



Benchmarking study on mouse phenotyping facilities

February 2010

TABLE OF CONTENTS

EXECUTIVE SUMMARY	2
INTRODUCTION	3
METHODOLOGY	4
RESULTS	8
Results from the survey	8
Results from the data sheets	18
Appendix I	24
Tests performed in <u>allergy</u> screen area	26
Tests performed in <u>behaviour</u> screen area	27
Tests performed in <u>cardiovascular</u> screen area	29
Tests performed in <u>clinical chemistry</u> screen area	30
Tests performed in <u>dysmorphology</u> screen area	32
Tests performed in <u>energy metabolism</u> screen area	33
Tests performed in <u>eye</u> screen area	35
Tests performed in <u>immunology</u> screen area	36
Tests performed in <u>lung function</u> screen area	37
Tests performed in <u>nociception</u> screen area	38
Tests performed in <u>neurology</u> screen area	39
Tests performed in <u>molecular phenotyping</u> screen area	40
Tests performed in <u>pathology</u> screen area	41
Tests performed in <u>steroid metabolism</u> screen area	42
Tests performed in <u>environment</u> screen area	43
Tests performed in <u>angiogenesis</u> screen area	44
Tests performed in <u>ear</u> screen area	45
Tests performed in <u>cancer</u> screen area	46
Tests performed in <u>imaging</u> screen area	47
Tests performed in <u>in vitro service</u> screen area	48
Tests performed in <u>inflammation</u> screen area	49
Tests performed in <u>microbiology and pathogens</u> screen area	50
Tests performed in <u>parasitology</u> screen area	51
Tests performed in <u>pharmacology</u> screen area	52



EXECUTIVE SUMMARY

- INFRAFRONTIER is a pan-European initiative to establish a research infrastructure in the field of biomedical sciences. It was set-up to provide capacities for two specific demands of the scientific community: 1) systemic phenotyping and 2) archiving and distribution of mouse models
- Aiming at having a global view on systemic phenotyping of mouse models, the goals of this study were: 1) to collect technical, administrative and management information of each mouse phenotyping facility 2) to gain insight into the organisation types, targeted user groups, business models and the applied phenotyping concepts.
- The selection of the mouse phenotyping facilities obeyed to three criteria:
 - Broad approach to phenotyping services,
 - Visibility of the phenotyping facility,
 - Existence of a publically available list of the phenotyping services offered.
- This study is composed of 2 parts: a survey regarding the administrative and management aspects of the mouse phenotyping facilities and a pre-filled data sheet with technical information concerning the screen areas and tests performed on each screen area.
- This study was conducted between November 2009 and January 2010.
- The participation rate of the survey was 66%. Thirty facilities worldwide were contacted, twenty agreed to participate.
- The main results of this study are:
 - Most of the phenotyping facilities are publically run facilities. Private facilities are underrepresented in this study;
 - The majority of the phenotyping facilities aim at cost recovery; either as full or as partial cost recovery;
 - The common trend to the phenotyping facilities is the service to external users (high- and low- throughput phenotyping service);
 - The majority of the phenotyping facilities, offer primary phenotyping, following their own protocols;
 - There is no typical size of a specialized phenotyping facility (number of users, 2009),
 - The phenotyping facilities offer between 6 and 11 screen areas. The most common screen areas are Clinical Chemistry, Pathology and Energy Metabolism.
- This report will be made available to the participants of this study.



INTRODUCTION

- INFRAFRONTIER is a pan-European initiative to establish a research infrastructure in the field of biomedical sciences for the benefit of human health.
- The main goal of INFRAFRONTIER is to provide sufficient capacities for **systemic phenotyping, archiving and distribution of mouse models** accessible to the biomedical research community, thus aiming at bridge the ‘translational gap’ between basic and clinical research.
- INFRAFRONTIER is divided in two parts: *Phenomefrontier* for systemic phenotyping and *Archivefrontier* for the archiving and distribution of mouse models. *Phenomefrontier* is based on the pan-European cooperation of specialized phenotyping facilities (mouse clinics).
- In this context, it is imperative to have a global view of the phenotyping services offered worldwide. Hence the need for a benchmarking study on mouse phenotyping facilities, conducted by INFRAFRONTIER. In line with the aim of this study, no distinction was made between INFRAFRONTIER-affiliated and non-INFRAFRONTIER-affiliated phenotyping facilities.
- The objectives of this benchmarking study were to collect technical, administrative and management information of each mouse phenotyping facility, in order to gain insight into the organisation types, targeted user groups, business models and the applied phenotyping concepts.
- The selection of the facilities was based on the following criteria:
 - i) Mouse phenotyping facilities that have a broad approach to phenotyping services (i.e., facilities that offer more than one screen area);
 - ii) Their visibility within the scientific community and external users;
 - iii) Mouse phenotyping facilities which have available a list of phenotyping services for both internal and external users (e.g. by means of a public website).



METHODOLOGY

- This study encompassed 2 parts:
 - **1st part:** A survey with 10 questions regarding administrative and management aspects of each mouse clinic. The questions are presented in their original form in the *Results* section of this report.
 - **2nd part:** A prefilled data sheet with technical information concerning the screen areas and tests performed on each screen area.

Firstly, data was collected from the available information on each facility website.

Secondly, data was sent back to the facility managers, who revised and edited the datasets, which are included in this report (see **Appendix 1**). Regular contact and discussions were maintained with the facility managers to ensure that the information presented here is the most accurate and up to date.

- Thirty mouse phenotyping facilities worldwide were invited to participate in this study (**Table 1**). Twenty of these facilities welcomed the opportunity to participate (**Table 2**).
- The survey was conducted between November and December 2009. Technical data (data sheets) regarding screens areas and tests performed in each screen area were analysed between November 2009 and January 2010.



RESULTS

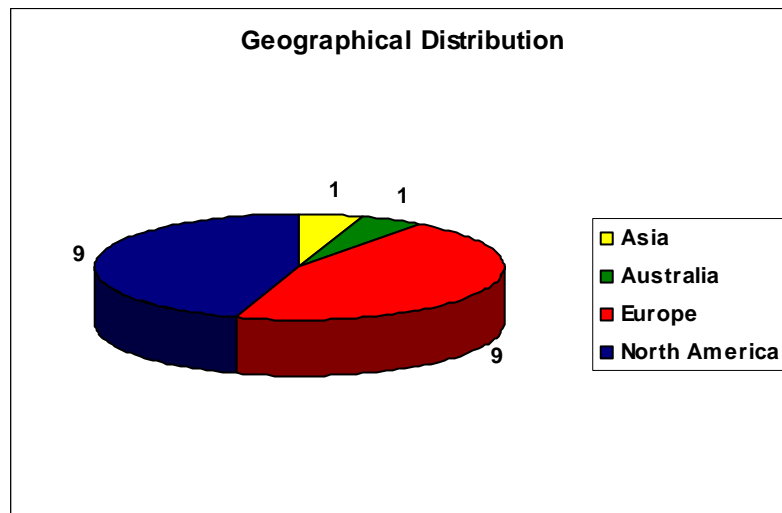
Table 1: List of institutions invited to participate in this study

	Name	Country	Participation (YES/NO)
1	German Mouse Clinic	Germany	YES
2	Frimorfo	Switzerland	YES
3	Institut Clinique de la Souris	France	YES
4	The Wellcome Trust Sanger Institute	UK	YES
5	MRC Harwell, Mary Lyon Centre	UK	YES
6	Core Facility for Genetic Physiology, Sweden	SE	YES
7	Universidad Autonoma de Barcelona	Spain	YES
8	Czech Centre for Phenogenomics	Czech Republic	YES
9	Monterotondo Mouse Clinic	Italy	YES
10	Australian Phenomics Facility	Australia	YES
11	Japan Mouse Clinic	Japan	YES
12	Taiwan Mouse Clinic	Taiwan	NO
13	Toronto Center for Phenogenomics	Canada	YES
14	Case Western Reserve University	USA	YES
15	Charles River Phenotyping Screens	USA	YES
16	Jackson Laboratory Phenotyping Services	USA	YES
17	Laboratory Animal Science Programme, National Cancer Institute	USA	NO
18	Mammalian Genetics Phenotyping, Novartis Research Foundation	USA	NO
19	Mouse Phenotyping Core Facility - Baylor College of Medicine	USA	NO
20	Mouse Phenotyping Shared Resources, Ohio State University	USA	YES
21	Phenotyping Core, Johns Hopkins University	USA	YES
22	Research Animal Diagnostic Laboratory, University of Missouri	USA	NO
23	Taconic	USA	NO
24	Unit for Laboratory Animal Medicine, University of Michigan	USA	NO
25	University of California, Comparative Pathology Lab.	USA	YES
26	University of Cincinnati Medical Centre	USA	YES
27	University of Texas, Southwestern Medical Centre	USA	NO
28	University of Washington, Seattle	USA	NO
29	Vanderbilt University, Mouse Metabolic Phenotyping Centre	USA	NO
30	Yale Mouse Research Pathology	USA	YES



- The geographical distribution of the facilities participating in this study was taken into consideration.
- From the 20 facilities: 9 facilities are located in North America (USA and Canada), 9 in Europe; 1 in Asia and 1 in Australia (**Figure 1**).

Figure 1: Geographical distribution of the mouse phenotyping facilities participating in this study



- The list of the facilities included in this study, their status as well as their web links from where the information was initially obtained, is presented in **Table 2**.



Table 2: List of the participating institutions, its status (operational / planned) and their web link

Name	Abbreviation	Status	Link
German Mouse Clinic	GMC	Operational	http://www.mouseclinic.de
Frimorfo	FFO	Operational	http://www.frimorfo.com/
Institut Clinique de la Souris	ICS	Operational	http://ics-mci.fr
The Wellcome Trust Sanger Institute	Sanger	Operational	http://www.sanger.ac.uk/modelorgs/mouse.shtml
MRC Harwell, Mary Lyon Centre	MRC	Operational	http://www.har.mrc.ac.uk/
Core Facility for Genetic Physiology, Sweden	CFGP	Operational	Not available
Universidad Autonoma de Barcelona	UAB	Planned	Not available
Czech Centre for Phenogenomics	BIOCEV	Planned	Not available
Monterotondo Mouse Clinic	MMC	Planned	Not available
Japan Mouse Clinic	JMC	Operational	http://mouseclinic.brc.riken.jp/en
Australian Phenomics Facility	APF	Operational	http://www.apf.edu.au/services/pathology.shtml
Toronto Center for Phenogenomics	TCP	Operational	http://www.phenogenomics.ca/
Charles River Phenotyping Screens	CRPS	Operational	http://www.criver.com/en-US/ProdServ/ByType/Discovery/Pages/PhenotypingServices.aspx
University of California, Comparative Pathology Lab.	UC-CPL	Operational	http://www.vetmed.ucdavis.edu/ars/cpl.html
Jackson Laboratory Phenotyping Services	JAX	Operational	http://jaxservices.jax.org/phenotyping/index.html
Mouse Phenotyping Shared Resources, Ohio State University	MPSR, OSU	Operational	http://www.vet.ohio-state.edu/255.htm
Phenotyping Core, Johns Hopkins University	JHU	Operational	http://www.hopkinsmedicine.org/mcp/PHENOCORE/
Yale Mouse Research Pathology	YMRP	Operational	http://mrp.yale.edu/
Case Western Reserve University	CWRU	Operational	http://www.case.edu/med/mmpc/index.html
University of Cincinnati Medical Centre	UCINC	Operational	http://medcenter.uc.edu/



Question 1:

Name and affiliation of the person filling in this questionnaire:

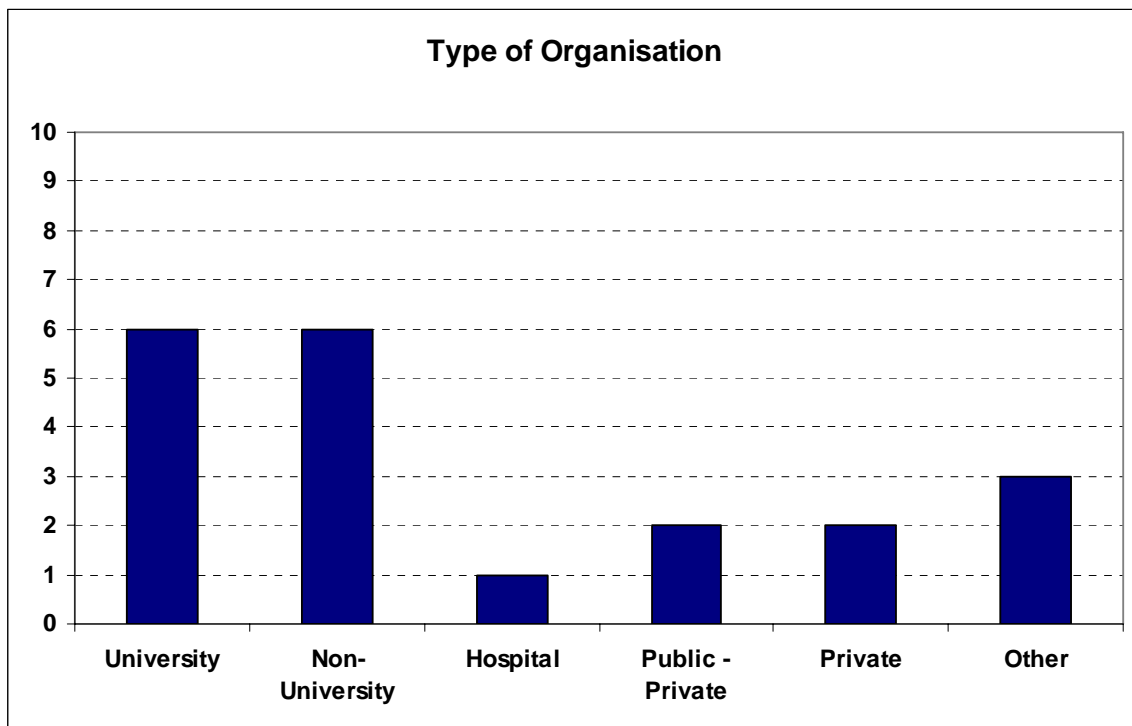
- In order to keep the anonymousness of the answers given, only the position hold by the person filling this questionnaire is given in **Appendix I** (see page 24).

Question 2:

To which category does your phenotyping facility belong to?

- Public-University
- Public-Other academic research institutions (non-University)
- Public-Hospital
- Public-Private
- Private
- Other

Figure 2: Type of organisation of the institution participating in this study



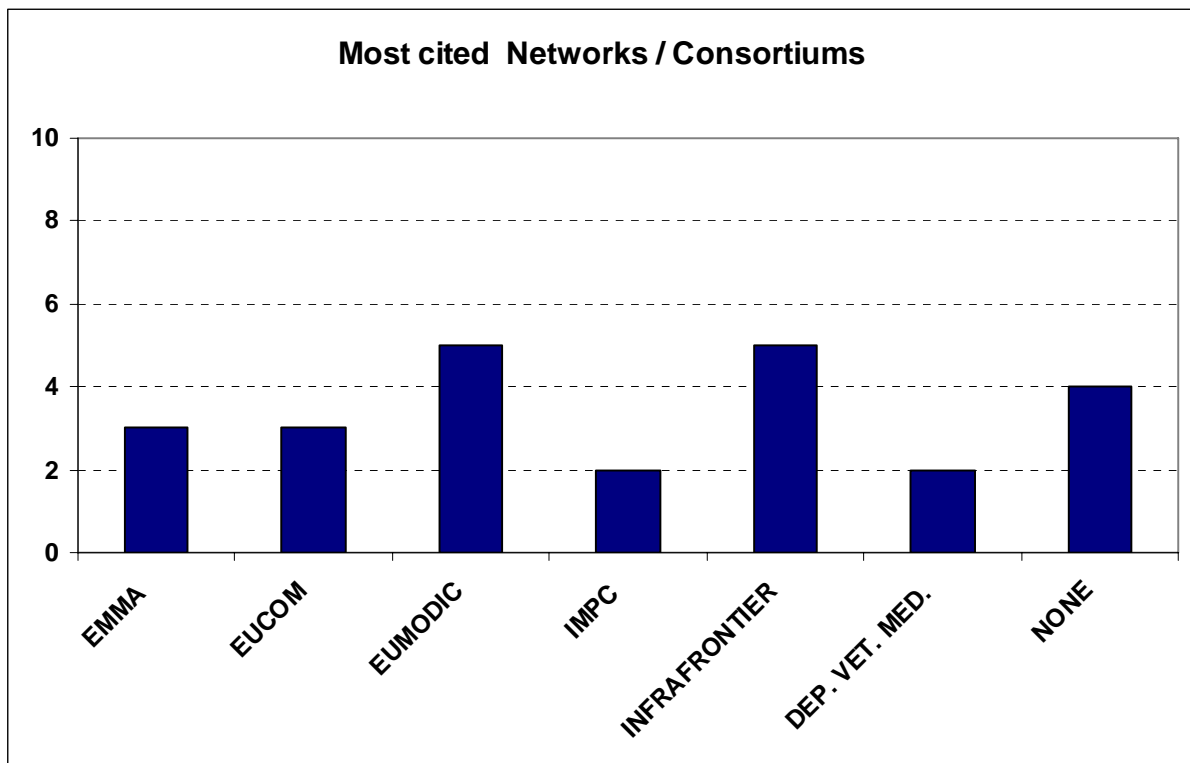
- Most of the facilities included here, representing 60% of the total, are run by public institutions (e.g. Public-universities, research institutions and hospitals).
- Privately run facilities are underrepresented in this study. 10% of the participating facilities are privately run and 10% of the participating facilities belong to a public-private institution.



Question 3:

Is your phenotyping facility integrated in any network / consortium (if yes please indicate its name)

Figure 3: Networks / consortiums most cited by the phenotyping facilities participating in this study



- **EUMODIC** and **INFRAFRONTIER** were the most cited networks / consortiums by the European participants of this study (5 facilities).
- All the **publicly run facilities** participating in this study cited at least **one national** network / consortium in which they are included (for a comprehensive list, see **Appendix 1**, page 25).
- **Privately run facilities** are not integrated in any network / consortium.

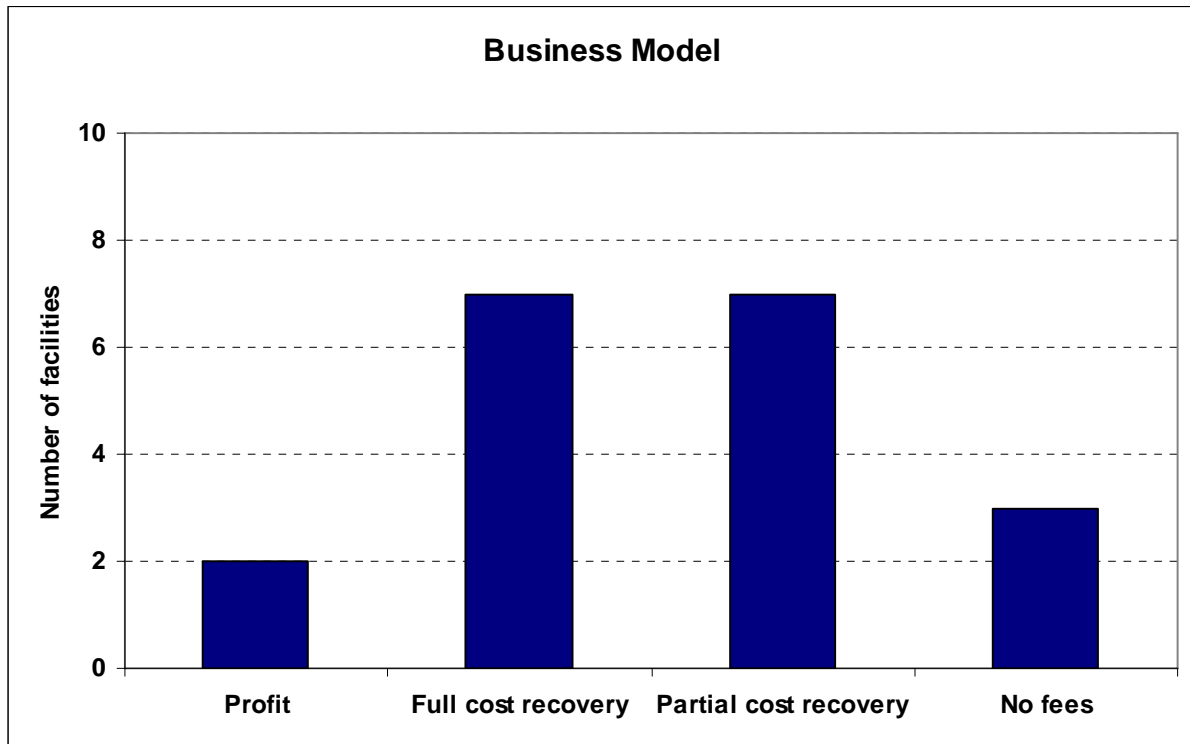


Question 4:

What is the business model of your facility?

- We aim at obtaining full cost recovery
- We aim at obtaining partial cost recovery
- We take no fees (other returns, e.g., scientific collaborations)
- Other

Figure 4: Type of business models adopted by the facilities integrated in this study



- Most of the facilities aim at either full cost recovery or at partial cost recovery representing each, 35% of the total.
- 15% of the participating facilities do not take any fees but do have other returns (e.g., scientific collaborations).
- The privately-owned facilities in contrast aim at generating profit, representing 10% of the total.
- 10% of the facilities are currently reviewing their business model (answered as ‘Other’, not shown in **Figure 4**).

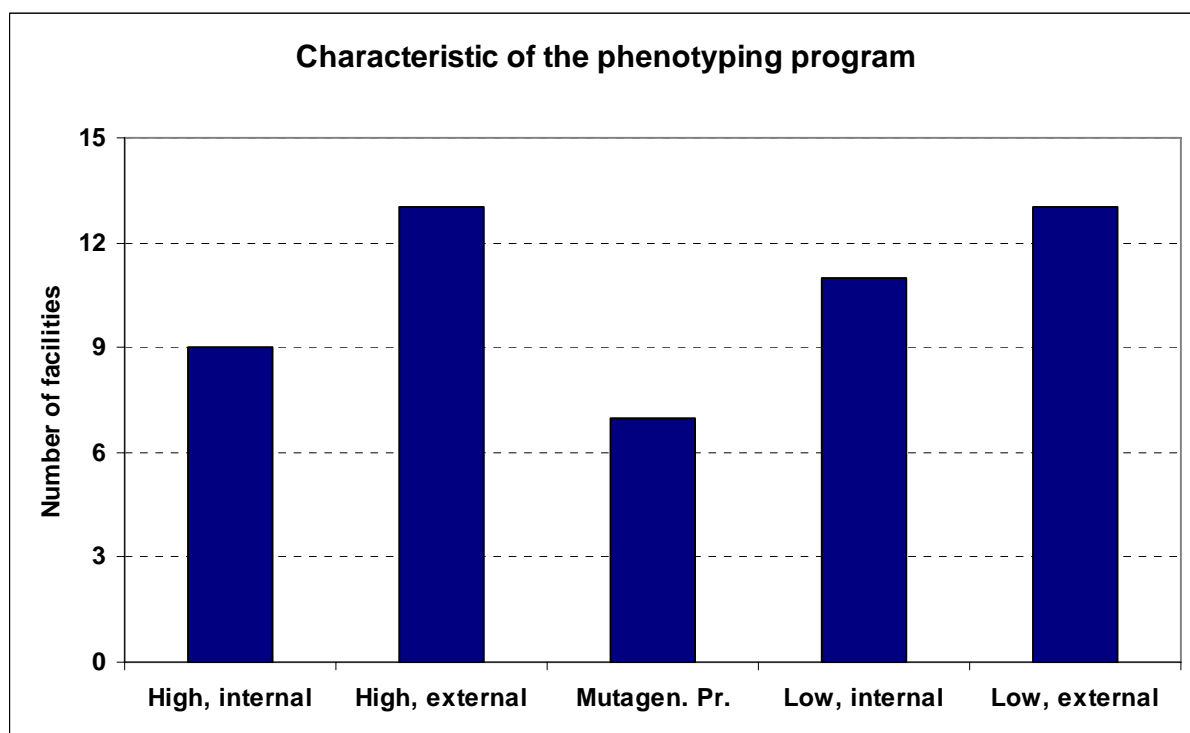


Question 5:

What is the characteristic of your phenotyping facility? (Multiple answers possible)

- We offer high phenotyping services for 'in house' research programs
- We offer high throughput phenotyping services for external users
- We do high throughput phenotyping in the context of large-scale mutagenesis programs
- We offer custom designed (low throughput) phenotyping services for 'in house' research
- We offer custom designed (low throughput) phenotyping services for external users
- Other

Figure 5: Characteristics of the phenotyping program at the facilities included in this study



- The common trend in most of the facilities is the service to external users, either as part of high throughput phenotyping service (65% of the total) or as part of the of low throughput phenotyping service (65% of the total).
- Regarding the service for internal users: 45% of the facilities focus on high throughput phenotyping services whereas 55% focus on low throughput phenotyping services.
- 35% of the facilities participate in large scale mutagenesis programs.
- The possibility of custom-designed service packages to suit a wide variety of academic programs and commercial biotech was also mentioned by one of the participating facilities (answered as 'Other', not shown in **Figure 5**).

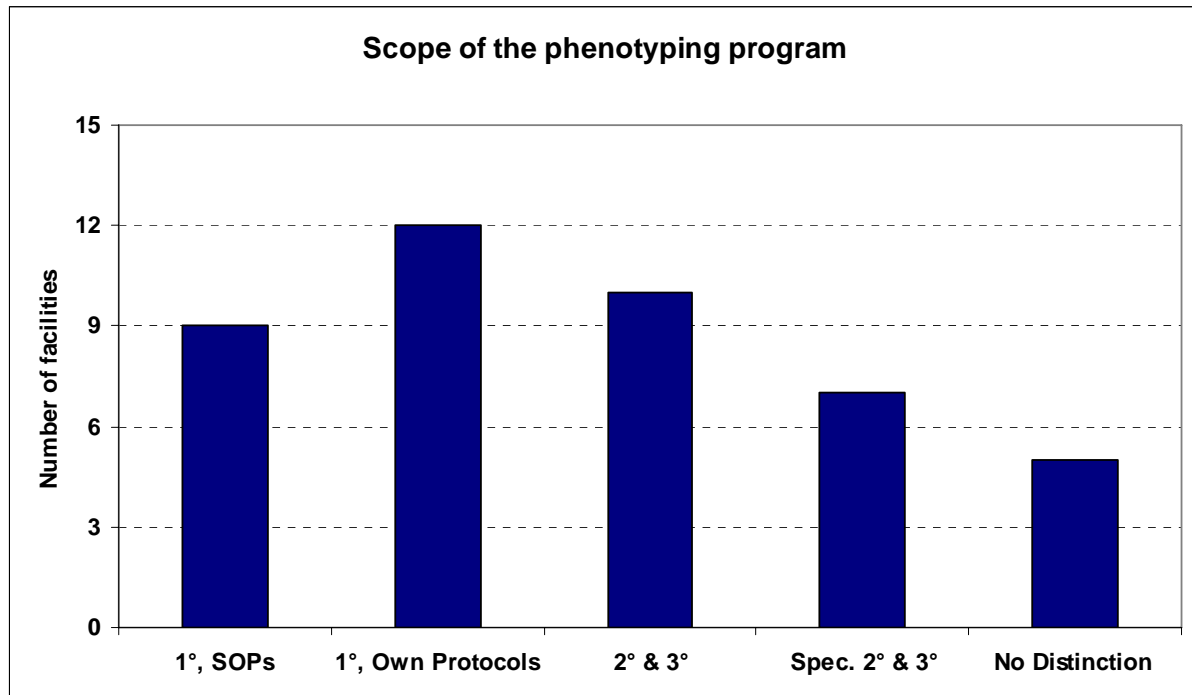


Question 6:

What is the scope of your phenotyping activities? (Multiple answers possible)

- We offer primary phenotyping, following standardized protocols (e.g. EMPreSslim protocol)
- We offer primary phenotyping, following our own protocols
- We offer secondary/tertiary phenotyping in most disease areas
- We do not distinguish between primary and secondary/tertiary phenotyping
- Other

Figure 6: Scope of the phenotyping program of the facilities considered for this study



- The vast majority of the facilities (75%) perform primary phenotyping screens either using their own protocols and / or following standardized protocols. It is noteworthy that the remaining 25% do not distinguish between primary and secondary / tertiary phenotyping and half of these are privately run facilities.
- 50% of the facilities contacted offer secondary and tertiary phenotyping screens in most disease areas and 35% of the facilities offer specialized secondary and tertiary phenotyping screens.
- Detailed information about primary, secondary and tertiary phenotyping screen areas can be found in **Table 3**.
- Detailed information about primary phenotyping screen areas can be found in **Table 4**.

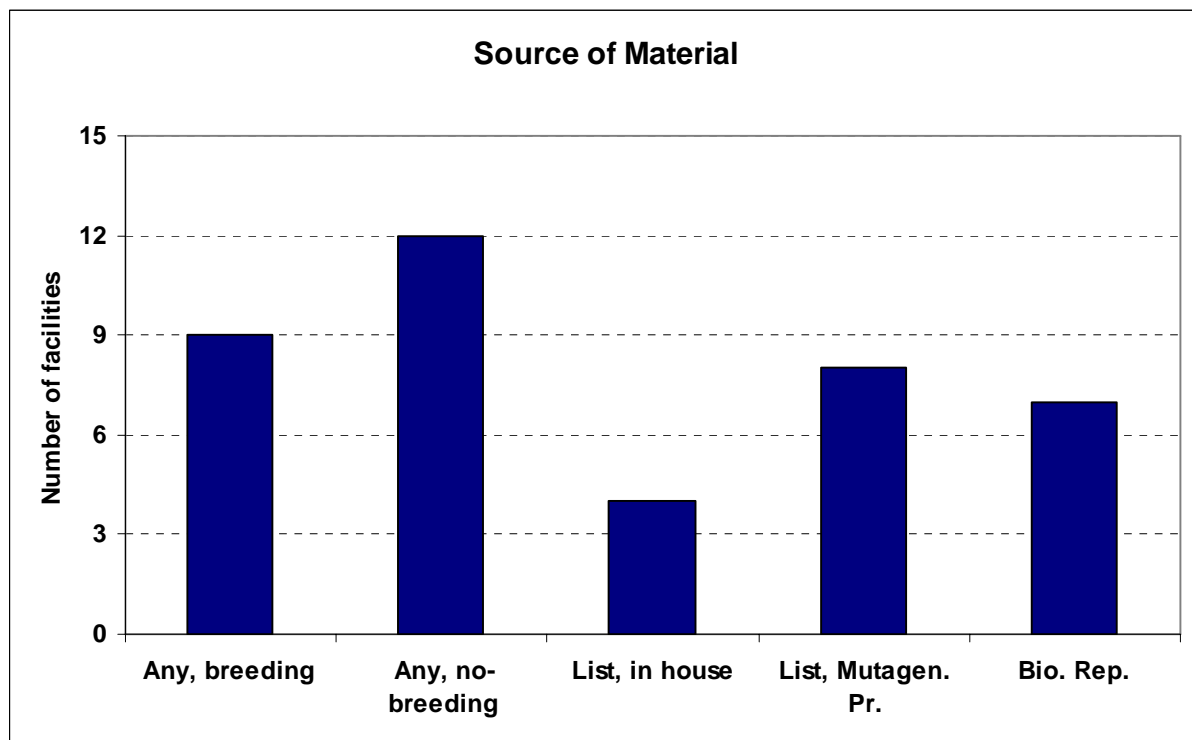


Question 7:

What is the source of mouse lines that are phenotyped in your facility? (Multiple answers possible)

- We phenotype any mouse line as long as the user provide us with the breeding pair (we undertake the breeding program)
- We phenotype any mouse line as long as the user provide us with the total amount of animals (we DO NOT undertake the breeding program)
- The user can choose from a list of mutant lines we produce on demand in-house
- The user can register his interest in transgenic lines that we produce in the context of large scale mutagenesis programs
- The user can choose frozen samples and / or live mouse from a biological repository
- Other

Figure 7: Source of mouse lines that are phenotyped in the facilities included in this study



- Most of the facilities phenotype any mouse line provided by the user (85%). 60% of the facilities enquired do not undertake the breeding program and 40% of the facilities only phenotype mouse lines as long as they are provided with the breeding pair. This finding is in line with the ‘external users’ orientation of the participant facilities.
- Mutant lines produced in the context of large scale mutagenesis program (40%); frozen samples and / or live mouse from a biological repository (35%) and mutant lines produced on demand, in-house (20%) are the other possible sources of material to be phenotyped by the participants’ facilities.

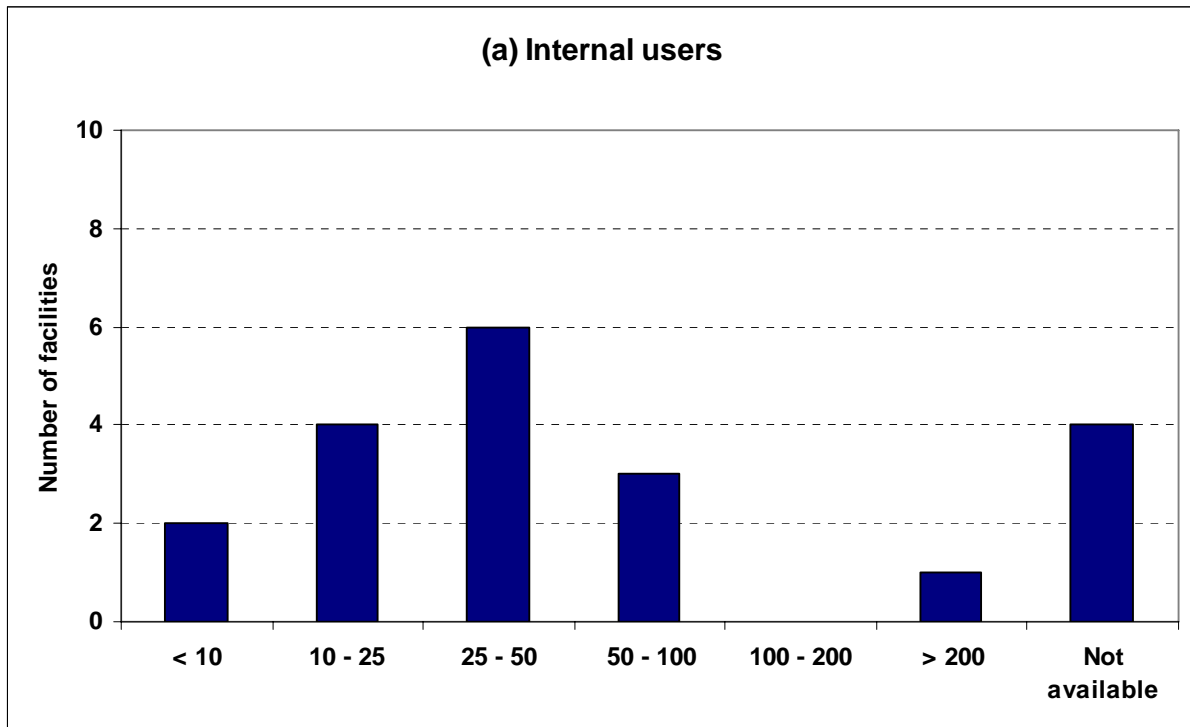


Question 8:

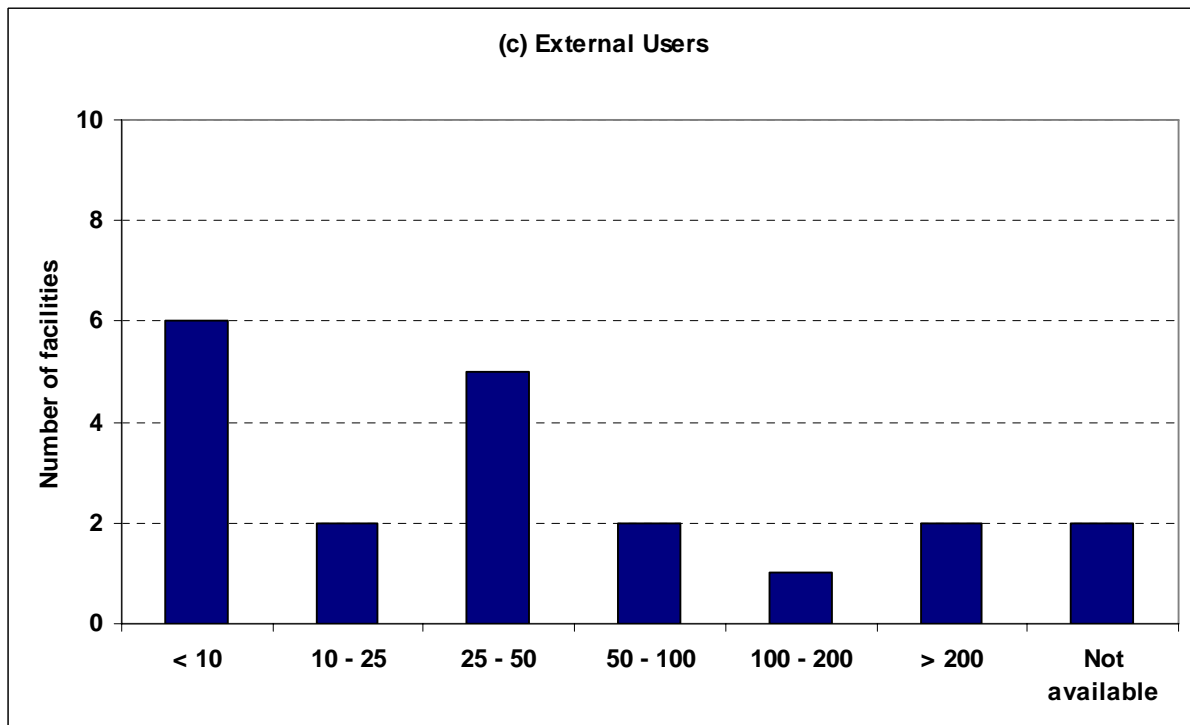
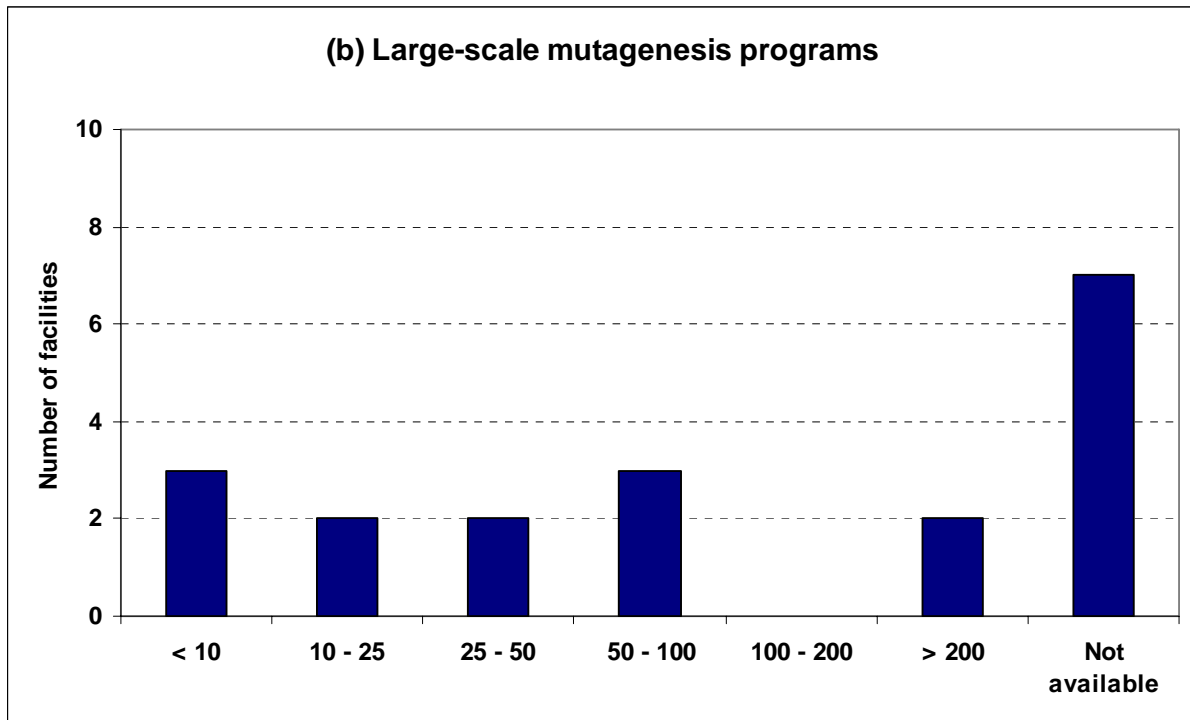
How many users can you service per year (actual state 2009)?

	Mouse lines for internal users	Mouse lines for external users	Mouse lines for large scale mutagenesis projects
Less than 10			
10 – 25			
25 – 50			
50 – 100			
100 – 200			
More than 200			

Figure 8: Annual phenotyping capacities (2009) divided in (a) internal users, (b) large scale mutagenesis programs and (c) external users available in the mouse facilities considered in this study



- 30% of the phenotyping facilities reserve 25 – 50 slots for internal use (Figure 8a)
- 35% of the phenotyping facilities do not have slots available for large scale mutagenesis programs (Figure 8b)
- 30% of the phenotyping facilities have less than 10 slots available for external users, followed by 25% of the phenotyping facilities that reserve 25-50 slots for external users (Figure 8c).



Summing up:

- There is currently no typical size of a specialised phenotyping unit.
- Small units with less than 10 slots exist next to large facilities with more than 200 slots and between those extremes the whole range is covered.

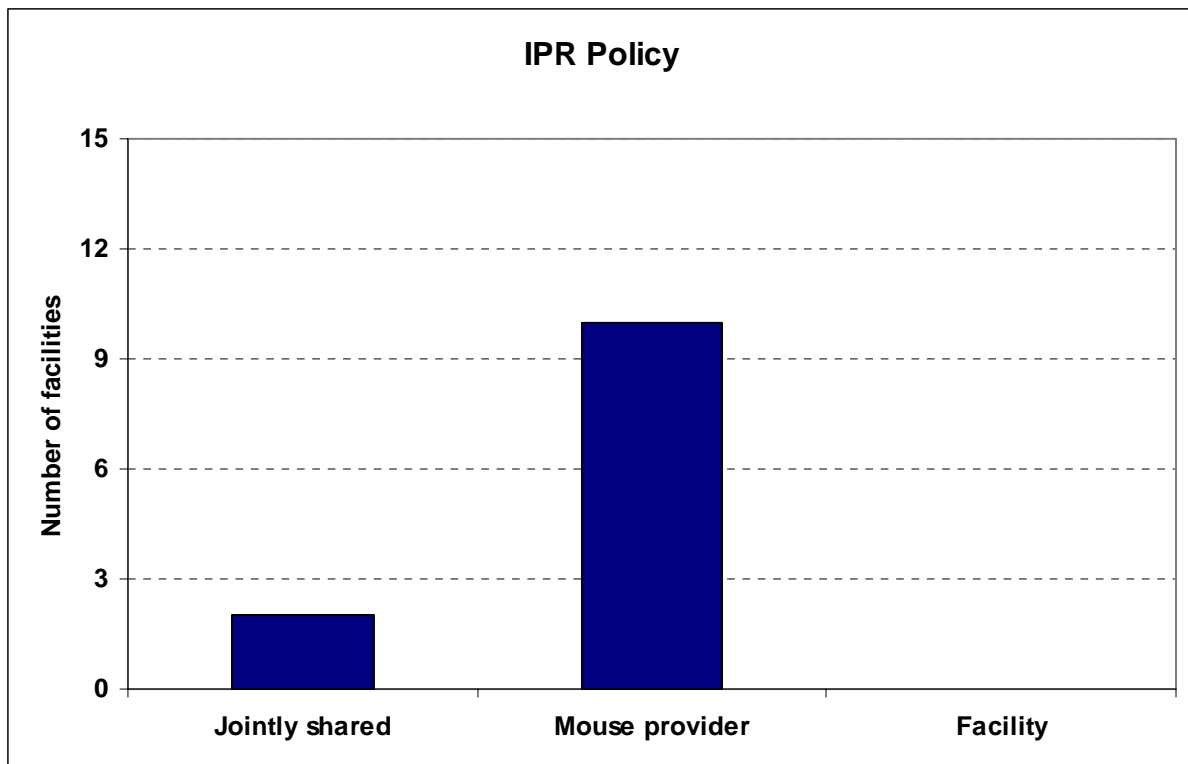


Question 9:

What is the ‘Intellectual property rights policy’ of your phenotyping facility?

- Its is jointly shared by the mouse line provider and the phenotyping facility
- It is solely owned by the mouse line provider
- It is solely owned by the phenotyping facility
- Other

Figure 9: Intellectual property rights (IPR) policy followed by phenotyping facilities



- 50% of the facilities waive the Intellectual Property Rights to the mouse line provider.
- 15% of the facilities jointly shared the Intellectual Property Rights with the mouse line provider
- None of the phenotyping facilities indicate sole ownership of the Intellectual Property Rights.

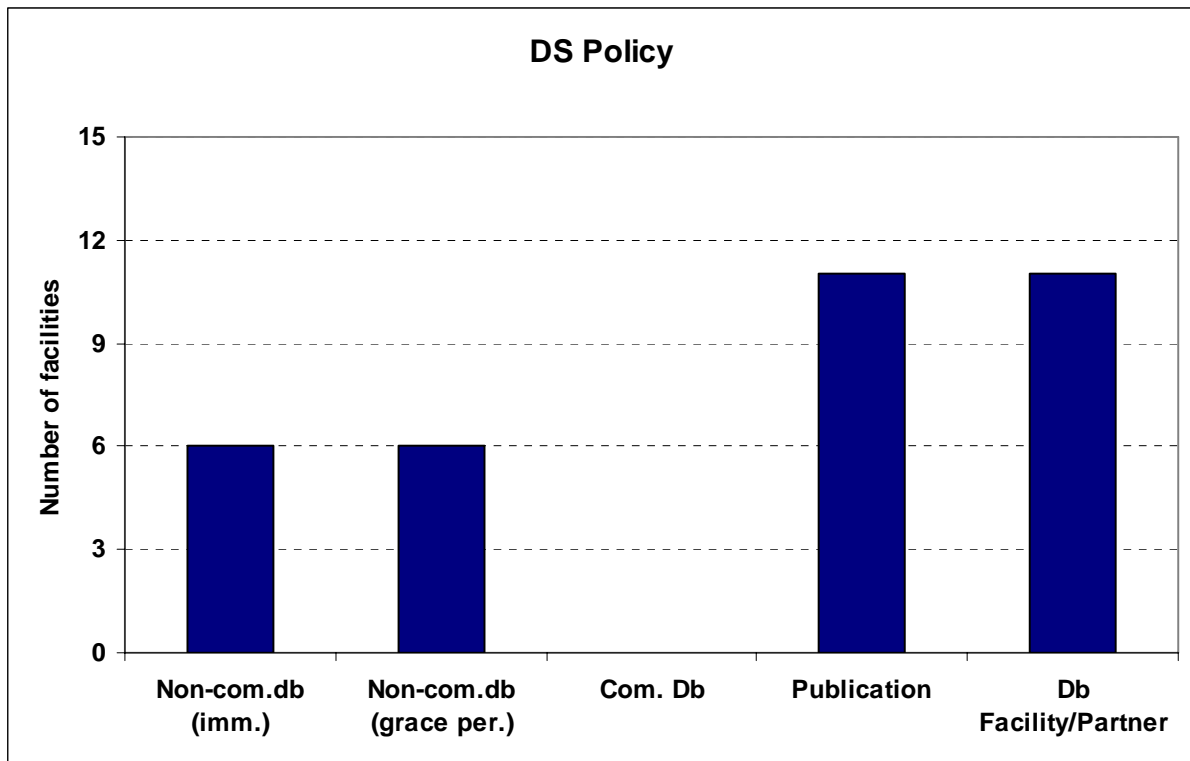


Question 10:

What is the ‘Data Sharing policy’ of your phenotyping facility (Multiple answers possible)

- Data is uploaded in a non-commercial public repository (e.g. Europhenome) immediately after the phenotyping procedure is concluded
- Data is uploaded in a non-commercial public database repository (e.g. Europhenome) after a grace period
- Data is uploaded on a commercial database
- Data is made public by means of a publication
- Data remains in the database of the phenotyping facility / partner
- Other

Figure 10: Data sharing (DS) policy followed by the phenotyping facilities

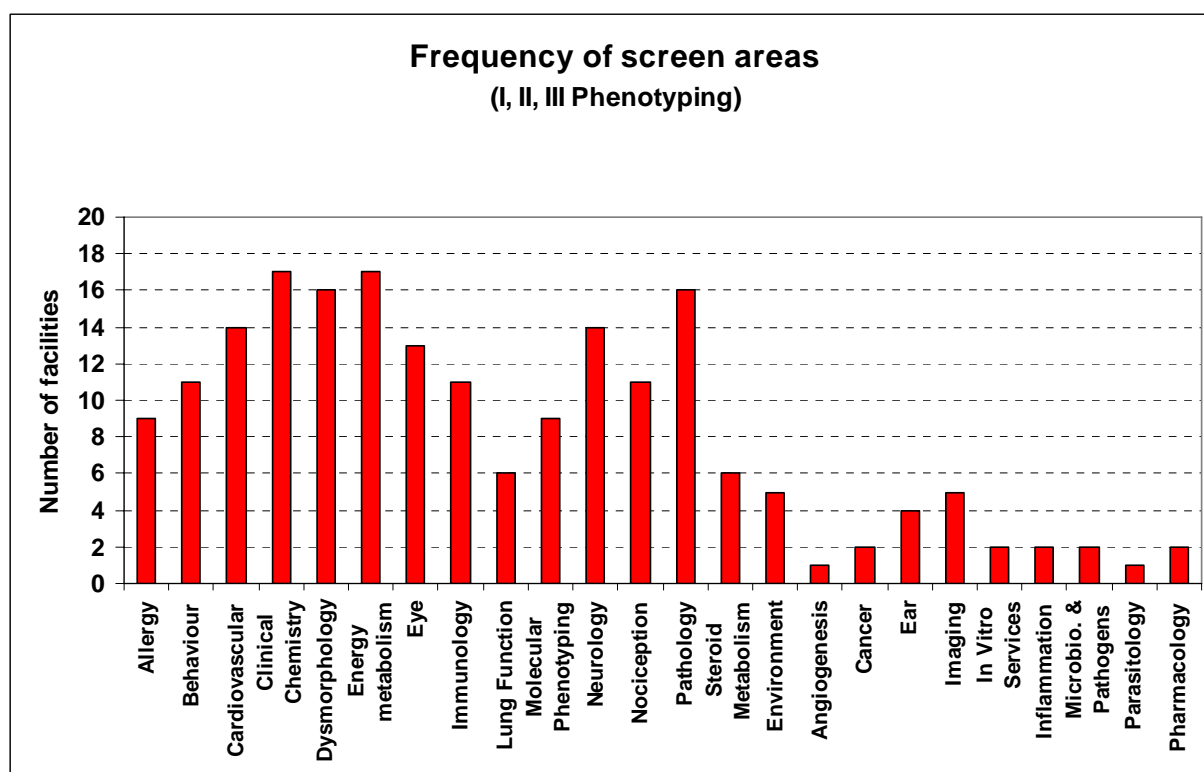


- The majority of the facilities upload the phenotyping data either in their own database or in the database of the mouse line provider institution (50%) or the data is made public by means of a publication (50%).
- Phenotyping data is uploaded in a non-commercial public database repository either immediately after the phenotyping procedure is concluded (30%) and /or the data is uploaded in a non commercial public database repository after a grace period (30%).
- None of the facilities contacted upload the phenotyping data to a commercial database.



Based on the pre-filled [data sheets](#) with technical information concerning the screen areas, the following information was compiled (**Figure 11 - 14**; **Table 3 - 4**). Regarding tests performed on each screen area See **Appendix I, Table 1 – Table 24**.

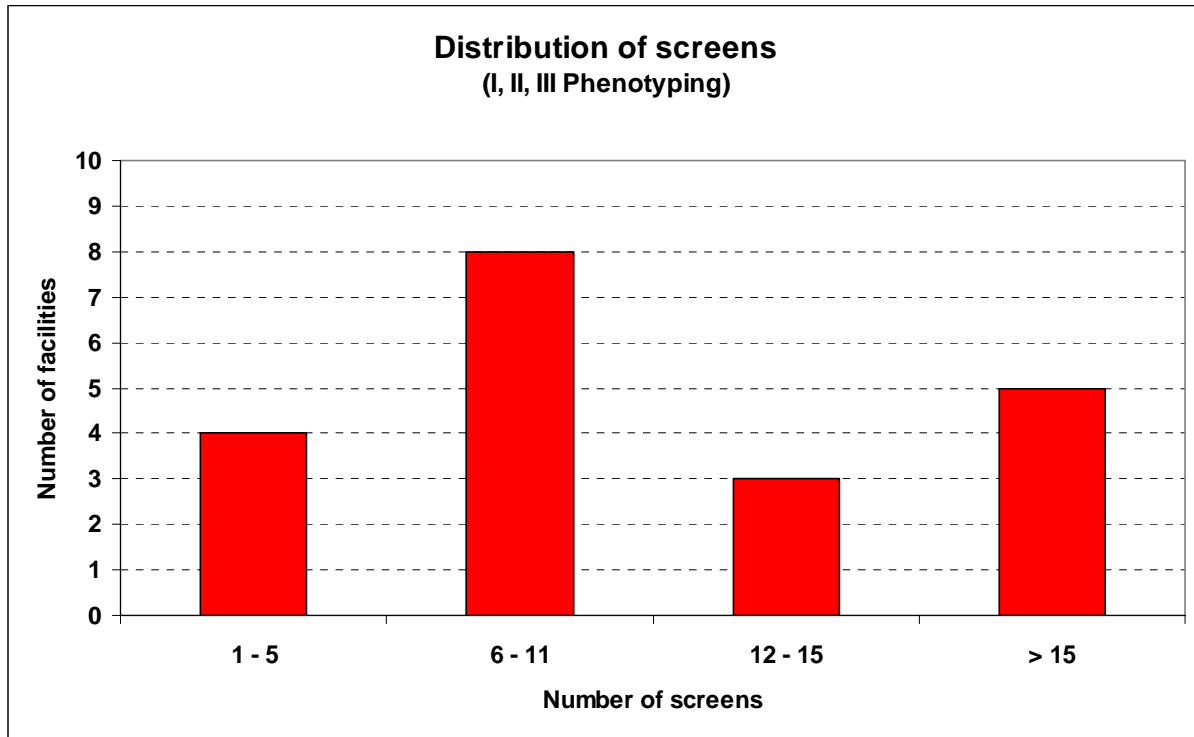
Figure 11: Number of screen areas performed at the different phenotyping facilities (no distinction between primary, secondary and tertiary phenotyping)



- When no distinction is made between primary, secondary and tertiary screens, the most common screens are **Clinical Chemistry screen** (17 phenotyping facilities), **Energy metabolism screen** (17 phenotyping facilities), **Pathology screen** (16 phenotyping facilities) and **Dymorphology screen** (16 phenotyping facilities). In contrast, the less common screens are: **Angiogenesis** and **Parasitology** (each screen available in only one phenotyping facility). (For information only considering primary phenotyping screens, see **Figure 13**).



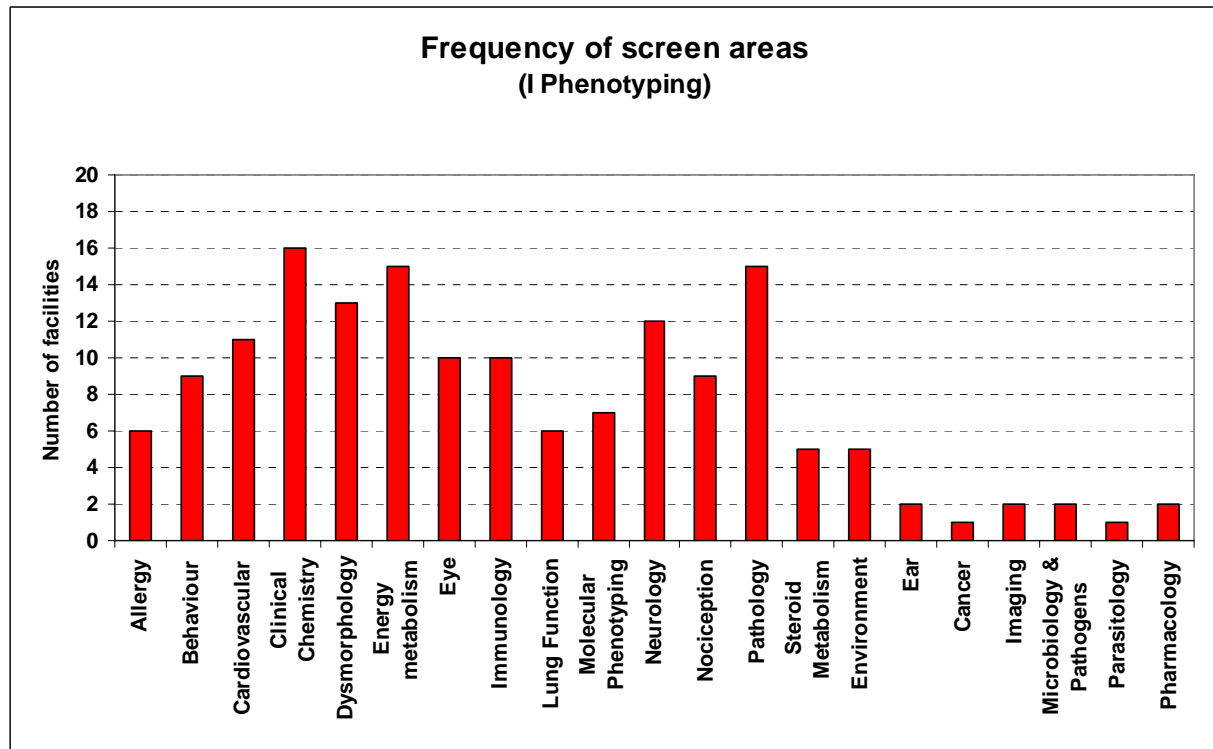
Figure 12: Class-distribution of the screen areas available at the different phenotyping facilities (no distinction between primary, secondary and tertiary phenotyping)



- When no distinction is made between primary, secondary and tertiary screens, 35% of the phenotyping facilities offer between 6 and 11 screen areas; 25% of the phenotyping facilities offer between 12 and 15 screens areas; 20% of the phenotyping facilities offer between 1 and 5 screen areas and 15% of the phenotyping facilities offer more than 15 screen areas. (For further information regarding primary phenotyping only, see **Figure 14**).



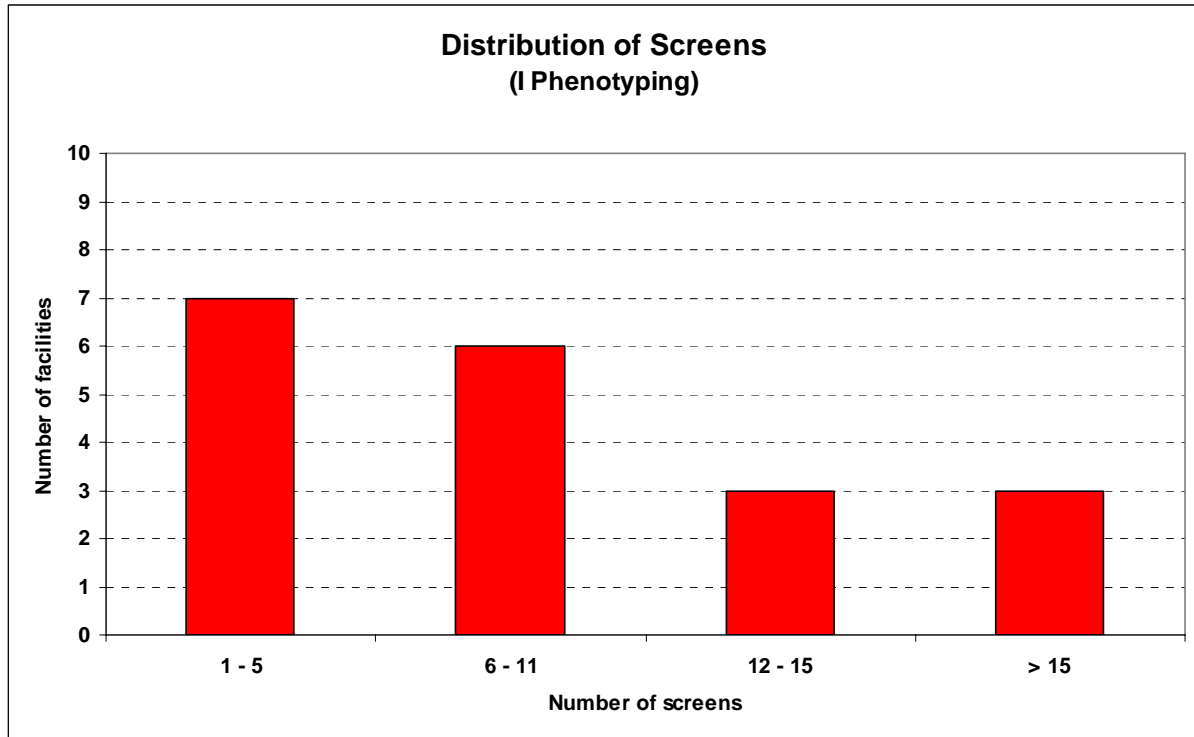
Figure 13: Number of screen areas performed at the different phenotyping facilities (only primary phenotyping)



- When considering primary phenotyping only, the **Clinical Chemistry** screen, **Energy Metabolism** screen, **Pathology** screen and **Dysmorphology** screens remain the most common screens (see **Figure 11** for primary, secondary and tertiary phenotyping).



Figure 14: Class-distribution of the screen areas available at the different phenotyping facilities (only primary phenotyping)



- When considering only primary phenotyping 35 % of the facilities offer between 1 to 5 screen areas; 30% of the facilities offer between 6 to 11 screen areas; 20 % offer between 12 to 15 screen areas and 10% of the facilities have available more than 15 screen areas (see **Figure 12: primary, secondary and tertiary phenotyping**)

A comprehensive list containing detailed information on the different screen areas available at each phenotyping facility is shown in **Table 3** (no distinction between primary, secondary and tertiary phenotyping) and in **Table 4** (only primary phenotyping).



Table 3: Summary of the phenotyping screen areas (primary, secondary and tertiary phenotyping) offered by the facilities included in this study

	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX	MPSR-OSU	JHU	YMRP	UCINC	CWSR	
Allergy	X	X		X		X	X		X				X	X		X					
Behaviour	X	X	X	X		X	X	X	X	X	X		X		X		X				
Cardio-vascular	X	X	X	X	X	X	X	X	X	X	X		X		X		X		X	X	X
Clinical Chemistry	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Dys-morphology	X	X	X	X	X	X	X	X	X	X	X		X		X	X					
Energy metabolism	X	X	X	X	X	X	X	X	X	X	X		X		X	X			X	X	
Eye	X	X	X	X		X	X	X	X	X	X		X			X					
Immunology	X	X	X			X	X	X	X	X		X	X	X			X	X			
Lung Function	X	X		X		X	X		X				X				X				
Molecular Phenotyping	X	X	X	X		X	X		X			X	X						X		
Neurology	X	X	X	X	X	X	X	X	X	X	X		X		X				X		
Nociception	X	X	X	X		X	X	X	X	X	X		X		X						
Pathology	X	X	X	X	X	X	X		X		X	X	X	X	X	X	X	X	X		
Steroid metabolism	X	X				X	X						X								
Environment	X		X	X		X	X														
Angiogenesis													X								
Ear	X	X		X			X													X	
Cancer		X											X								
Imaging	X	X		X			X						X						X		
<i>In vitro</i> service		X											X								
Inflammation		X											X								
Microbiology & Pathogens														X			X				
Parasitology														X							
Pharmacology		X					X														

[§] = Planned phenotyping facility



Table 4: Summary of the primary phenotyping screen areas offered by the facilities included in this study

	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX	MPSR-OSU	JHU	YMRP	UCINC	CWRU
Allergy	X	X		X		X	X							X						
Behaviour	X	X		X		X	X	X	X		X				X					
Cardio-vascular	X	X	X	X	X	X	X	X	X						X				X	X
Clinical Chemistry	X	X	X	X	X	X	X	X	X		X	X		X	X	X	X		X	X
Dys-morphology	X	X	X	X	X	X	X	X	X	X					X	X	X			
Energy metabolism	X	X	X	X	X	X	X	X	X	X					X	X		X	X	X
Eye	X	X	X	X		X	X	X	X	X						X				
Immunology	X	X				X	X	X	X			X		X				X		
Lung Function	X	X		X		X	X		X											
Molecular Phenotyping	X	X	X	X		X	X			X										
Neurology	X	X	X	X	X	X	X	X	X				X		X			X		
Nociception	X	X	X	X		X	X	X	X						X					
Pathology	X	X	X		X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Steroid metabolism	X			X		X	X													
Environment	X	X	X			X	X													
Ear		X		X			X									X				
Cancer													X							
Imaging		X					X									X				
Microbiology & Pathogens														X			X			
Parasitology														X						
Pharmacology		X					X													

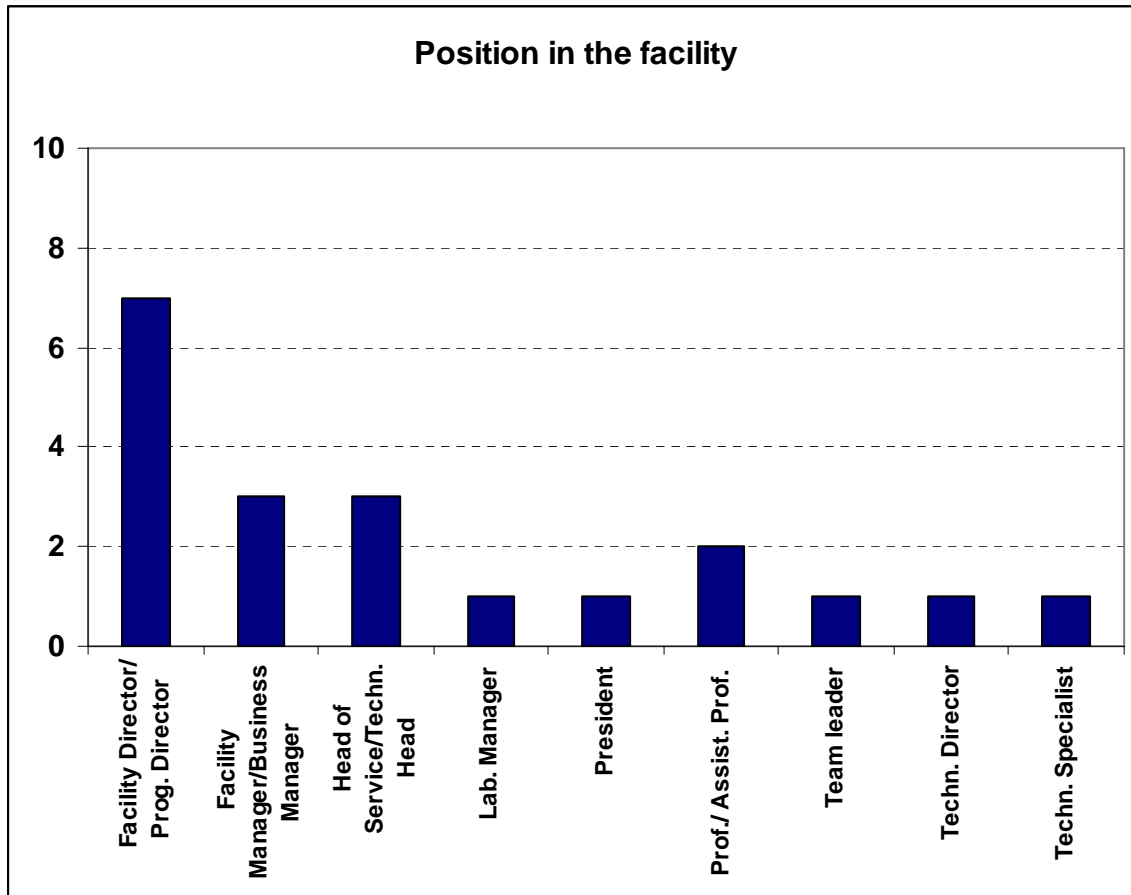
[§] = Planned phenotyping facility



Appendix I:

Question 1: Name and affiliation of the person filling in this questionnaire:

Figure I: Affiliation of the participants



- The position hold by the participants varies from Facility Director to Technical Specialist.
- 35% of the participants hold a position of Facility Director/ Program Director (7 facilities); 15% Facility Manager / Business Manager (3 facilities) and 15% Technical Head / Head of Service (3 facilities).



Question 3:

Is your phenotyping facility integrated in any network / consortium (if yes please indicate its name)

Table I: Network / consortiums list in which the participating facilities are involved

Acronym	Full Name
APN	Australian Phenomics Network
CASIMIR	Coordination and Sustainability of International Mouse Informatics Resources
CPMPSR, OSU	Comparative Pathology and Mouse Phenotyping Shared Resource, Ohio State University, Department of Veterinary Medicine
CIBERDEM	Centro de Investigación Biomédica en Red de Diabetes y Enfermedades Metabólicas Asociadas
CMHD	Centre for Modelling Human Disease
CLINIGENE	---
OSUCCC	Ohio State University Comprehensive Cancer Centre
InterPhenome	Integration of Mouse Phenome Data Resources
KOMP	Knock Out Mouse Project Repository
NIH-MMPC	National Institute of Health - Mouse Metabolic Phenotyping Consortium
NorIMM	Nordic Infrastructure for Mouse Models
NFGN	Nationales Genomforschungsnetz Deutschland
SweIMP	Swedish Infrastructure for Mouse Phenotyping
---	University of California at Davis (UCD) School Veterinary Medicine



List of the tests performed in each screen area at the different facilities

The information contained in **Table 1** to **Table 24** was revised by the participants in this study unless stated otherwise

Table 1: Tests performed at the allergy screen area

ALLERGY	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
Anal.Cell. Sub-pop.	2	X				X			2												
BAL	2	X				X			2				2	1		3					
Bronchial reactivity	3	X		X		X			2				2								
Evaluation allergen-specific T-cells response	2								2				2								
Specific sensitisation with Model allergens	2	X		x					2												
Total IgE	1	X		x					2				2								
Histology	2	X		X																	
FACS	2			X																	
Th1 Th2 cytokine panel	2																				
Lung expression profile	3																				
Full Ig panel	2	X		X																	

1 = Tests included in primary phenotyping screen

2 = Tests included in secondary phenotyping screen

3 = Tests included in tertiary phenotyping screen

X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

§ = Planned phenotyping facility



Table 2: Tests performed at the behaviour screen area

BEHAVIOUR	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*
2-choice swim test													2							
5 choice serial react. time	2																			
Accelerated Rotarod	2	1		X				1	1	1	2		2							
Acoustic Startle reflex	2	1	1	X		X		1	1	1	2		2				X			
Active avoidance		2																		
Alter. Y maze	2			X		X			1	1			2							
Beam Walking		2												2						
Cage climbing														2						
Contextual fear conditioning		X												2						
Cross-modal PPI		2																		
Cylinder test														2						
Electromyography		2																		
Elevated + maze	2	x		X		X			1	1			2				X			
Fear startle response	2			X		X			1				2							
Food/water intake		2																		
Forced swim	2	2		X					1	1			2							
Gait analysis				X																
Inclined plane		2												2						
Latent Inhibition									2											
Light-dark box	2	X		X		X			2	1	2									
Long term circadian activity		2																		
Modified Hole board	2									1										
MoRaG		2																		
Morris water maze		2							2				2				X			
Object Recognition	2	2				X			1	1			2							
Olfactory perception	2			X		X			1	1										
Open Field	1	1	1	X		X		1	1	1			2				X			
Operant learning tasks	2	X				X			1	1			2							
Passive and													2							



Table 3: Tests performed at the cardiovascular screen area

CARDIO-VASCULAR	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*
Aortic Blood Flow Velocity									1											
Atherosclerosis		2											2							
Blood flow																			X	
Blood pressure	1 (PHR, PR)*	1	2	X	X	X		1	1	1	2		2						X	
Blood pressure (telemetry)		2							2											
Cardiac function		1																	X	
Cardiovascular telemetry (HR and BP)		2	2																	
Dyslipidemia		X											2							
ECG	1	1		X	X	X			1		2		2				X			
ECG (telemetry)		2							2											
Heart histology	2	1	1																	
Heart rate	1	1	2					1												
Heart weight	1	1	1																	
Histology		1		X												X				
Models of hypertension: Angiotensin II, DOCA salt, LNAME		2																		
Models of hypertrophy: isoproterenol		2																		
Ultrasound biomicroscopy	2			X		X			2		2		2				X			

1 = Tests included in primary phenotyping screen

2 = Tests included in secondary phenotyping screen

3 = Tests included in tertiary phenotyping screen

X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

* PHR, PR = Peripherally heart rate, pulse rate

§ = Planned phenotyping facility



Table 4: Tests performed at the clinical chemistry screen area

CLINICAL CHEMISTRY	GMC	ICS	SANGER	MRC	CFGP	UAB ^s	BIOCEV ^s	MMC ^s	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
Adipokine		1																			
Adiponectin						X															
Clinical Chem.	1	1	1	X		X		1	1	1	1,2	1	2	1		1	X				
Coagulation tests	3	2																			
Cytokines		2																			
EPO	2	2																			
Glucose Tolerance Test	1	1	1	X	X	X		1	1	1	2		2	x			X			X	
Haematology	1	1	1	X		X		1	1	1	1	1	2	1		1	X				
<i>In vivo</i> glucose uptake						X															
Insulin like Growth Factor I	3	2		X		X				1			2								
Insulin release						X															
Insulin tolerance test	2 (Diab.)	2				X															
Insulin sensitiv. measurement	2 (Diab.)	2																		X	
Leptin		1				X			1												
Lipoprotein profiles		2																		X	
Luminex cytokine panel		2				X								X							
Luminex endocrine panel	3	2				X								X							
Plasma biomarkers													2								
Plasma glucose levels	1	1												X						X	
Serum Insulin Concentration	2	1		X		X				1	2		2	1							
Thyroid hormones		2																			
Urinalysis	2	2		X									2	X							
Urinary Protein Electrophoresis	3	2																			
Multiple ELISA & bioplex		2		X										X							



Table 5: Tests performed at the dysmorphology screen area

DYS-MORPHOLOGY	GMC	ICS	SANGER	MRC	CFGP	UAB ^{\$}	BIOCEV ^{\$}	MMC ^{\$}	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
μ CT	2					X			2	1			2								
Bone cell culture	3																				
Bone densitometry	1	1	1	X		X		1	1	1	2		2								
Bone turnover / met. & hormone reg.	2								2				2								
Dysmorphological Ana.	1	1	1	X	X	X		1	1	1						1					
Histology				X										X							
Mechan. Bending (3 point bending test)	2	1							2				2								
p QCT	2			X					2	1			2								
Skeleton preparation	2	2	2	X		X			2	1			2								
X-ray Analysis	1	1	1	X		X		1	1	1	3		2			1					

1 = Tests included in primary phenotyping screen

2 = Tests included in secondary phenotyping screen

3 = Tests included in tertiary phenotyping screen

X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

\$ = Planned phenotyping facility



Table 6: Tests performed at the energy metabolism screen area

ENERGY METABOLISM	GMC	ICS	SANGER	MRC	CFGP	UAB ^S	BIOCEV ^S	MMC ^S	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
Activity	1	2	1																		
Activity & Heart Rate			2			X		1	1				2								
Adlib food consum.	1	2	1	X		X		1	1	1			2								
All parameters under Food Restriction	2	2		X					1				2								
Body Temperature	1	1	1		X	X		1	1	1			2								
Body weight	1	1	1	X		X		1	1	1	1		2			1				X	
Chemical Analysis Carcass	3					X														X	
Cholesterol, lipid profile	2 CC	2											2	X							
Chronobiological analysis			2	X																	
Cold exposure	2	2																			
DEXA scan	1 DYS												2								
Diabetes	2 (Diab.)												2	X							
Dyslipidemia		1											2								
Food Assim. Coef.	2			X									2								
Glucose clamp	2 (Diab.)	2																			
Glucose homeostasis	1,2 CC/ (Diab.)	1																			
Glucose metabolism	2 (Diab.)	2												X						X	
Hormone substrate measurements																				X	
Indirect Calor.	1	1	1	X		X		1	1	1			2				X			X	
Indirect calor. under fed, fasted and reefered state	2	2																			



Table 7: Tests performed at the eye screen area

EYE	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
Electro-retinography	2	1				X			2		2		3								
Funduscopy	1	1	1	X		X			2	1	2		3								
Histology	2	1		X		X			2	1			3	X							
Intraocular Pressure (gonioprism /Tonometer)									2												
LIB	1												3								
Ophthalmoscopy		1						1	1												
Optokinetic Drum	2	1	2	X		X			2				3			1					
Slit lamp	1	1	1	X		X		1	1	1			3								
Biomicroscopy																					

1 = Tests included in primary phenotyping screen
 2 = Tests included in secondary phenotyping screen
 3 = Tests included in tertiary phenotyping screen
 X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

§ = Planned phenotyping facility



Table 8: Tests performed at the immunology screen area

IMMUNOLOGY	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
Ag-specific ELISA	3								2	1			2	X							
Anti DANN antibodies (ELISA)	1									1			2	1							
Bioplex (Immunoglobulin's)	1	1	1			X		1	1				2								
Citrobacter rodentium challenge			1																		
Flow cytometry	1	1	1			X		1	1			1	2								
Immunochemistry																	X	X			
Listeria monocytis challenge	2		2																		
MHC-multimer staining	2																				
Rheumanoid factor (ELISA)	1									1			2								
Salmonella typhimurium challenge			1																		
Citrobacter rodentium challenge			1																		

1 = Tests included in primary phenotyping screen
 2 = Tests included in secondary phenotyping screen
 3 = Tests included in tertiary phenotyping screen
 X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised
[§] = Planned phenotyping facility



Table 9: Tests performed at the lung function screen area

LUNG FUNCTION	GMC	ICS	SANGER	MRC	CFGP	UAB ^{\$}	BIOCEV ^{\$}	MMC ^{\$}	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX	MPSR-OSU	JHU	YMRP	UCINC	CWRU*
Bleomycin-induced lung fibrosis		3											2							
Cell status (lung after methacholine)	3	2				X			1				2							
Cell status (untreated lung)	3	2				X			1				2							
Lung function analysis	2	1		X		X			2								X			
Whole body plethysmography	1	1		X		X			1											

1 = Tests included in primary phenotyping screen

2 = Tests included in secondary phenotyping screen

3 = Tests included in tertiary phenotyping screen

X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

^{\$} = Planned phenotyping facility



Table 10: Tests performed at the nociception screen area

NOCICEPTION	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
Analgesic drugs	2	2		X		X				1											
Hot plate	1	1	1	X		X		1	1	1	2		3								
Neuropathological pain models	2					X															
Stress induced Analgesia	2					X															
Tail flick	1	1		X		X			1		2		3								
Tonic pain (Formaldehyde)	1	1				X															
Visceral pain (Chem. stimuli)	1					X															
Von Frey' test	1	2				X															

1 = Tests included in primary phenotyping screen

2 = Tests included in secondary phenotyping screen

3 = Tests included in tertiary phenotyping screen

X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

§ = Planned phenotyping facility



Table 11: Tests performed at the neurology screen area

NEUROLOGY	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*
Balance beam																		X		
Electromyography	3	2				X				1			2							
Footprint analysis	2					X			2				2							
Grip Strength	1	1	1	X		X		1	1	1			2					X		
Muscles biopsies	3	2		X		X				1			3	X						
Neuropathology				X																
Open Field		1				X							2							
Rotarod	1	1	2	X	X	X			1	1			2					X		
Serum lactate measurement	2			X		X					3		2	X						
Sleep cages				X																
SHIRPA	1	1	1	X	X	X		1	1	1	1		2							
Stair case	2					X							2							
Telemetric EEG	3												2							

1 = Tests included in primary phenotyping screen

2 = Tests included in secondary phenotyping screen

3 = Tests included in tertiary phenotyping screen

X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

§ = Planned phenotyping facility



Table 12: Tests performed at the molecular phenotyping screen area

MOLECULAR PHENOTYPING	GMC	ICS	SANGER	MRC	CFGP	UAB ^{\$}	BIOCEV ^{\$}	MMC ^{\$}	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
Enzymatic activities						X															
Gene expression profile	1	2	1	X		X			2			1	1								
Genotyping		1		X									1								
<i>In situ</i> hybridization		2										1									
Metabolites analysis						X															
Protein expression profile						X															
Tail tip stored frozen as source of DNA archive		2	1																		
<i>In vivo</i> phenotyping		x																			X

1 = Tests included in primary phenotyping screen

2 = Tests included in secondary phenotyping screen

3 = Tests included in tertiary phenotyping screen

X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

^{\$} = Planned phenotyping facility



Table 13: Tests performed at the pathology screen area

PATHOLOGY	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
Classical hist. H&E staining and/or special stainings		1	1																		
Confocal microscopy		3~				X															
Embryology		2																			
Episcopic Fluor. Image Capture									2												
Histopathology		1							1							X					
Immuno-histochemistry		2		X									2		X						
<i>In situ</i> hybridization		2											2								
Laser Capture Micro dissection		3~							2												
Macroscopy+ Necropsy	1	1	1	X	X	X			1		1	1	2	1		1	X	X			
Microscopy+ Histology	1	1		X		X			1			1	2	1		1	X	X			
SEM						X															
Reporter gene expres. staining		2		X																	
Virtual Pathology				X																	
TEM						X															
Tissue collection, shipping to external collab.		x				X									X						
Whole tissue scanner & Image Analysis									1												
Biobank of ~41 paraffin embedded tissues/organs			1																		

1 = Tests included in primary phenotyping screen
 2 = Tests included in secondary phenotyping screen
 3 = Tests included in tertiary phenotyping screen
 X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not yet available / not revised
 ~ = In collaboration with IGBMC
 § = Planned phenotyping facility



Table 14: Tests performed at the steroid metabolism screen area

STEROID METABOLISM	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
Additional Steroids	2					X							3								
DHEA	1					X							3								
Metabolomics	2												3								
Testosterone	1	2				X							3								
Corticosterone		2																			
Progesterone		2																			

1 = Tests included in primary phenotyping screen

2 = Tests included in secondary phenotyping screen

3 = Tests included in tertiary phenotyping screen

X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

§ = Planned phenotyping facility



Table 15: Tests performed at the environment screen area

ENVIRONMENT	GMC	ICS	SANGER	MRC	CFGP	UAB ^{\$}	BIOCEV ^{\$}	MMC ^{\$}	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*
Infection	1		1																	
Air Pollution	1																			
Stress	1																			
Stress induced hyperthermia			1																	
Nutrition	1		1	X		X														
Physical exercise	1			X		X														

1 = Tests included in primary phenotyping screen

2 = Tests included in secondary phenotyping screen

3 = Tests included in tertiary phenotyping screen

X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

^{\$} = Planned phenotyping facility



Table 16: Tests performed at the angiogenesis screen area

ANGIOGENESIS	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
Aortic ring assay													3								
Dynamic contrast-enhanced MRI													3								
Matrigel plug assay													3								
Mouse Corneal Micropocket Assay													3								
Tube formation assay													3								

1 = Tests included in primary phenotyping screen

2 = Tests included in secondary phenotyping screen

3 = Tests included in tertiary phenotyping screen

X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

§ = Planned phenotyping facility



Table 17: Tests performed at the ear screen area

EAR	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
Click box	X	1		X																	
ABR		2		X																	
Acoustic/Auditory		2															X				

1 = Tests included in primary phenotyping screen

2 = Tests included in secondary phenotyping screen

3 = Tests included in tertiary phenotyping screen

X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

§ = Planned phenotyping facility



Table 18: Tests performed at the cancer screen area

CANCER	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWU*	
Combination Drug Therapy													3								
Irradiation/ Radiotherapy													3								
Maximal Tolerated Dose													3								
Metastatic models													3								
Neurotoxicity													3								
Orthotopic models													3								
Subcutaneous syngeneic													3								
Subcutaneous xenograft		2											3								
Transgenic models													3								
Tumour progression		2																			

1 = Tests included in primary phenotyping screen
 2 = Tests included in secondary phenotyping screen
 3 = Tests included in tertiary phenotyping screen
 X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

§ = Planned phenotyping facility



Table 19: Tests performed at the imaging screen area

IMAGING	GMC	ICS	SANGER	MRC	CFGP	UAB ^{\$}	BIOCEV ^{\$}	MMC ^{\$}	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*
Bioluminescence													3							
Computed Tomography	X												3				X			
DEXA scan	X	1											3							
Fluorescence													3							
Magnetic Resonance Imaging	X			X									3							
Magnetic Resonance Spectroscopy													3							
Positron Emission Tomography													3				X			
Ultrasound	X	1											3							
QNMR Echo MRI		1															X			
High resolution radiography																	X			
SPEC	X																X			
IVIS																	X			

1 = Tests included in primary phenotyping screen
 2 = Tests included in secondary phenotyping screen
 3 = Tests included in tertiary phenotyping screen
 X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

^{\$} = Planned phenotyping facility



Table 20: Tests performed at the *in vitro* service screen area

IN VITRO SERVICE	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
Apoptosis assays		2											3								
Cytokine release assays													3								
ELISA													3								
Excitotoxicity													3								
Flow cytometry													3								
IC50 - EC50 assays													3								
Microtubule polymerization assay													3								
Multiplex assays													3								
Neurit Outgrowth Assay													3								
Signal transduction analysis													3								
Western Blots													3								

1 = Tests included in primary phenotyping screen

2 = Tests included in secondary phenotyping screen

3 = Tests included in tertiary phenotyping screen

X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

§ = Planned phenotyping facility



Table 21: Tests performed at the inflammation screen area

INFLAMMATION	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
Bleomycin-induce pulmonary fibrosis		3											2								
Carrageenan-induced footpad oedema													2								
Delayed-type hypersensitivity													2								
Experimental autoimmune encephalomyelitis													2								
LPS-induced cytokine release		3											2								
Rheumatoid arthritis													2								
Sponge granuloma													2								
Thioglycollate-induced peritonitis													2								
TNP-OVA immunization		3											2								

1 = Tests included in primary phenotyping screen

2 = Tests included in secondary phenotyping screen

3 = Tests included in tertiary phenotyping screen

X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

§ = Planned phenotyping facility



Table 22: Tests performed at the microbiology and pathogens screen area

MICROBIOLOGY PATHOGENS	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*
Full microbial. Screening of nasopharynx cecal cont.														X						
Mol. Diagnostics for screening of bacterial and viral etiologies														X						
Serology														X			X			
Parasitology														X			X			
Heliobacter PCR														X			X			

1 = Tests included in primary phenotyping screen
 2 = Tests included in secondary phenotyping screen
 3 = Tests included in tertiary phenotyping screen
 X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

§ = Planned phenotyping facility



Table 23: Tests performed at the parasitology screen area

PARASITOLOGY	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC-CPL	JAX*	MPSR-OSU	JHU	YMRP	UCINC	CWRU*	
Direct parasite screening of cecal contents														X							
Ecto- and endo-parasite screenings														X							

1 = Tests included in primary phenotyping screen

2 = Tests included in secondary phenotyping screen

3 = Tests included in tertiary phenotyping screen

X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

§ = Planned phenotyping facility



Table 24: Tests performed at the pharmacology screen area

PHARMA- COLOGY	GMC	ICS	SANGER	MRC	CFGP	UAB [§]	BIOCEV [§]	MMC [§]	TCP	FFO	JMC	APF	CRPS	UC- CPL	JAX*	MPSR- OSU	JHU	YMRP	UCINC	CWRU*
Pharmacology (food admix)		X																		

1 = Tests included in primary phenotyping screen
 2 = Tests included in secondary phenotyping screen
 3 = Tests included in tertiary phenotyping screen
 X = No distinction between primary, secondary and tertiary phenotyping

* = Detailed information not revised

§ = Planned phenotyping facility