windowless) rooms do not meet the full definition of “sanctuary”, they do constitute significant improvements in animal welfare. Indeed, the implementation of full sanctuary conditions, including access to open air enclosures, would have compromised the unique Specific Pathogen Free (SPF) status of the animals, which maintains their high research value.
B. Health Canada’s Response to the Expert Panel’s Concerns about Animal Welfare

As noted above, the original Expert Panel had raised various concerns about certain conditions in the 1997 facilities that fell below acceptable standards of animal welfare. These had also been noted in previous site visits by the Canadian Council on Animal Care. In its tour of the facility the Follow-up Panel paid special attention to whether these concerns had been adequately addressed. We made the following observations.

Health Canada’s effective population reduction measures have largely resolved the crowding and confinement concerns that contributed significantly to the housing inadequacies observed in 1997. Most of the animals in the colony are now housed in “harem” groups containing one male and up to 12 females, together with some juveniles, which allow for fairly normal patterns of social interaction. These are maintained in large rooms, provided with branches and swings for easy exercise and recreation. These facilities represent a good standard of housing by international standards.

The animals have reasonable ability to exercise and generally appear fit. A very few obese animals were observed in the more confined caging, which is used for fertile males and others that cannot be housed in harem groups. The space generally seems sufficient to prevent social aggression from emerging as a major welfare problem. Where it occurs, the staff remove victims or offenders from the cage for “time out”, which they reported effectively defuses the conflict behaviour upon return to the cage.

Similarly, the group size and competition was reported to us as supporting reasonable social harmony. Stereotyped behaviour was rarely exhibited during our brief visit. Fear of humans, which is a major welfare concern for animals in captivity, seemed largely absent. On the contrary, most animals seemed relaxed or interested in the unfamiliar faces of the visitors. This was a major change from what the original Expert Panel observed during their 1997 site visits. Staff and management are to be commended for achieving these major improvements.

Housing animals in single or double cages is obviously much less desirable. We noted that few animals remain in this type of housing. While recognizing that mature aggressive males and jeopardized females need to be isolated in more restrictive housing, we encourage staff to keep up their efforts to minimize the use of such housing.
The Follow-up Panel noted that the staff has made major efforts to tame most of the female animals, to the point that routine practices (e.g., blood sampling, weighing, transfer between rooms for cleaning) can be done without chemical or other restraints. Many animals have become conditioned to accept catching without the use of nets or other devices commonly used in group housing situations, since they have learned to cooperate without fear. For animals that still require chemical restraint, there may be scope to use operant conditioning methods whereby animals will more “voluntarily” allow mildly invasive procedures.

The Follow-up Panel also noted that the CCAC Assessment Report of January 22-23, 2003 contained only Regular recommendations, and that previous Serious recommendations regarding animal housing had been resolved.

IV. Evaluation of the Feasibility of Re-initiating a Breeding Program in the NHP Colony

The Terms of Reference for this Follow-up Panel included a request from Health Canada that the Panel consider the question of whether it would be advisable, and consistent with the framework and recommendations of the original Expert Panel to re-initiate a breeding program in the NHP colony. In assessing the proposal to resume some breeding in the colony, we feel that the principles of the original Panel Report still apply. Hence, we evaluate the plan to resume breeding in terms of the principles and recommendations of the original Panel Report.

In 1997, the Expert Panel recognized that the colony, despite a critical lack of funds to maintain it at the time, is “without question a valuable national resource which could play an essential role” in research that might be needed to respond to future health crises. Since that time, several things have changed:

1. Funding for health research has increased, so that we now see greater prospects for requiring non-human primates (NHPs) in high priority, fundamental health research in Canada.

2. Several new disease concerns have arisen, creating more urgency for certain types of health research as a national priority. A few animals are already needed and designated for SARS research in Health Canada laboratories in Winnipeg.
3. The research community is paying greater attention to genetic aspects of disease, and research tools to study genetic aspects of disease are more available. The fact that the Health Canada NHP colony has a fully documented pedigree of every animal makes it uniquely valuable for research in which the genetic aspects of disease are crucial.

As a result of these developments, there is arguably both greater need and greater ability to use the colony for high priority health research than in 1997.

Colony staff reported to us that the nearly complete cessation of breeding, which was deemed necessary to reduce the colony to a size that could be justified, funded and adequately housed, has resulted in an aging colony. Some animals critical for the genetic diversity of the colony will soon be too old to reproduce. Moreover, because the younger females have not been exposed to mother-infant pairs, they have not had the opportunity to develop satisfactory maternal behaviour through observing experienced mothers. For both these reasons, staff felt that there is some urgency to recommence breeding if the colony is to be maintained. Thus, even if there were no immediate use for animals for high priority health research, there might still be an argument to resume some level of breeding to maintain the colony, and its current genetic diversity, for the future.

Nonetheless, colony staff reported, on the basis of consultations with CIHR-funded researchers, that there is a demand for some animals for high priority health research in Canada at present. This was confirmed by the CIHR representative at our meeting. One estimate put the need at 40 animals per year. Therefore, there appears to be a rationale to resume breeding to produce a modest number of animals for fundamental health research in addition to maintaining the colony.

The Follow-up Panel noted, however, considerable uncertainty over the number of animals actually required. We encourage Health Canada to improve their estimates of the number of animals needed for fundamental health research, perhaps by (1) canvassing researchers other than those funded by CIHR, and (2) trying to obtain more accurate estimates of likely need through CIHR and its grant holders.

Even with better projections of need, there will be some uncertainty over how much breeding is required. Because of unpredictable fertility, infant mortality and sex ratio of progeny (more females than males will be needed as replacement breeders), there will be a need to mate more breeding females than would be required simply to produce the projected number of offspring. The question then arises whether to breed only the number of females likely to produce the projected number of
offspring required, or to estimate on the high side to be sure of meeting the required need and thus run the risk of producing slightly in excess of the actual need.

Here we repeat the principle in the Panel Report, that actions leading to increased importation of wild-caught1 animals should be viewed as undesirable in terms of both research and animal welfare. Colony staff reported to us that Canadian Food Inspection Agency records show an annual importation of about 600 macaque monkeys, about 90% of which are estimated to be cynomolgus macaques. Colony staff felt that many of these animals are likely used for commercial research such as drug toxicity and pharmacokinetic studies. Especially where animals are used in studies involving close human contact, there are good animal welfare arguments for using purpose-bred animals that are well accustomed to human presence and the laboratory environment.

Hence, if breeding were to produce some animals surplus to those needed as replacement breeders and animals for high-priority fundamental health research, we feel that these could, with appropriate controls, be used in an ethically acceptable manner in other (e.g., proprietary) research, which would otherwise utilize wild-caught animals. Such animals would have significantly poorer welfare than purpose-bred animals accustomed to human presence and the laboratory environment.

That said, we re-iterate that:

1. In respecting the “3 R’s” of Replacement, Reduction and Refinement, Health Canada should clearly avoid over-breeding to the point that (1) would encourage animal research that would otherwise be done with non-animal models, or (2) would encourage researchers to use NHP’S instead of animals of lower cognitive complexity. For these reasons, any surplus animals being sent to laboratories for non-Health Canada research should be sold at full market prices.

2. In respecting the principle of responsibility for animals it had bred, Health Canada should continue the practice of providing animals only to facilities under CCAC jurisdiction and only after the Health Canada Animal Care Committee has approved the protocol.

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1By “wild-captured” we include reference to animals from free-living but artificial colonies created to provide research animals. These are not wild in the true sense, and their capture does not have an ecological impact on wild populations. Nonetheless, colony staff reported to us that these animals are wild by nature and show fear and distress under conditions of captivity, transport and close human contact.
3. For any breeding, the points raised by the CCAC assessment panel should be observed. Any increase in the number of animals resulting from a breeding program should not permit the deterioration of animal housing conditions.
Members of the Royal Society of Canada Follow-up Panel:

Dr. Conrad G. Brunk, University of Victoria (Chair)
Conrad Brunk is Professor of Philosophy and Director of the Centre for Studies in Religion and Society at the University of Victoria. His areas of research and teaching include environmental and health risk management, environmental ethics, and value aspects of public policy. Dr. Brunk is a regular consultant to the Canadian government and international organizations on environmental and health risk management and biotechnology, and is a member of the Canadian Biotechnology Advisory Committee. He served as Co-Chair of the Royal Society of Canada Expert Panel on the Future of Food Biotechnology and Chair of the original RSC Expert Panel on the Health Canada Primate Colony. He is a founding member of the International Forum for TSE and Food Safety. Professor Brunk holds a PhD in Philosophy from Northwestern University, where he was both a Danforth-Kent and Woodrow Wilson Fellow.

Dr. Albert Clark, Queen’s University
Dr. Clark is a Professor in the Department of Biochemistry and Pathology at Queen’s University. He has been at Queen’s University since 1964. From 1981 to 1997 he was Associate Dean of Medical Research Services in the Faculty of Medicine, Queen’s University and Director of Research at the Kingston General Hospital. In 1994-95 he spent 9 months as the interim Acting Director of the Programs Branch at the Medical Research Council of Canada in Ottawa. From 1995-97 he was Acting Head and from 1997-2002 he was Head and Crain Professor in the Department of Biochemistry. He has served as Chair of the Queen’s University Animal Care Committee and has been a member of the Board of Directors of the Canadian Council of Animal Care. His research interests are in the area of steroid hormones and prostate biology.

Dr. David Fraser, The University of British Columbia
David Fraser is Professor of Animal Welfare in the Faculty of Agricultural Sciences and the W. Maurice Young Centre for Applied Ethics at the University of British Columbia. Previously he held research appointments at the Edinburgh School of Agriculture (1971-75), the Ontario Ministry of Natural Resources (1975-81), and the Central Experimental Farm in Ottawa (1981-97). His research has addressed animal welfare and behaviour issues of farm animals, laboratory animals, and wildlife. He is an Emeritus Scientist of Agriculture and Agri-Food Canada, a member of the Royal Society of Canada’s Standing Expert Panel on Animals in Research, and a trustee of the Animal Welfare Foundation of Canada. He is an advisor on animal welfare to many organizations including the World Organization for Animal Health (Paris), the National Council of Chain Restaurants and Food Marketing Institute (Washington), and the Burger King Corporation (Miami).

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