

A Survey of Mouse Pathology Requirements Across Europe



Priorities for Mouse Functional Genomic Research across Europe

Coordination Action funded by the European Commission

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Introduction

PRIME – Priorities in Mouse Functional Genomic Research across Europe is a coordination action project funded by the European Commission under its sixth framework programme. One of PRIME's workpackages is dedicated to identifying areas of need for training in mouse functional genomics, and identifying institutes able to offer appropriate courses, and seek sources of funding.

Through the EUMORPHIA project it became apparent that provision of expertise in mouse pathology in Europe was problematical, and that it would be useful to more formally assess the number of pathologists working in mouse functional genomics, the predicted need for mouse diagnostic pathology, and current and future training provision. This information was passed on to the PRIME management, and a committee of individuals from France, Germany, Sweden, Switzerland and the UK who are dedicated to the field of mouse pathology in their current positions and representatives of the PRIME project office was set up.

The committee met and decided to target the mouse community with questionnaires to collect information about the provision of mouse histopathology expertise in Europe with the aim of assessing how far demands for mouse diagnostic pathology are being met. Two different questionnaires were developed - one for pathologists working in the field, and the other for principal investigators working with mouse models.

The questionnaires were independently reviewed by Innervate Ltd to ensure that they would generate sensible information and were not biased in any way. The questions can be found in Appendix 1. The questionnaires were hosted on the PRIME website using a database developed by Innervate Ltd to ensure that the data was private and secure. All the information collated from the questionnaire was treated as confidential and was anonymised during the analysis.

A request for people to complete the questionnaires was sent by email with a link to the website. The emails were targeted and tailored for each questionnaire, and both were sent at the same time. To ensure the survey reached as many people as possible, each email contained a request for the message to be forwarded to any relevant personnel.

After four weeks the response rate was analysed and the invite was automatically resent to anyone who had not completed the questionnaire already, along with any new contacts received. A deadline of 3 weeks was imposed for the questionnaires to be completed – this coincided with the start of the European summer vacations. On 31st July 2006 the questionnaires were removed from the website and the database sent to Innervate Ltd for analysis.

Innervate Ltd carried out a straight analysis on the data, which was published on the PRIME website in October 2006. The PRIME project office carried out further, in-depth analysis of the data to understand the situation across Europe. This report builds upon the original data from Innervate and expands it with the further analysis by the PRIME project office. The analysis carried out by the PRIME project office, involved comparison of data from the four countries with the most respondents (France, Germany, Spain and UK) and comparative analysis across sections of data.

PRIME will send this report to appropriate Pathology bodies, veterinary schools and research institutes, as well as presenting at conferences such as FELASA/ICLAS, ESHG 2007 and EuroMouse II. The feed back received along with this report, will be used by PRIME to propose a strategy for possible future training programs and integration of resources.

Results: Pathologists' Questionnaire

Specialty

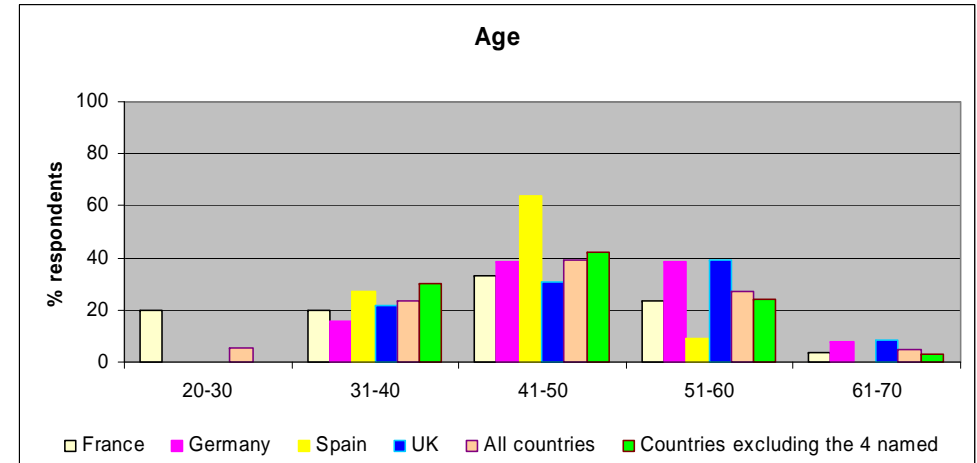
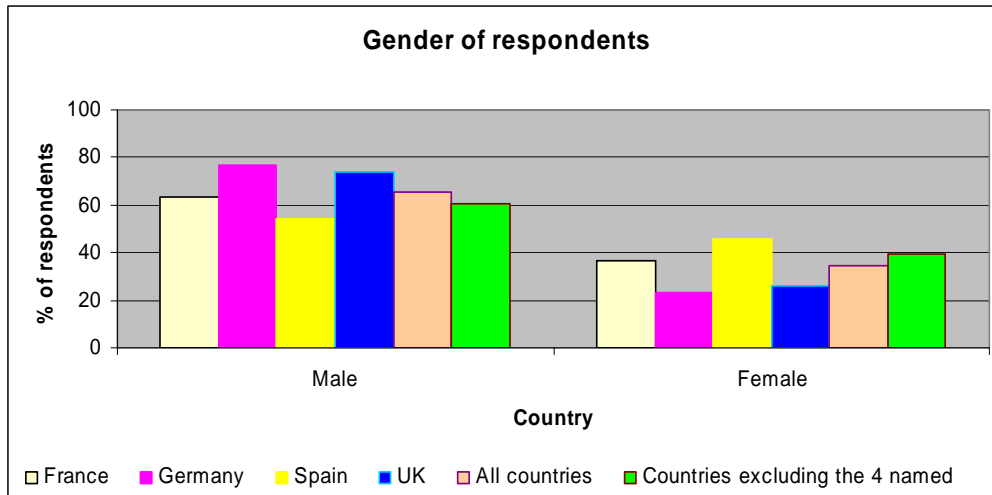
The pathologists' questionnaire was emailed to 546 individuals in total. Of these, 493 reached the recipient. A total of 124 responses were received. Of these, 110 worked in mouse pathology and so completed the entire survey. This represents a 25% response rate, with 22% providing useable data.

The questionnaire was sent by email. A reminder was sent after 4 weeks to individuals who had not replied.

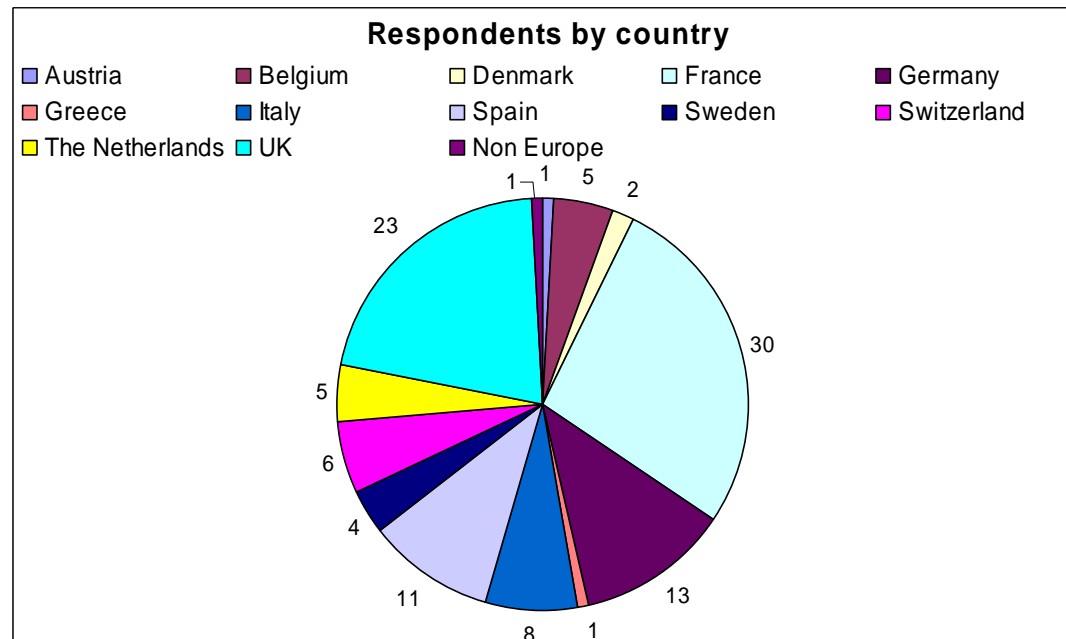
The first distribution list consisted of 538 individuals. This was compiled by the committee using personal contacts and membership lists from the European Society of Toxicologic Pathology (ESTP), European Society of Veterinary Pathology (ESVP), or European College of Veterinary Pathologists (ECVP). Of these, 47 did not reach the recipients.

After four weeks, 69 responses had been received; 43 of which were from the original distribution list. A further request was sent to individuals who had not returned the questionnaire, as well as eight new nominations. Six of these did not reach the recipient. A further 45 replies were received.

Section A: Analysis of Respondents



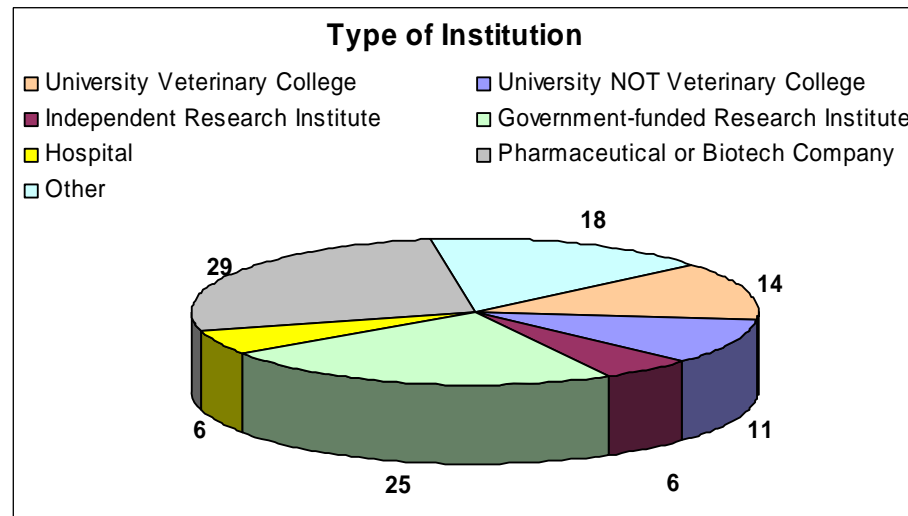
The majority of respondents (65.5%) were male and the largest proportion of respondents (39.4%) were in the age bracket 41-50 years.



The 4 countries which host greater than 10% of the respondents were analysed further and compared to the rest of the countries and all the countries to see if the data was skewed at all and to take note of different situations and view points.

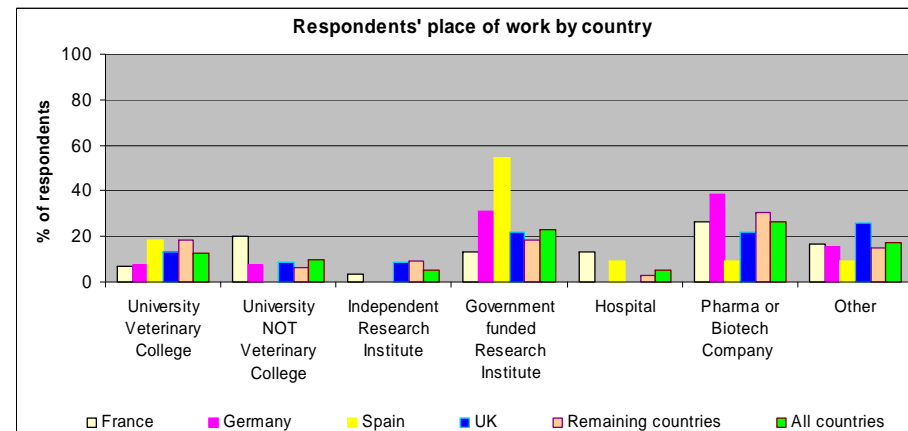
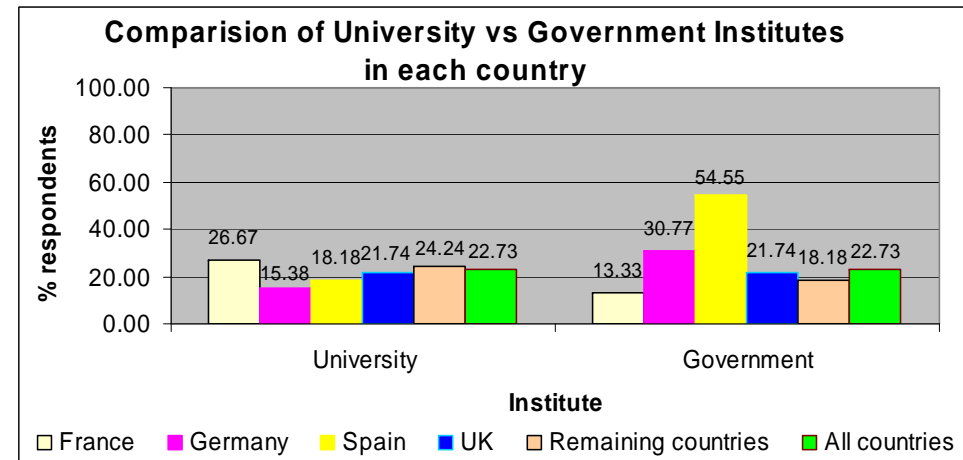
Section B: Professional Position

Institution

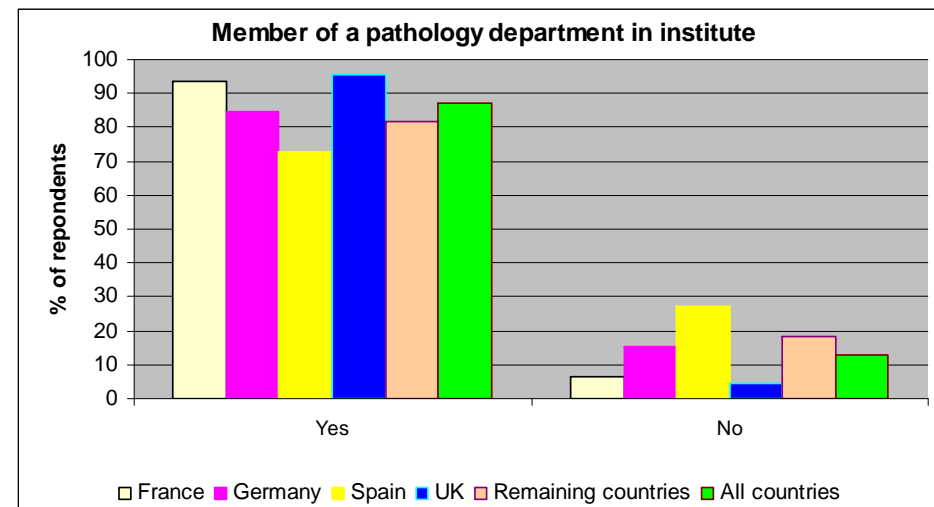


The largest proportion of responses (26.6%) came from industry (Pharmaceutical or Biotech Companies), closely followed by Government-funded Research Institutes (22.9%).

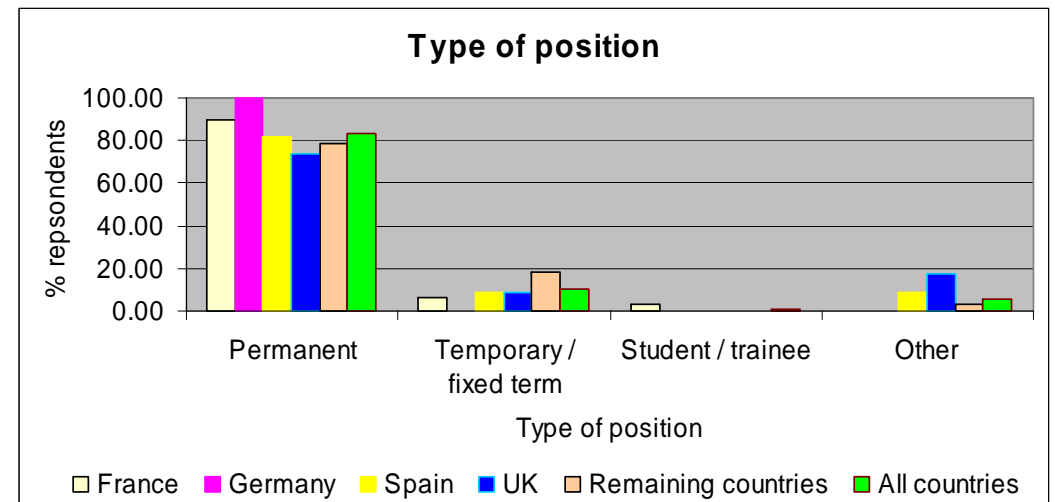
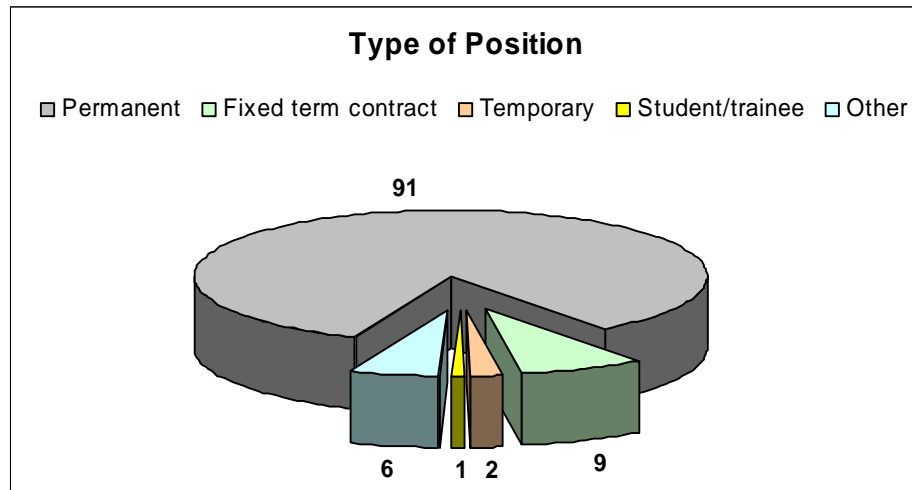
The response from across countries was looked more closely to see the distribution. It was then decided to compare the response from Universities (the two categories combined) compared to Government-funded research institutes.



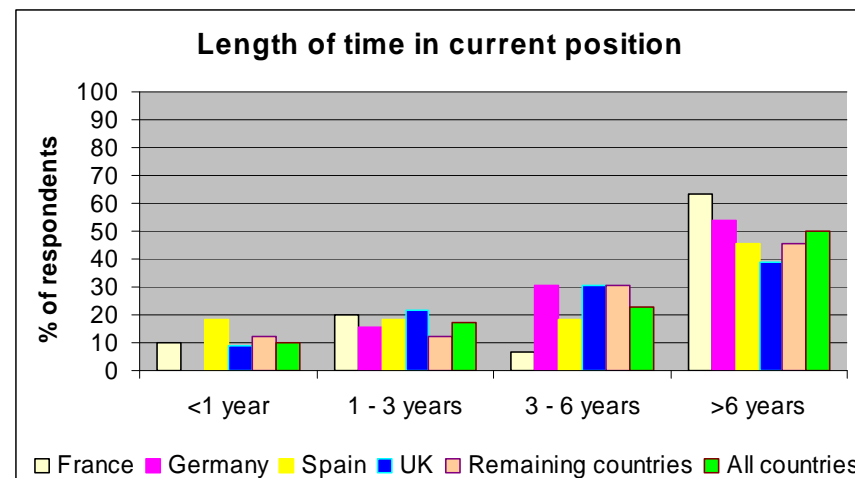
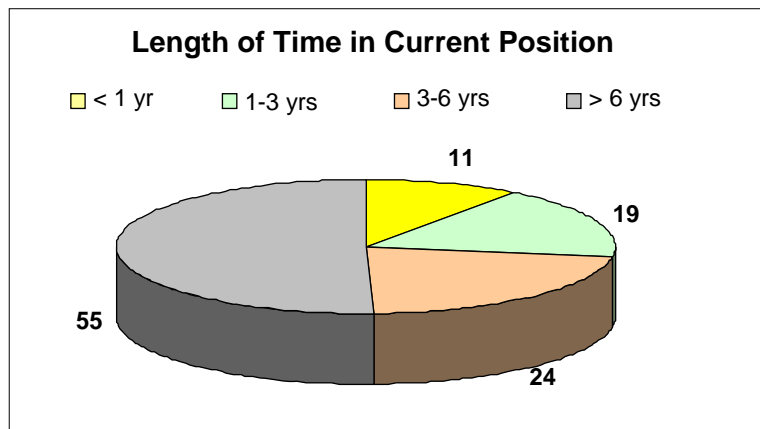
87.2% of respondents belong to a department or unit of pathology.



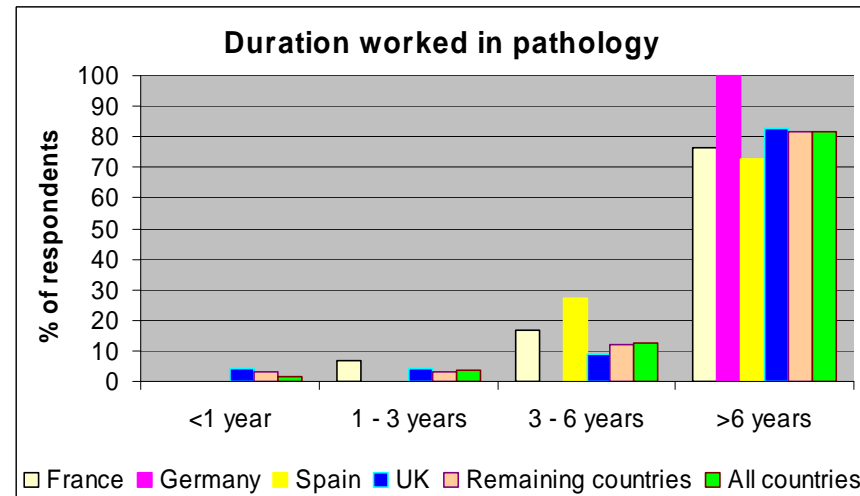
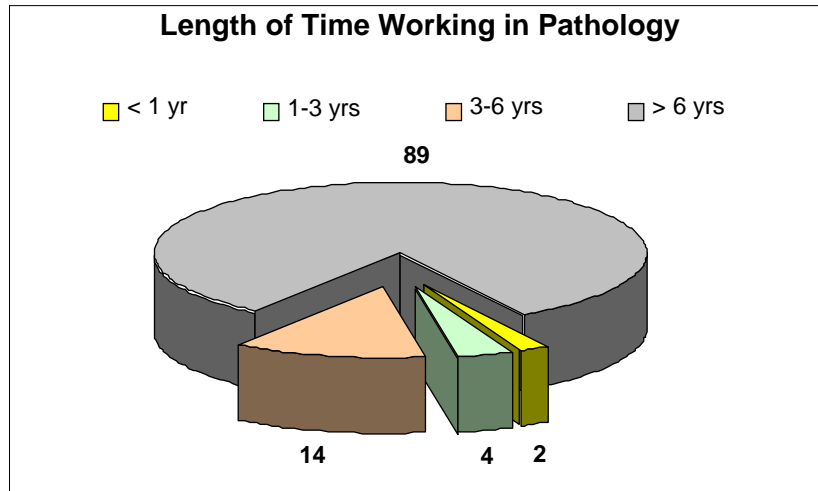
Position



Those who ticked "Other" (5.5%) described their position as "registrar", "self-employed", "collaborator, on a fixed term contract (which had expired and had not yet been decided how position was to continue)", "honorary position" and "consultant".
 91 (83.5%) of respondents are in a permanent position.

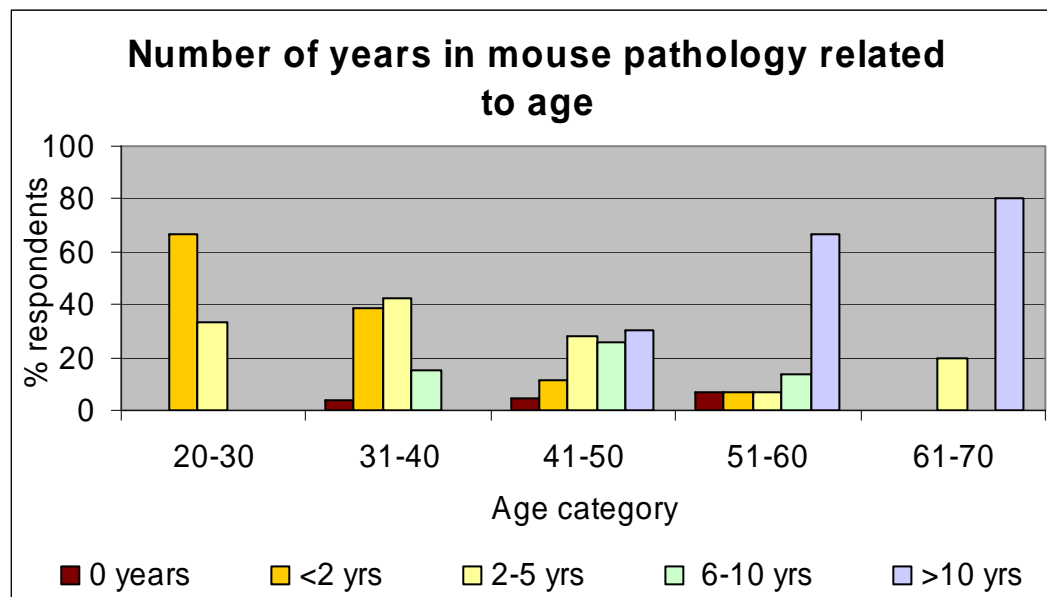


50.5% of respondents have been in their current position for more than six years.
 10 (9.2%) of the respondents occupy a part time position and 3 (30%) of these hold another pathology post.



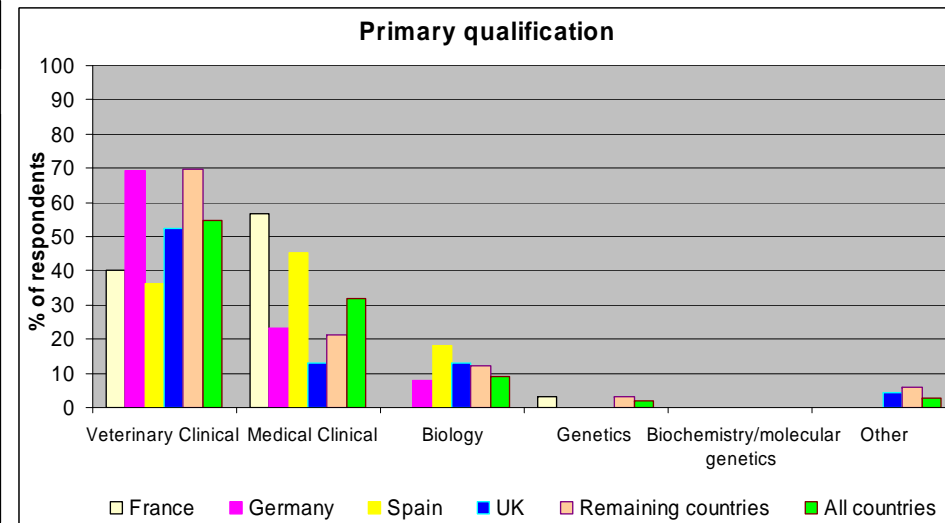
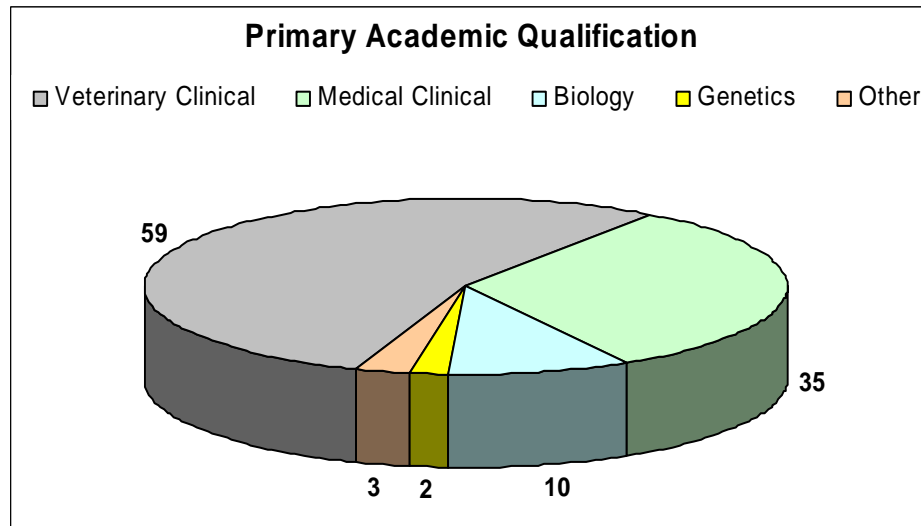
81.7% of respondents have worked in pathology for more than six years.

A comparison of age related to length of time in mouse pathology is below:



Section C: Training Background

Qualifications



“In my opinion, we have to preserve absolutely the diversity of Primary Academic qualification i.e. veterinary, biology or medical because all three need experimental pathologists, because they have complementary backgrounds & approaches.”

Despite this respondent’s opinion, biology as a primary academic qualification is under represented in the mouse pathologists surveyed. 86.2% of respondents’ primary academic qualification is clinical, with the majority (62.7%) of them holding a Veterinary Clinical qualification. Those who ticked “Other” specified “veterinary pathology”, “combination of biology, veterinary and clinical pathology”, and “dental”.

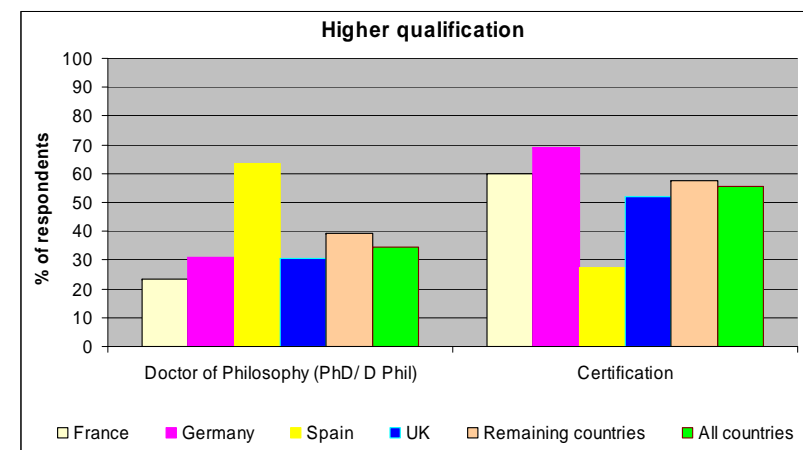
The next question asked respondents to tick which higher qualifications they held. Due to a technical error respondents were only able to select one option. A number of respondents noted this and specified in the text box that they held both. N.B. it is likely that the figure 18.3% under represents the number of respondents who hold both types of higher qualification.

42.2% of respondents hold a Doctor of Philosophy.

66.1% of respondents hold a certification by, or Membership / Fellowship of, a National or International Specialist Accreditation Body for pathology.

18.3% of respondents hold both of these (see above note).

22.9% do not hold any higher qualifications.



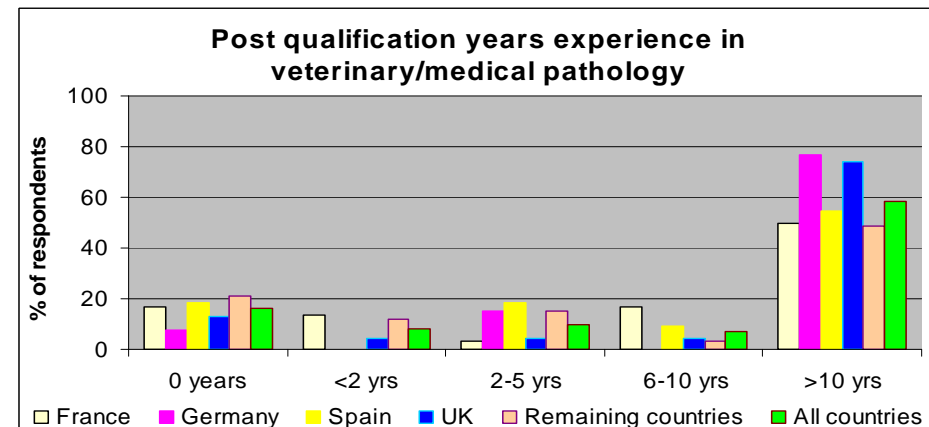
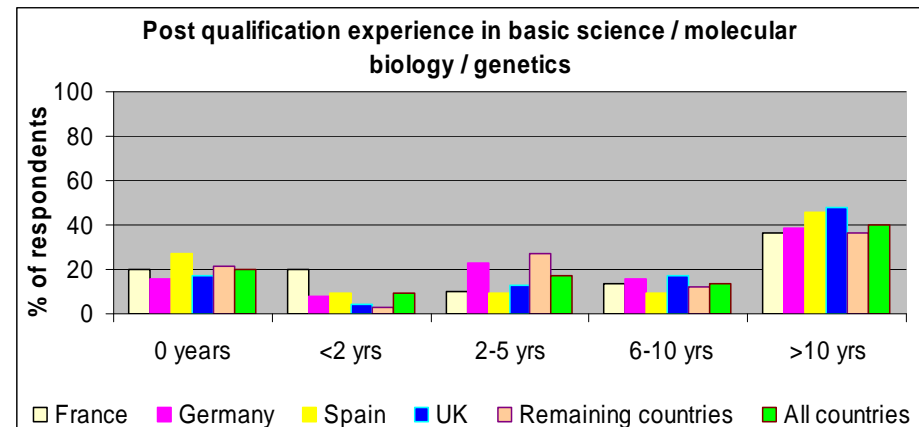
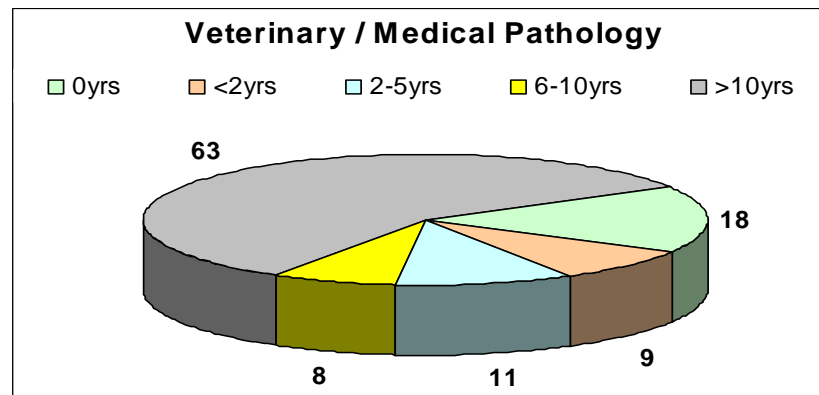
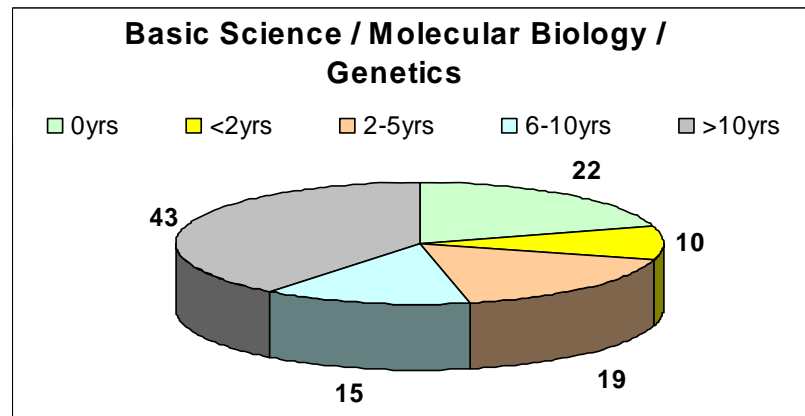
Of the national pathology body qualifications we found that 44 were happy to specify these qualifications and 28 were MRCPPath, FRCPath, ECVP or DESV (a full list, including definitions, can be found in Appendix 3). Four respondents held an ECVP in combination with another national body qualification (three with an MRCPPath or FRCPath and one with a DESV). All four were from the UK.

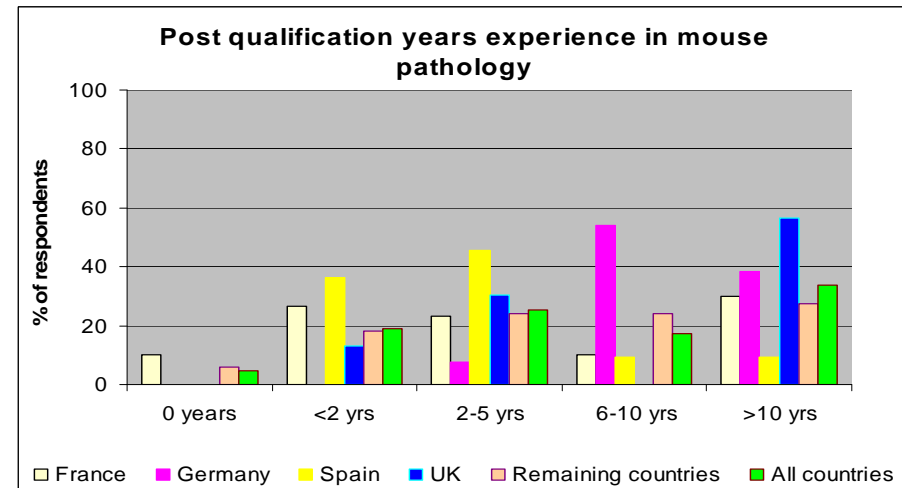
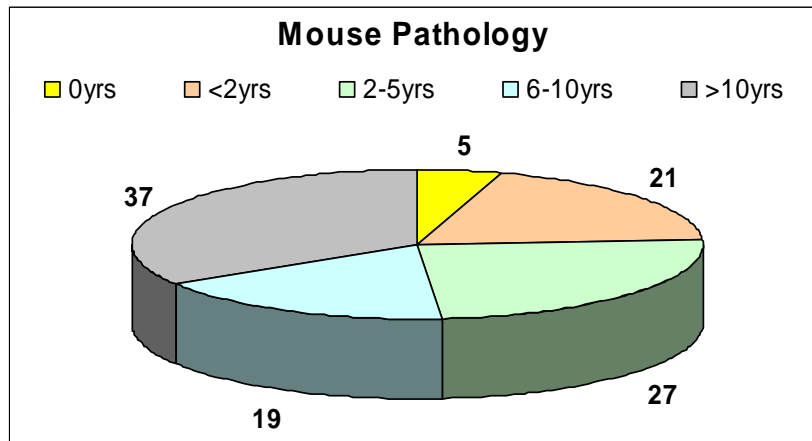
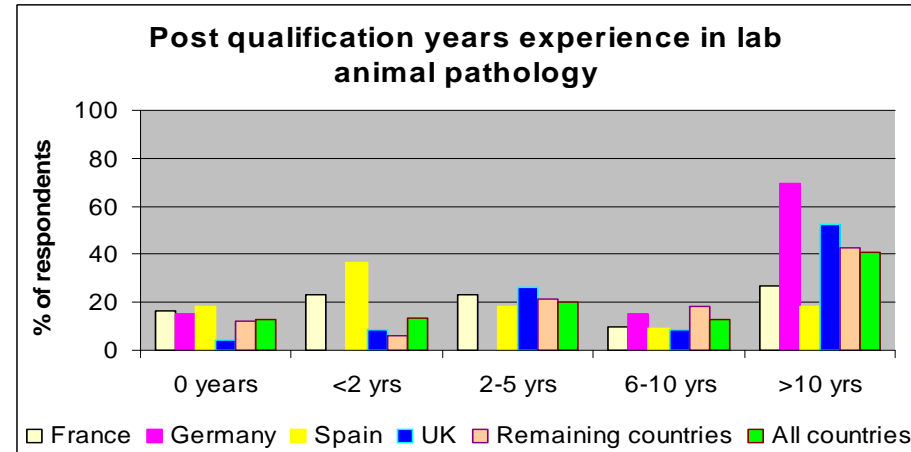
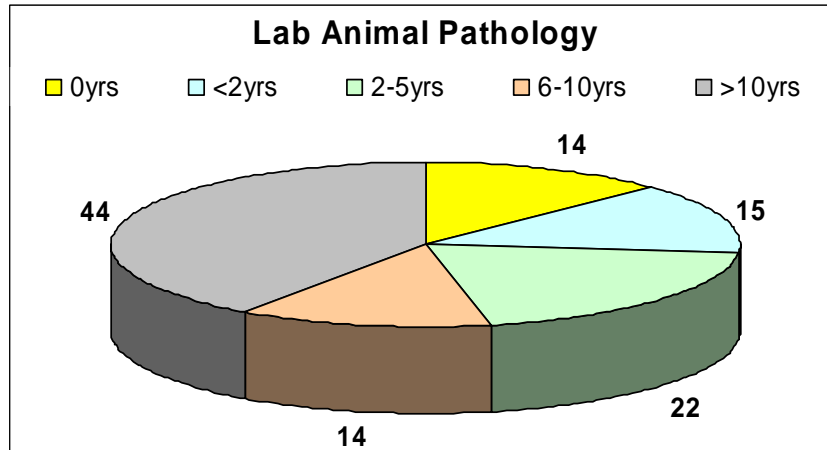
“People tend to change jobs throughout their careers and good basic training without narrow specialisation in the mouse is a much safer bet given the current lack of career opportunities in this narrow field.”

Post Qualification Experience

“Definitively it is a question of formality in this field as to who is regarded as a pathologist and who not. Experience should be the key criteria not any passing of formal exams which too often do not have anything to do with the real life in the lab.”

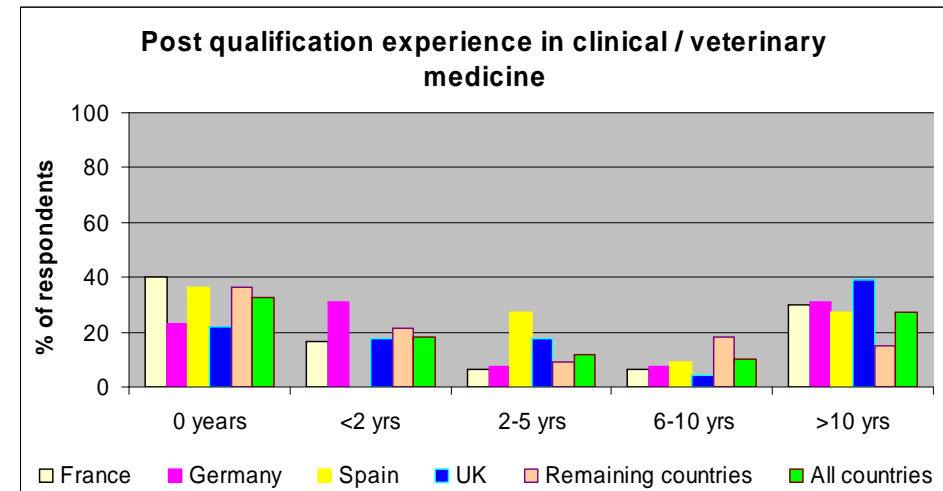
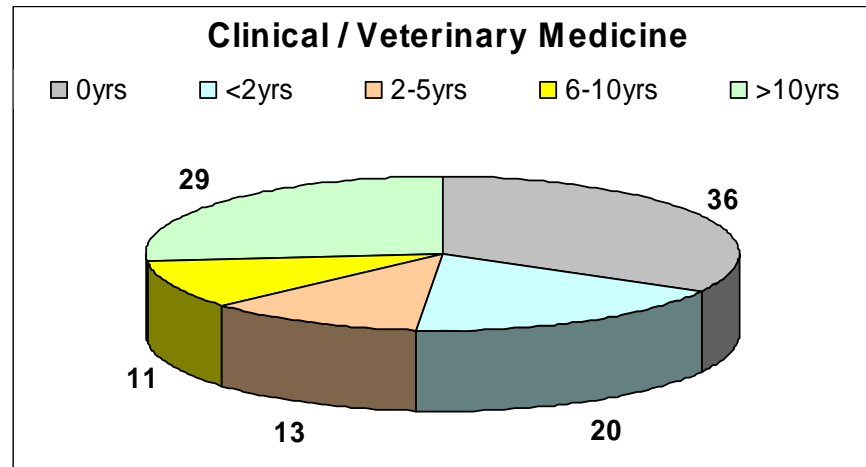
The majority of respondents have more than 10 years experience in basic science / molecular biology / genetics, veterinary / medical pathology, lab animal pathology and mouse pathology.





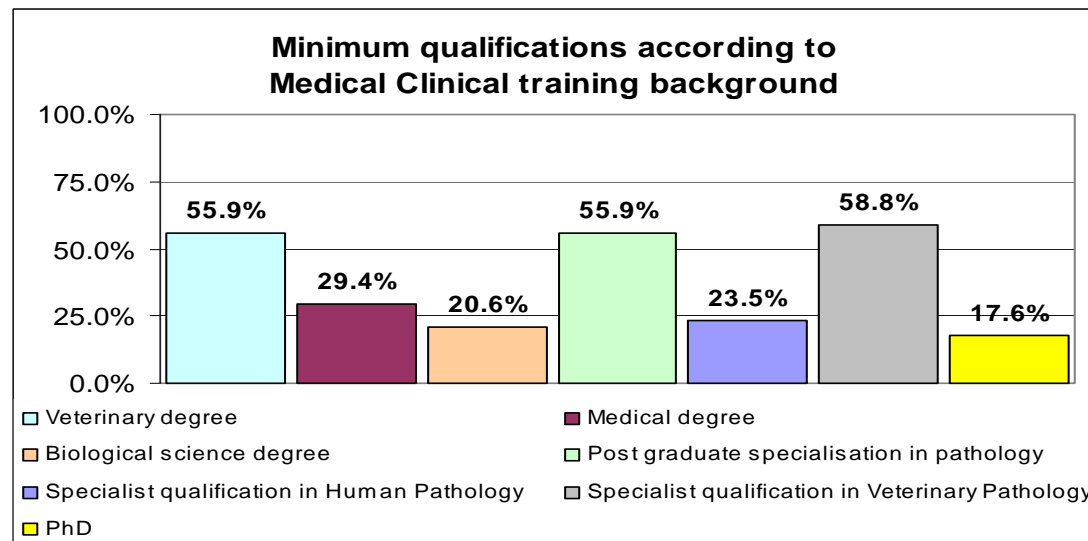
Spain has less people who have worked in mouse pathology for significant number of years – pathology appears to be an emerging field.

33% of respondents have no experience in clinical / veterinary medicine and 26.6% of respondents have more than 10 years experience in this area.



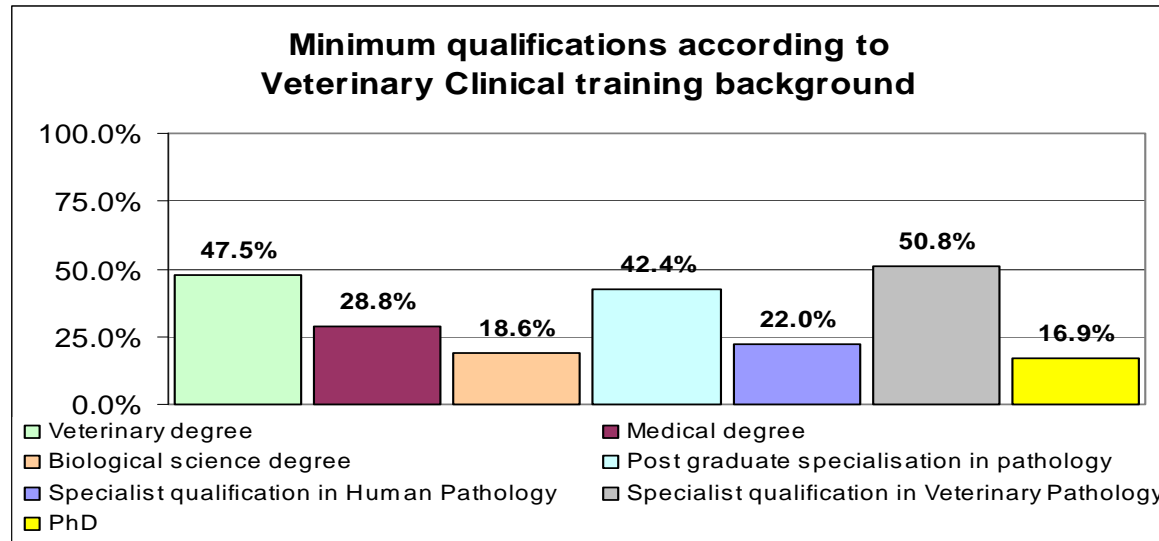
Of the 34 respondents who hold a Medical Clinical primary academic qualification:

- Only 29.4% of them feel it is a minimum qualification for a mouse pathologist
- Nearly double those numbers (55.9%) feel that a Veterinary Clinical qualification is a minimum qualification.
- Over half feel that a post graduate specialisation in pathology (55.9%) or a specialist qualification in veterinary pathology (58.8%) is a minimum qualification.

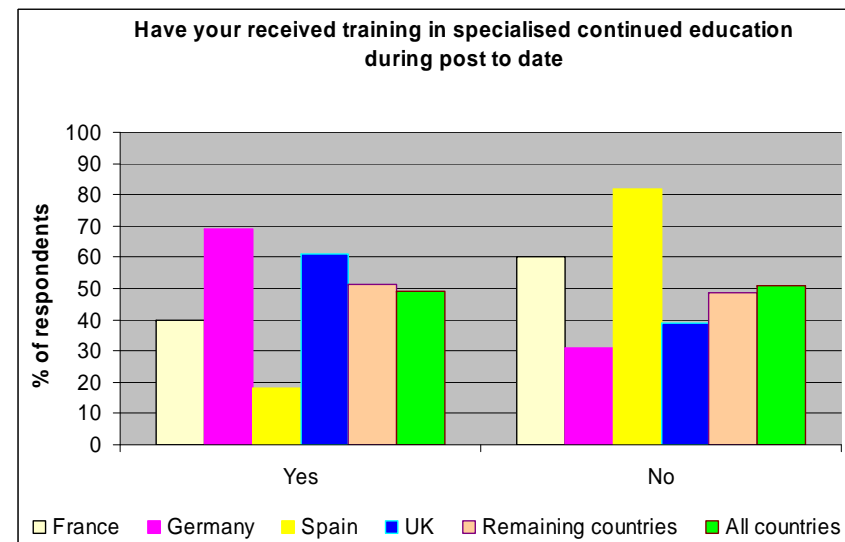
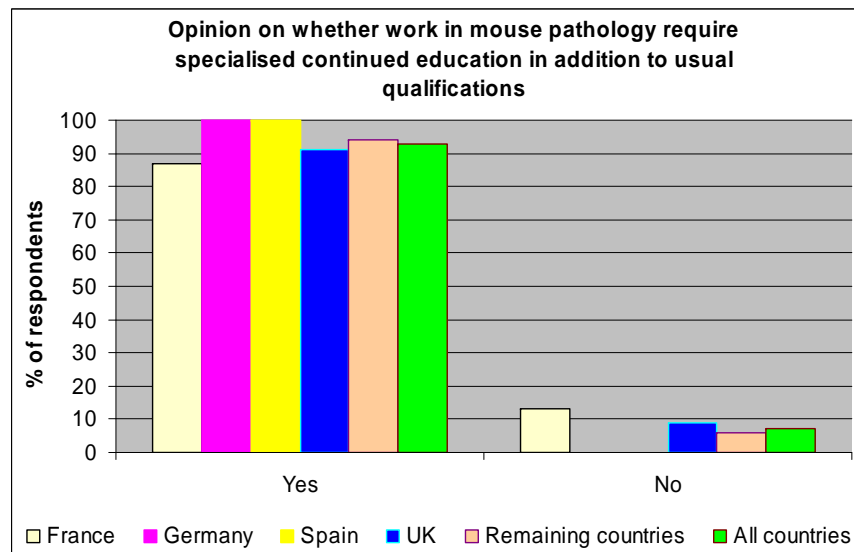


Of the 59 respondents who hold a Veterinary Clinical primary academic qualification:

- Less than half (47.5%) of them feel it is a minimum qualification for a mouse pathologist.
- 42.4% feel that a post graduate specialisation in pathology is a minimum qualification.
- 50.8% feel that a specialist qualification in Veterinary pathology is a minimum qualification.



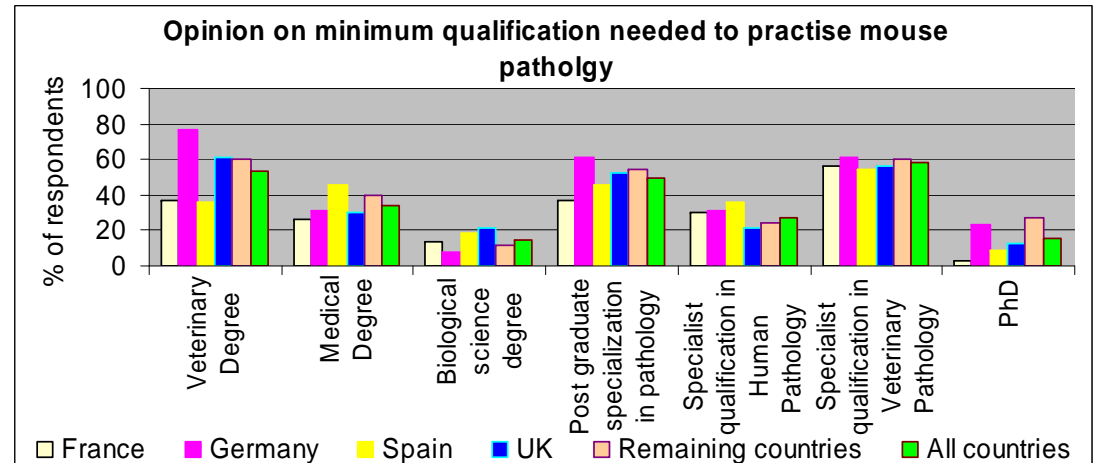
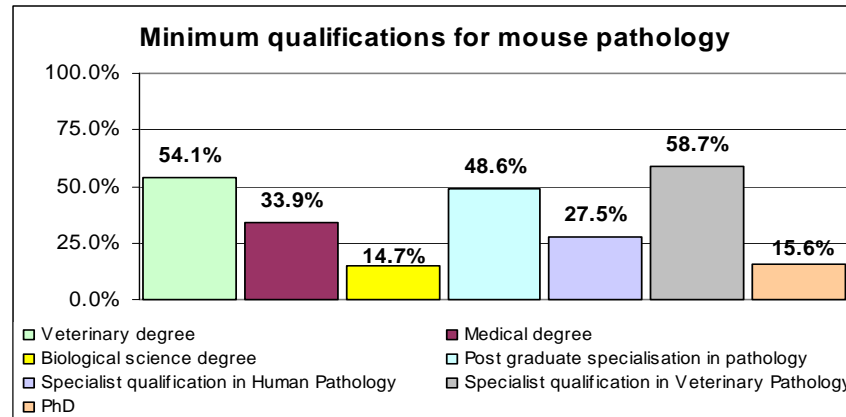
92.7% of respondents believe that their work in mouse pathology requires specialised continued education in addition to their qualifications. However, only around half of respondents 49.5% have received such training during the tenure of their post to date. Spain has least training for their mouse pathologists, this could be reflective of the fact it appears to be quite a new field.



Minimum qualifications

The three top responses when asked what the minimum qualifications they felt were necessary for the practice of mouse pathology were:

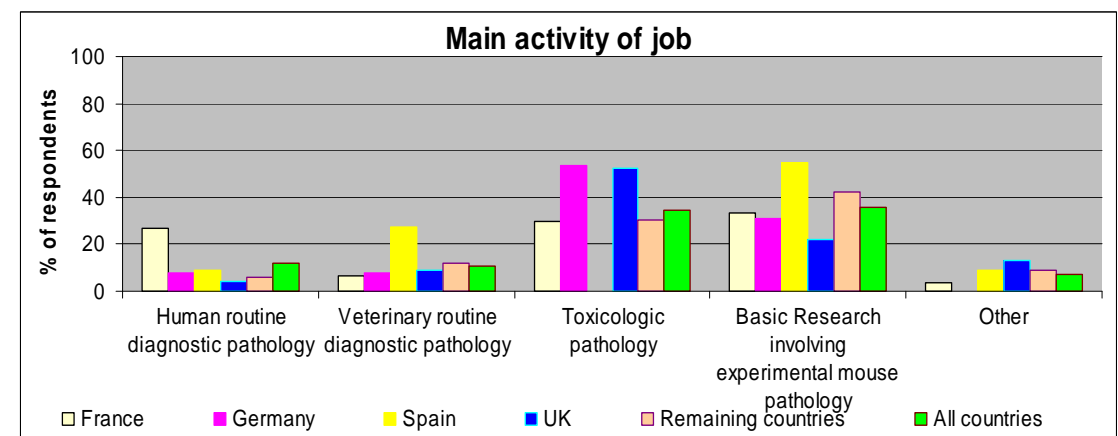
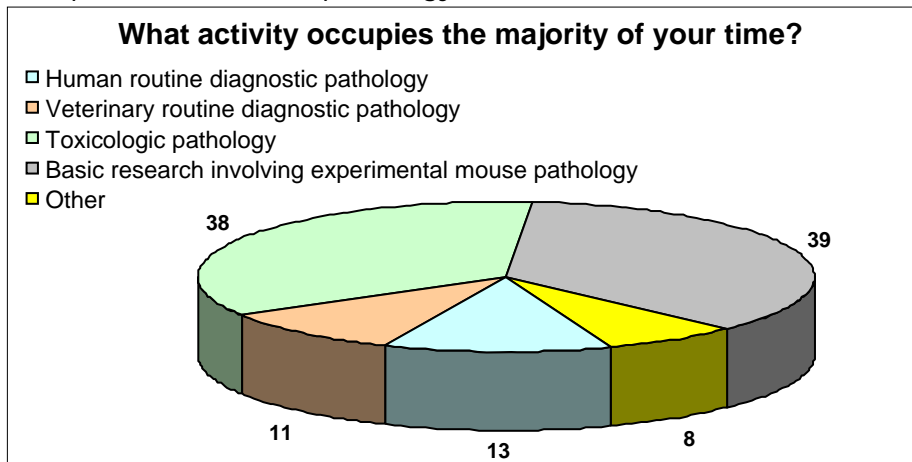
1. Specialist qualification in Veterinary Pathology (58.7%)
2. Veterinary degree (54.1%)
3. Postgraduate specialisation in pathology (48.6%)
- 4.

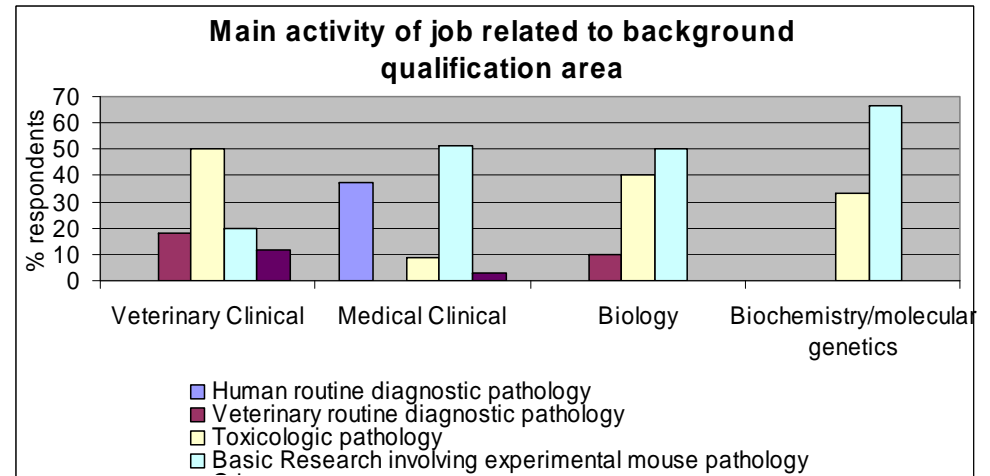
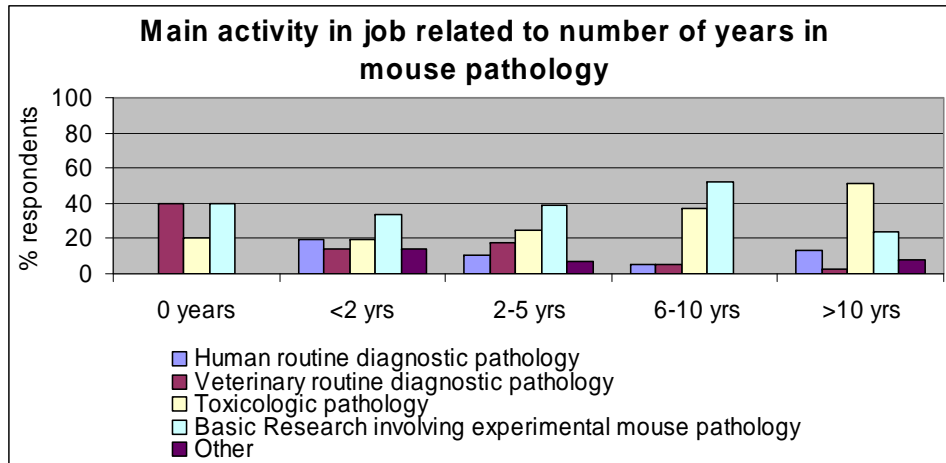


Section D: Activities as a Pathologist

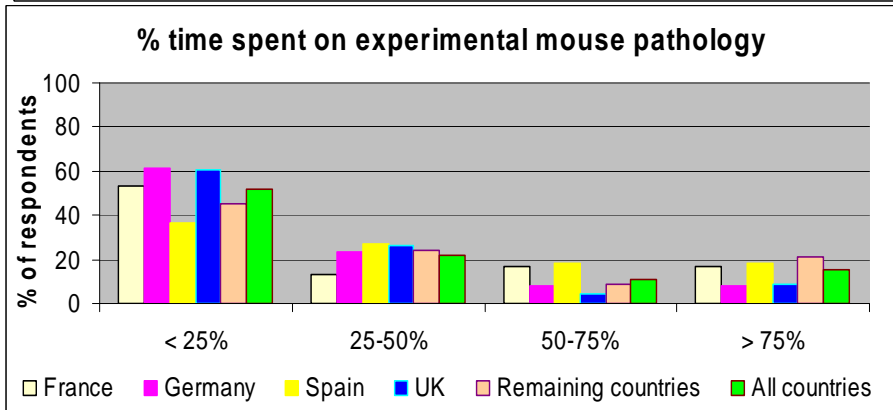
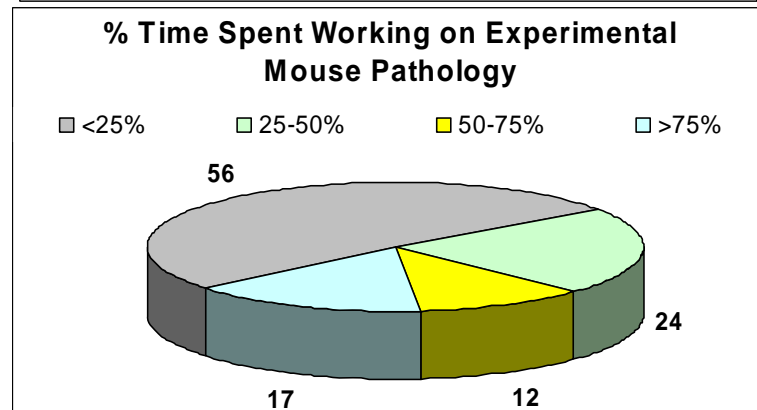
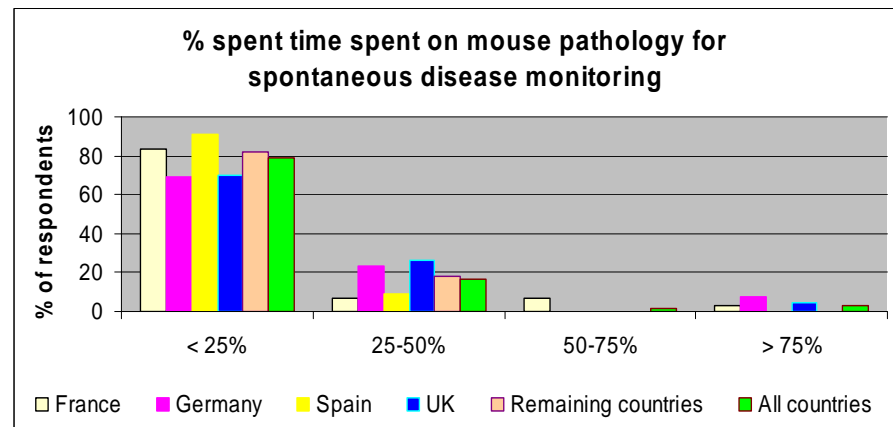
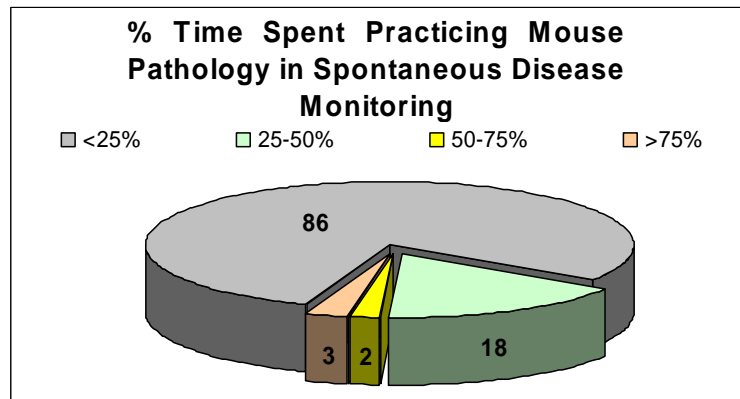
Activities

The two activities that respondents spend the majority of their time doing are toxicologic pathology (34.9%) and basic research involving experimental mouse pathology (35.8%)

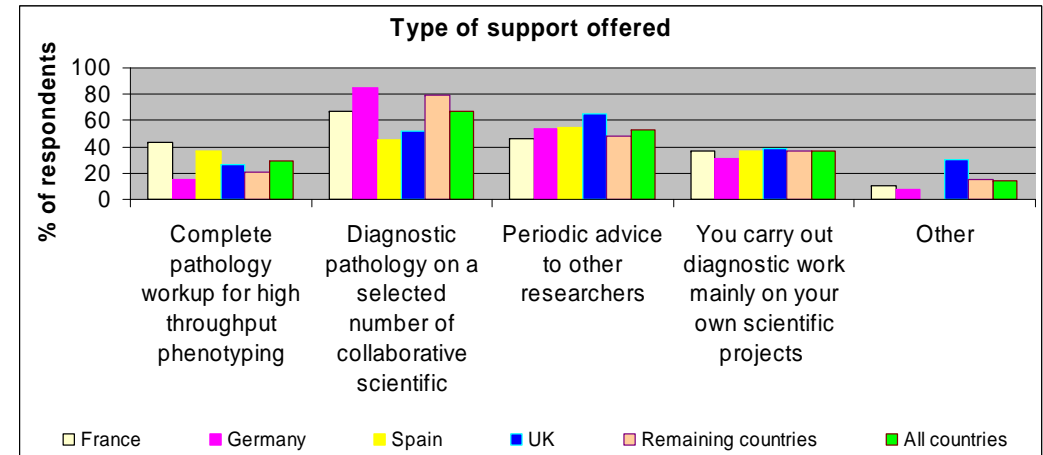
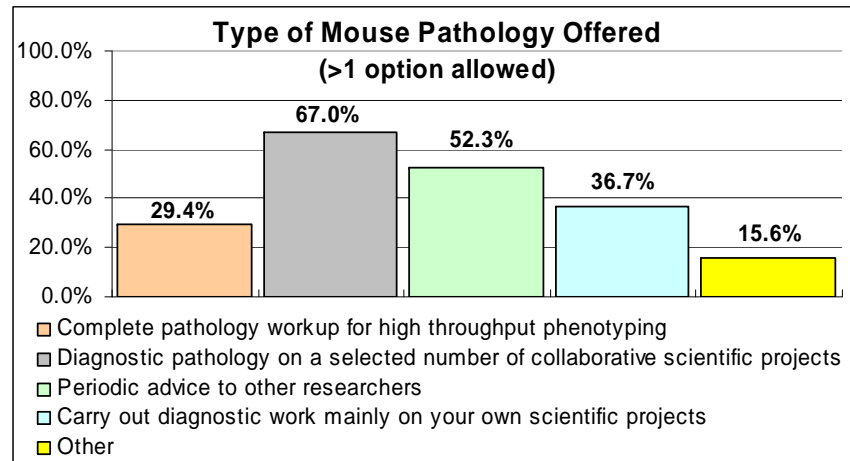




The majority of respondents spend less than 25% of their time practicing mouse pathology in spontaneous disease monitoring or working on experimental mouse pathology.



Type of Mouse Pathology Support offered



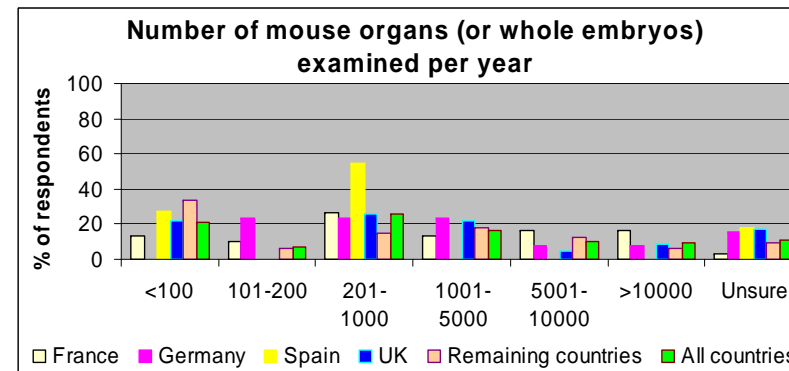
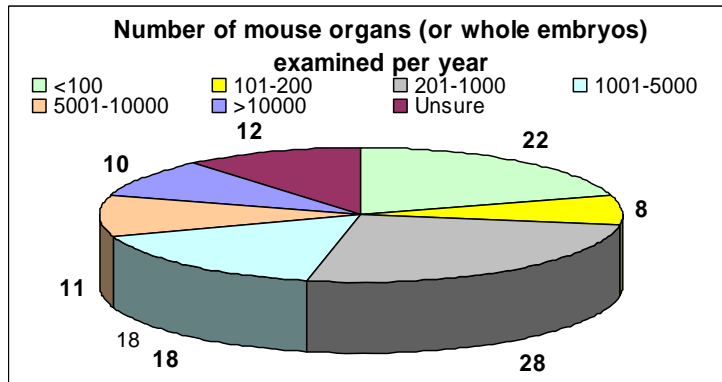
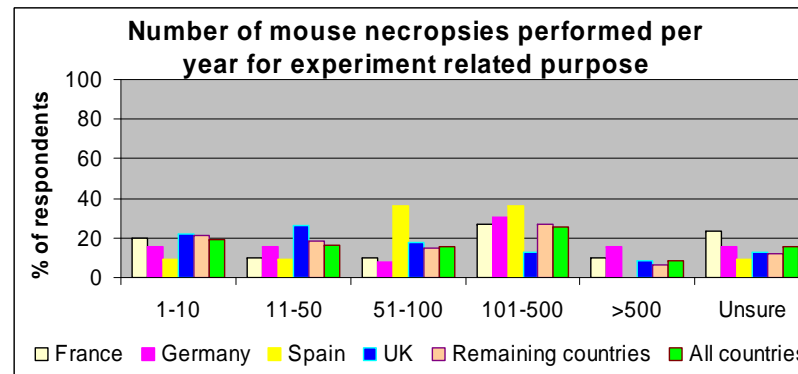
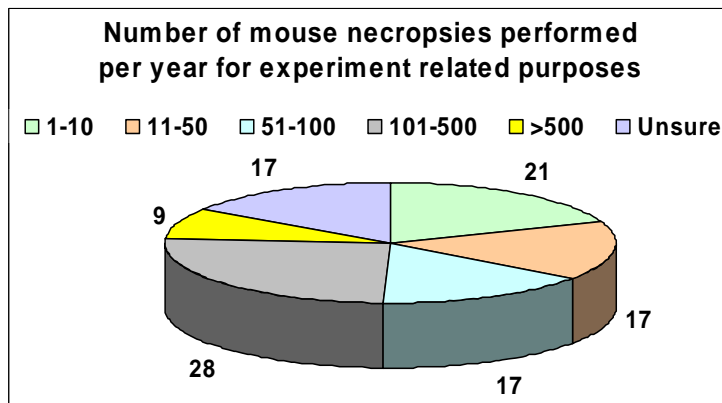
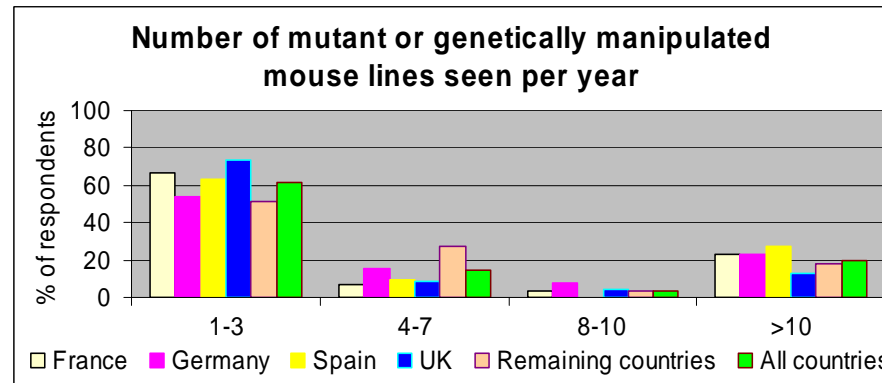
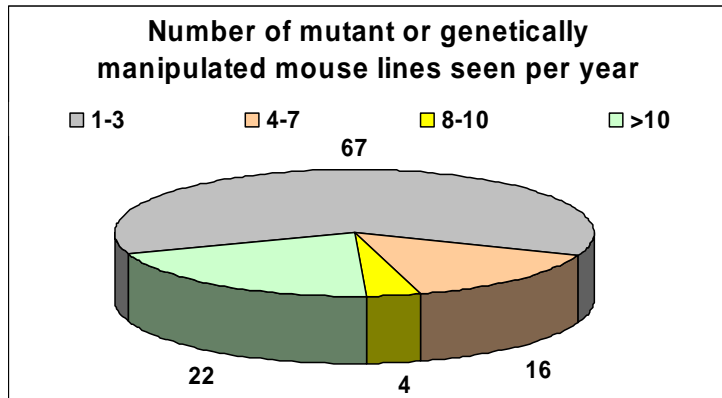
The majority of respondents (67%) offer diagnostic pathology on a selected number of collaborative scientific projects. Over half of respondents (52.3%) offer periodic advice to other researchers. 6 (5.5%) respondents offer all four types of mouse pathology.

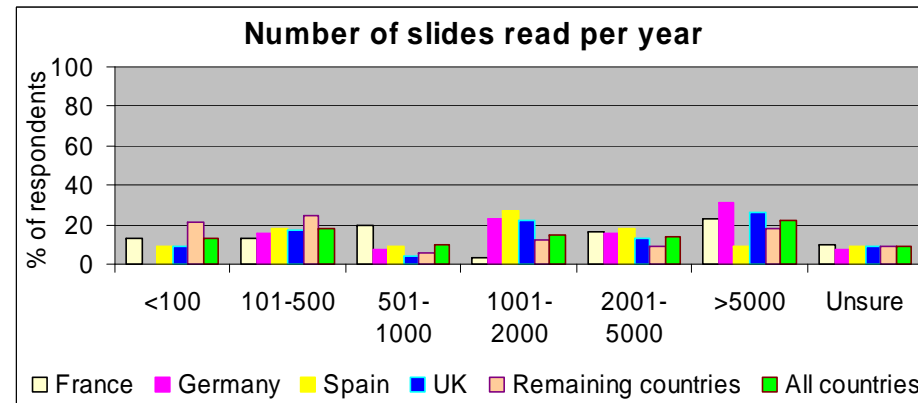
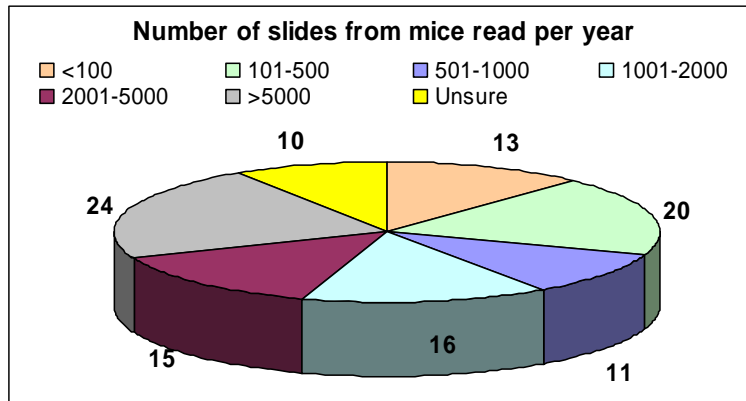
Of the 36.7% respondents who indicated that they carry out diagnostic work mainly on their own scientific projects, 70% of them are the principal investigator.

56.9% of respondents consider themselves to have special expertise in one particular organ system or specific pathology. A list of these specialities can be found in Appendix 3.

Volume of Work

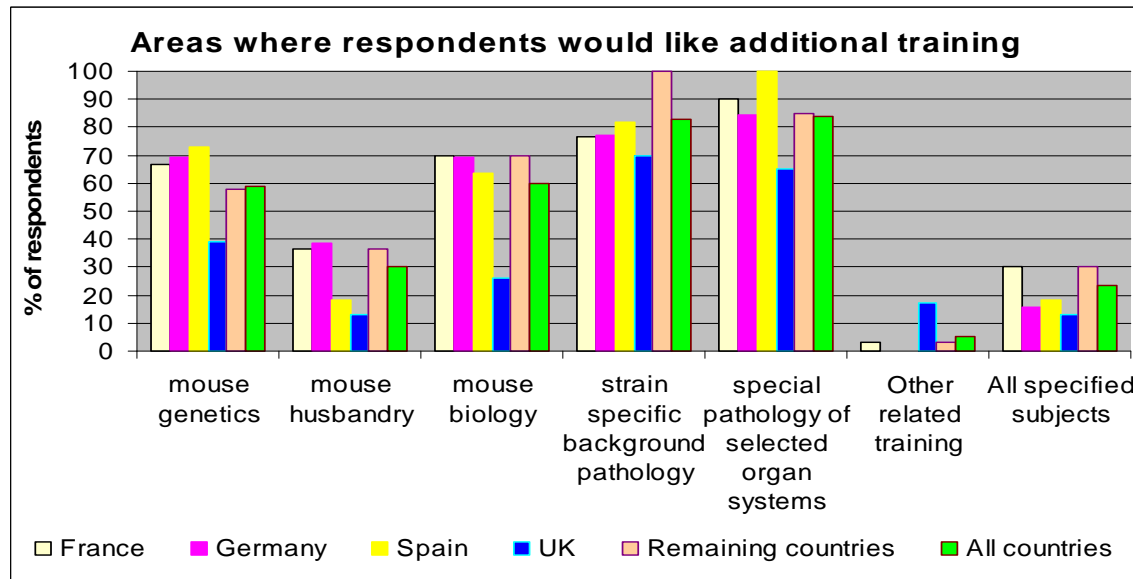
The majority of respondents only see between one and three mutant or genetically manipulated mouse lines per year. The volume of other specific activities (number of mouse necropsies performed, mouse organs examined and number of slides from mice read) varies.





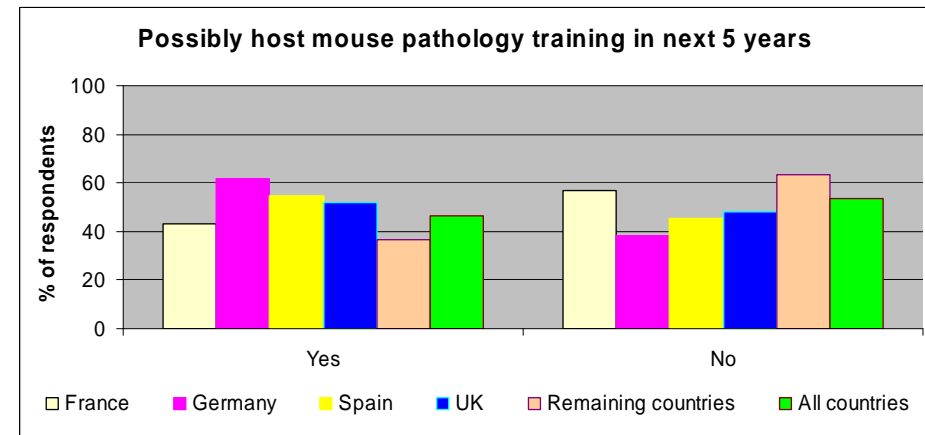
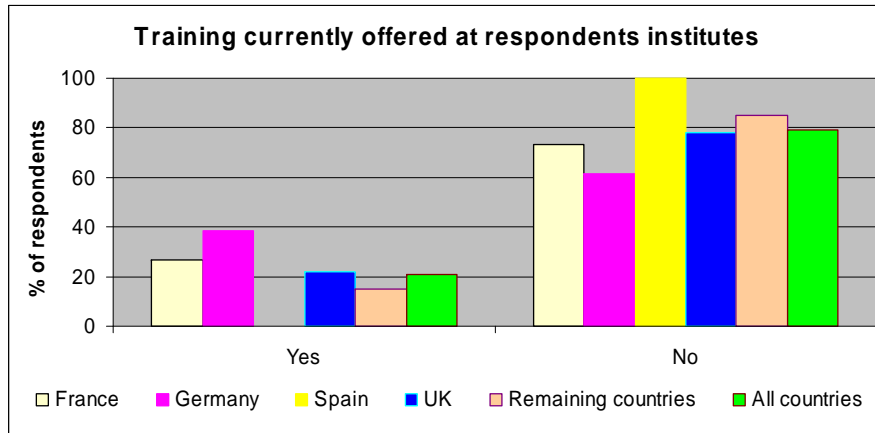
Further Training

The majority of respondents believe that they would benefit from additional training in mouse genetics (63.6%), mouse biology (62.3%), strain specific background pathology (84.9%), special pathology of selected organ systems (85%), but not in mouse husbandry (only 31.4%).

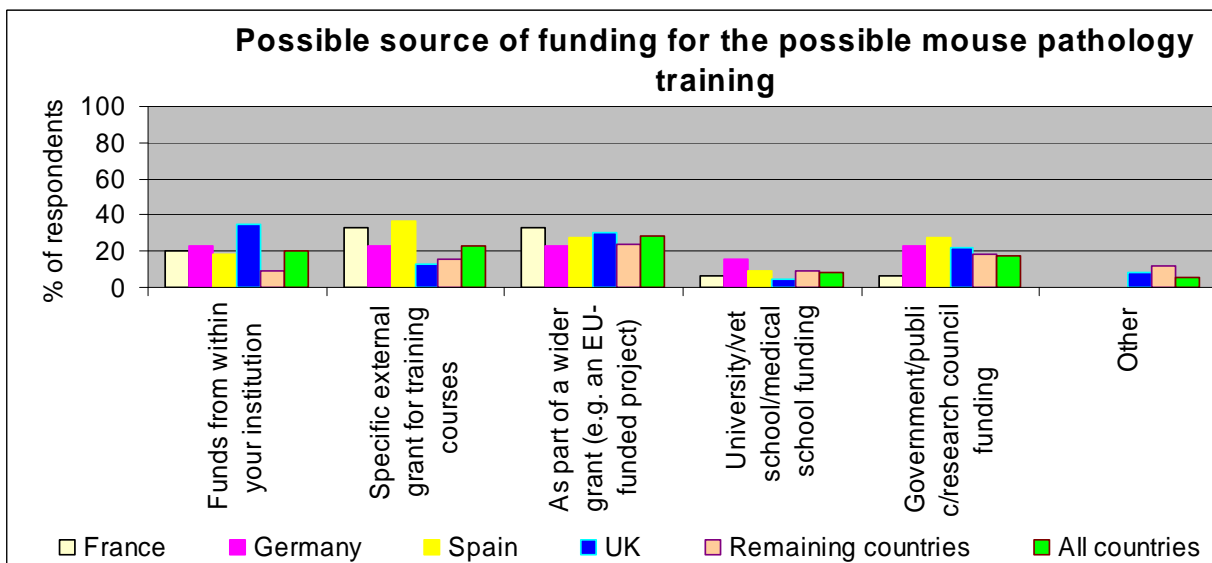


Other topics, where respondents felt they would benefit from additional training, include the use of antibodies for immunohistochemistry or immunofluorescence, electron microscopy of alimentary systems, general toxicologic pathology and phenotyping.

Despite the fact that 92.7% of respondents believe that their work in mouse pathology requires specialised continued education in addition to their qualifications, only around half of respondents (49.5%) have received such training during the tenure of their post to date. Training in mouse pathology is not currently being offered in the majority (78.9%) of respondent's institutes. However a breakdown by country shows that training varies between countries, with Germany having higher levels of training and Spain lower levels.



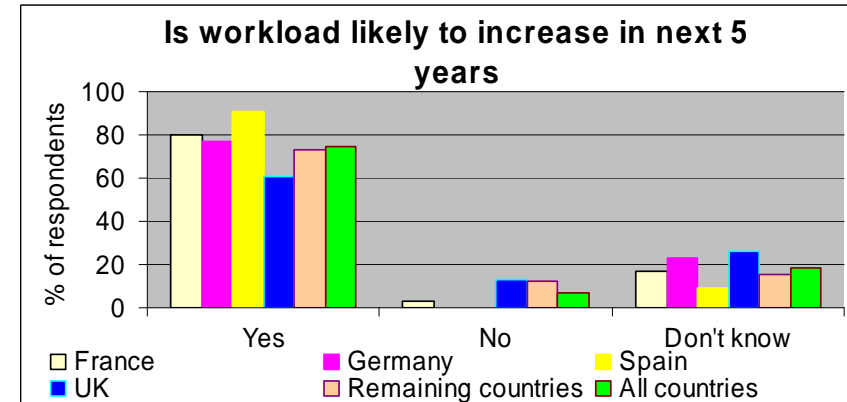
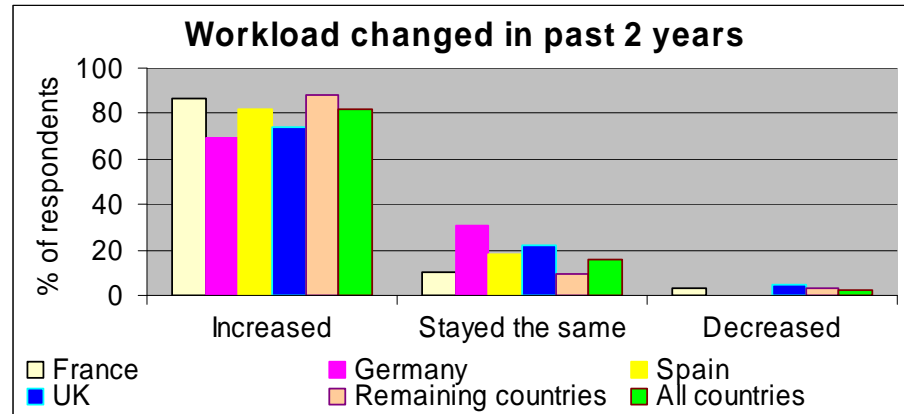
Less than half of respondents (46.8%) thought that their institution would be in a position to offer training in mouse pathology at some point in the next five years. Of these the majority (60.8%) thought that funding for training might be obtained as part of a wider grant (e.g. EU funded project).



Section E: Trends and the Future

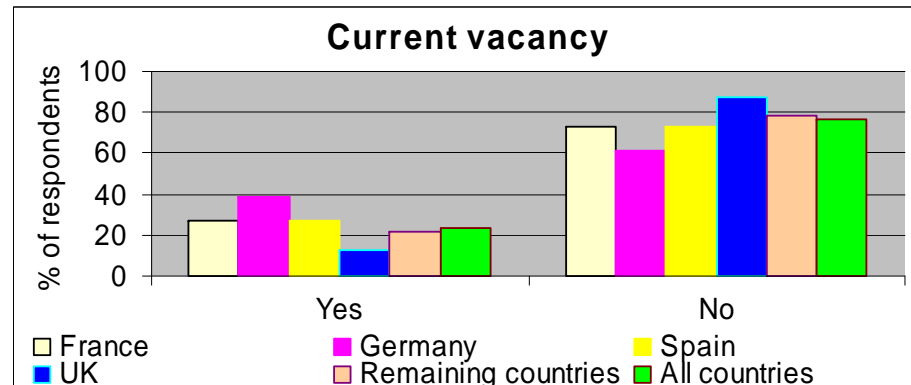
Workload

81.7% of respondents felt their workload had increased over the last two years and 75.2% expect their workload to increase over the next five years.

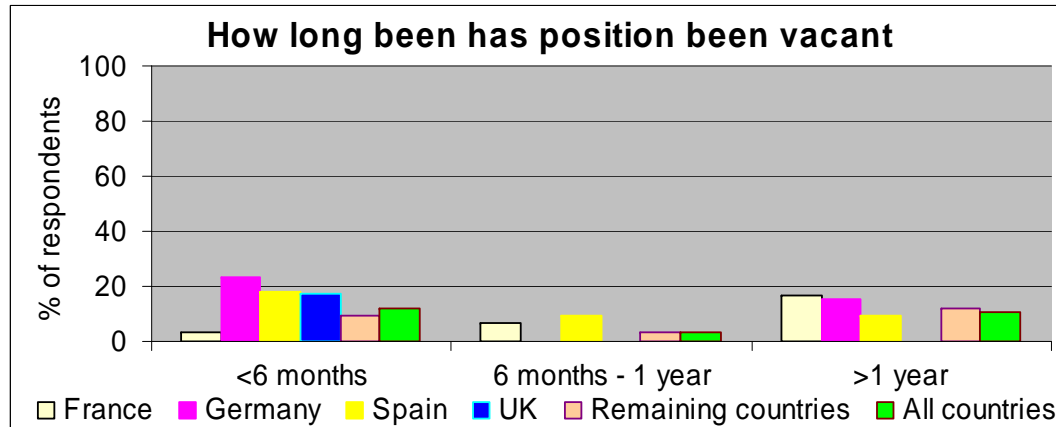


Vacancies

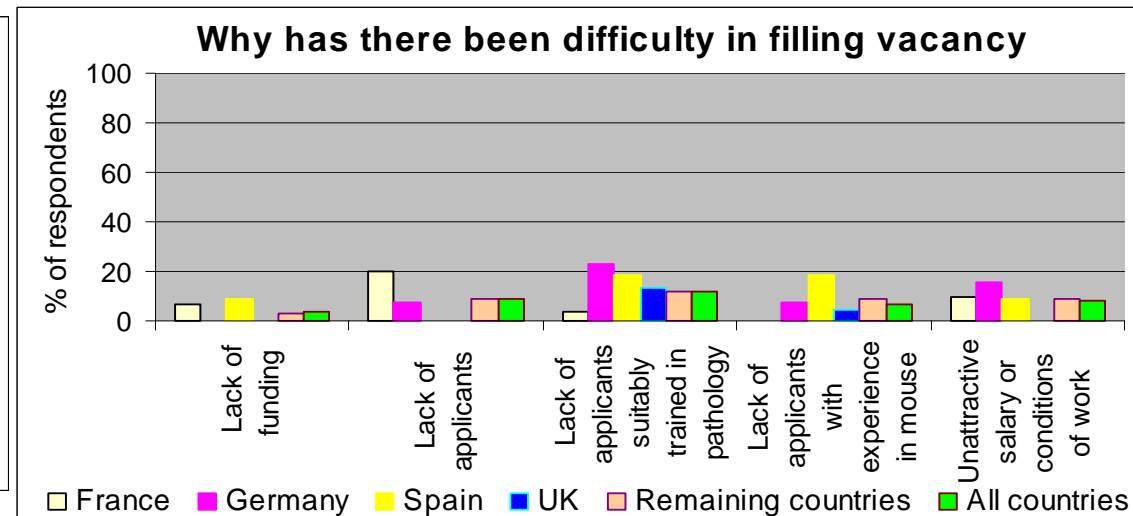
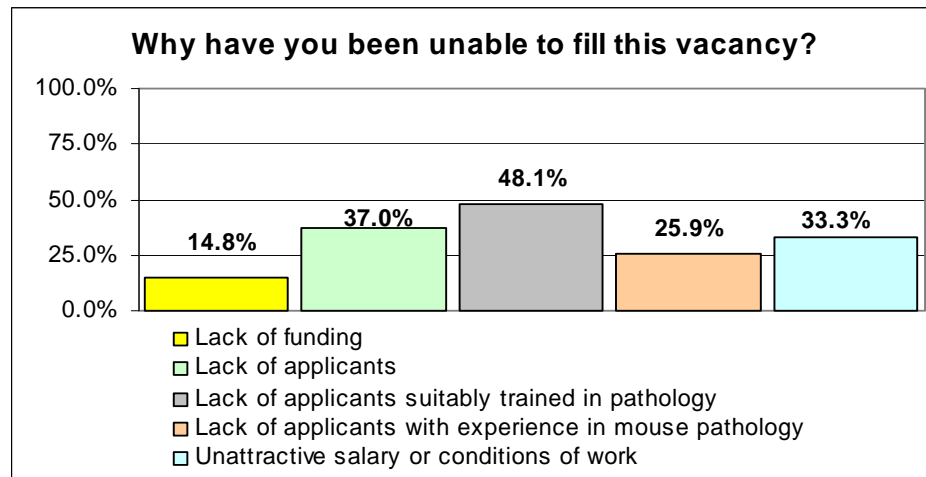
27 (24.8%) of the respondents have a vacant position for a pathologist in their workplace. However, three were from the same institute in The Netherlands and two were from the same institute in France and are therefore assumed to be talking about the same vacancy. The corrected number of vacancies is therefore 24 (22%).



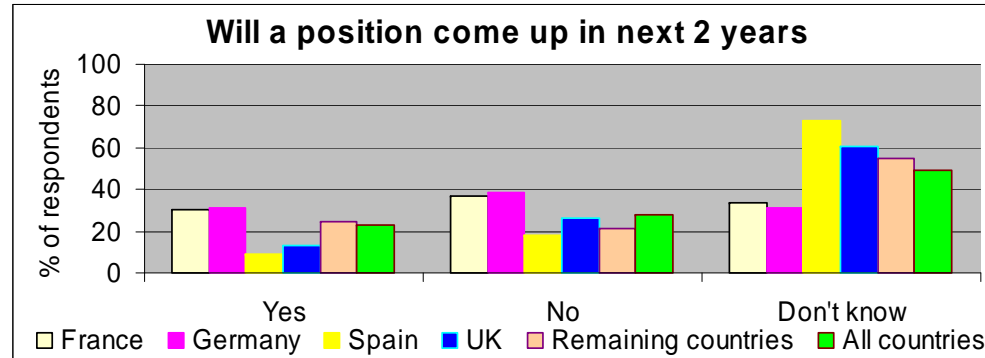
The majority of the vacancies were from government funded research institutes (38.5%) or pharmaceutical companies (38.5%). 9 of the positions (39.1%) have been vacant for more than a year.



Half of those with vacancies felt that this was due to a lack of applicants suitably trained in pathology. The two other favourite responses were lack of applicants and unattractive salary or conditions of work.



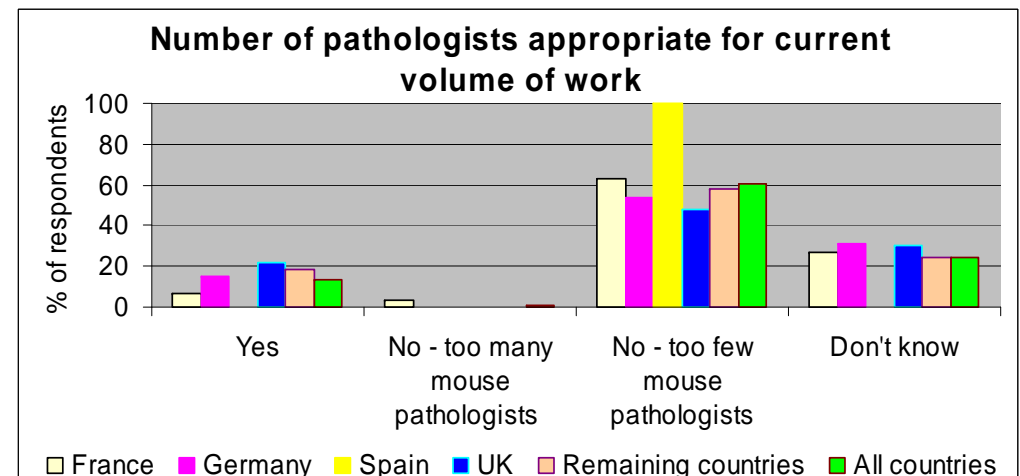
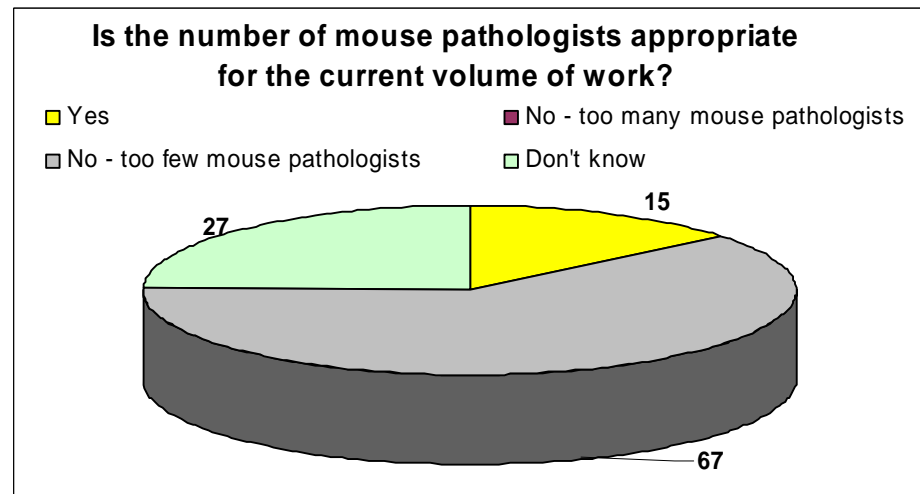
25 (22.9%) of respondents said that a position will be advertised in the next two years.

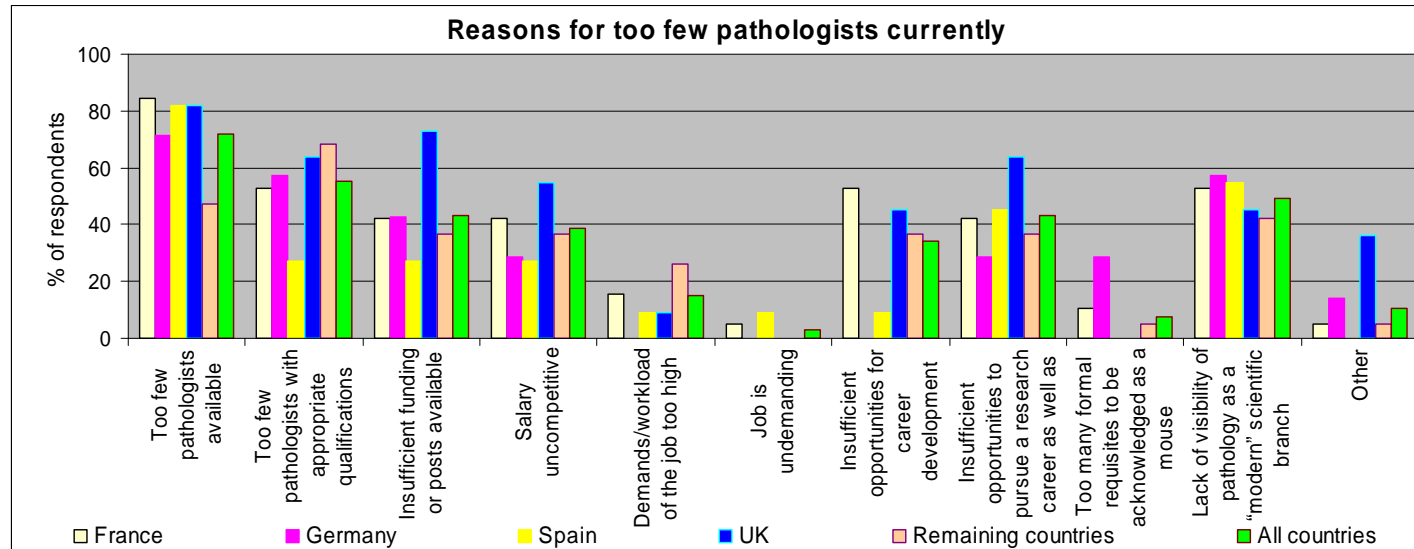


Number of Mouse Pathologists

“At the moment, we produce more than 200 different genetic modified mouse strains per year. None of them go through a proper pathology analysis unless there is a clinical problem with them. This tendency is due to the lack of pathologists and the view from scientists that pathology does not add to their science.”

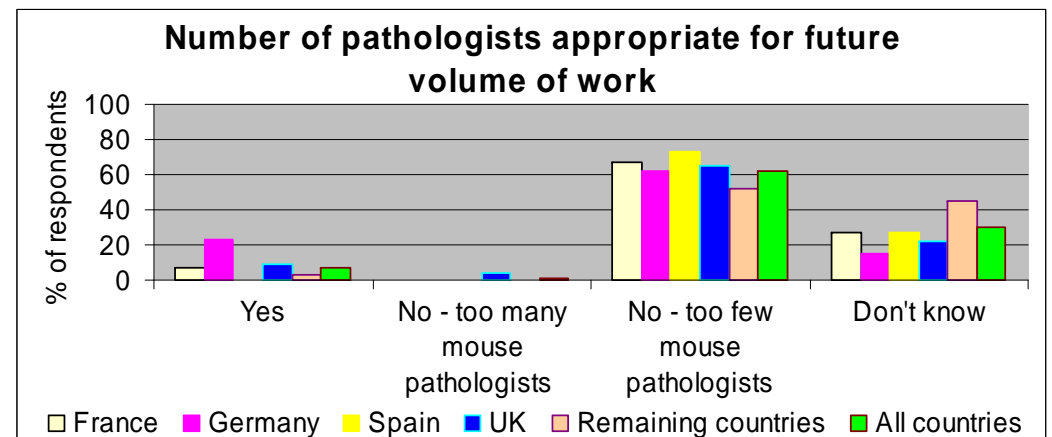
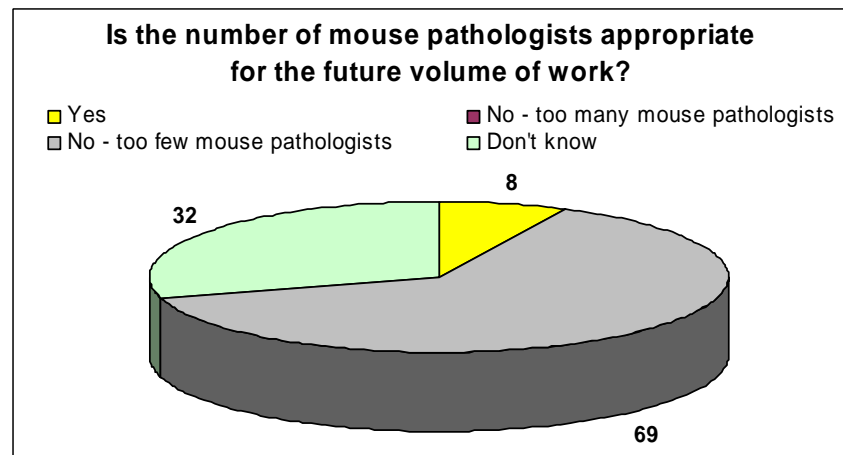
61.5% of respondents felt that there are too few mouse pathologists for the current volume of work. None of the respondents felt that there are too many mouse pathologists. Spain has 100% rate of saying too few pathologists





When asked about the future a similar number (63.3%) of respondents felt that there will be too few mouse pathologists for the future volume of work. Again, none felt that there will be too many mouse pathologists.

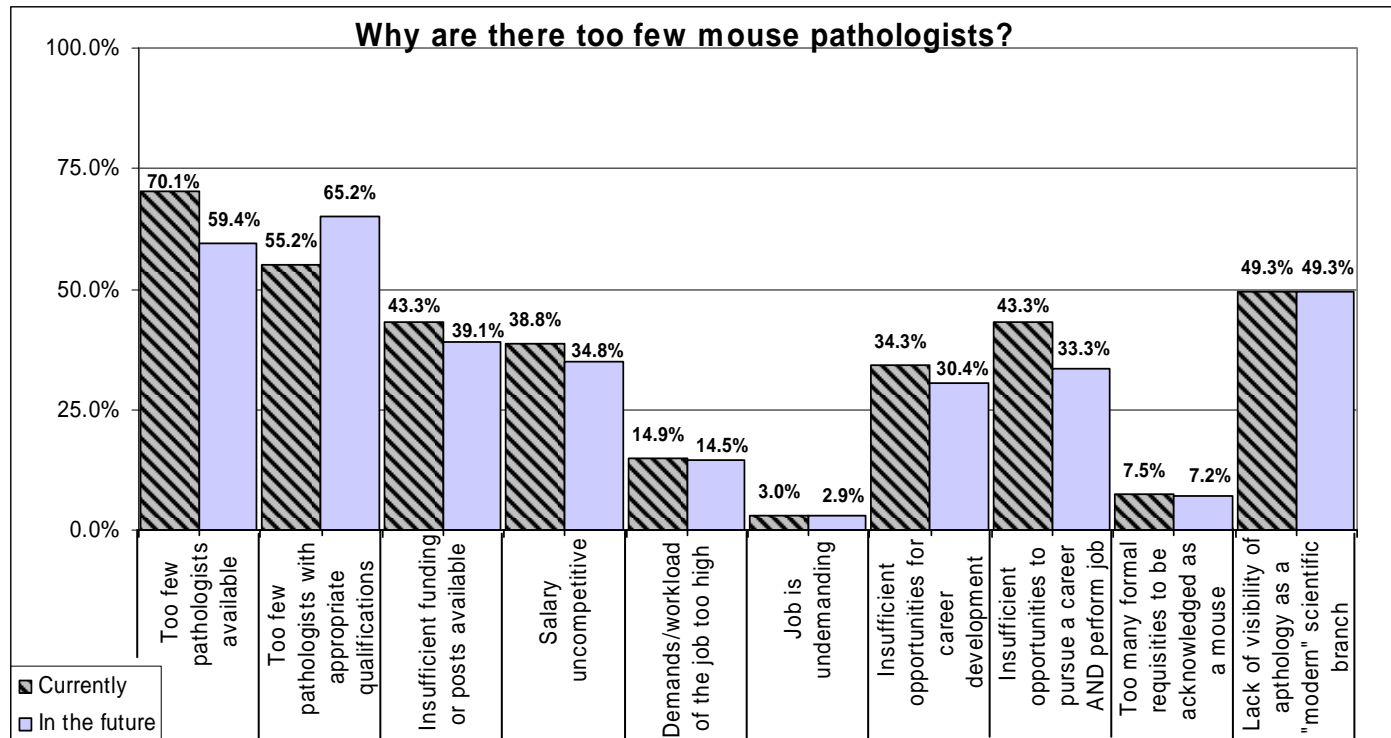
“The primary reason for an absence of mouse pathologists in British biomedical research is that as a discipline it falls between veterinary and human pathology. Vets are not exposed to species used in biomedical research and view them as the domain of human biomedical research. Human pathologists view them as animals and therefore the domain of vets. Hence there is no pool of interested pathologists.”



Lack of Mouse Pathologists

The three top reasons given for this lack of mouse pathologists both currently and in the future were:

1. Too few pathologists available
2. Too few pathologists with appropriate qualifications available
3. Lack of visibility of pathology as a “modern” scientific branch



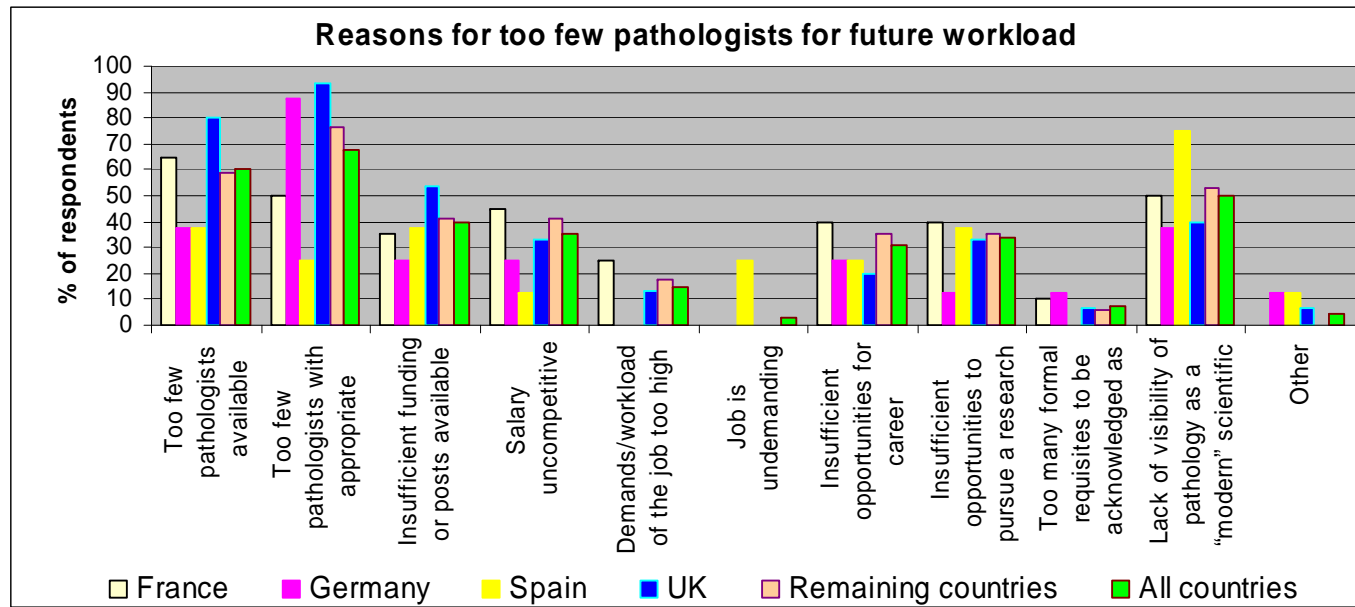
“Another problem is that working with laboratory animals is not a popular activity of veterinary and medical biology students, mainly due to the actions of animal right groups.”

However a breakdown by country shows variations – in particular

Spain is less concerned with there being too few pathologists with appropriate qualifications and rates insufficient opportunities to pursue a career as its third top reason, making its top three:

1. Too few pathologists available (81.8%)
2. Lack of visibility of pathology as a “modern” scientific branch (54.5%)
3. Insufficient opportunities for career development (45.5%)

This ties in with mouse pathology being quite a new discipline in Spain



"The solutions are achievable - however what is needed is a change in attitude from the scientific community, to parallel the support given to pathologists, both financially and otherwise, in the clinical setting or industry. Otherwise there will be a continued loss of exceptionally trained staff from academia to well paid jobs in the NHS or biotech industry in this country and abroad." – UK Respondent

Results: Principal Investigators' Questionnaire

Specialty

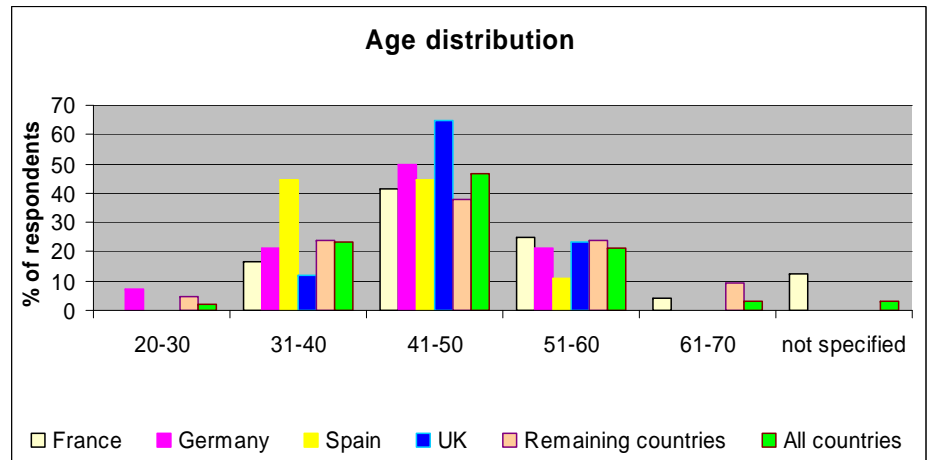
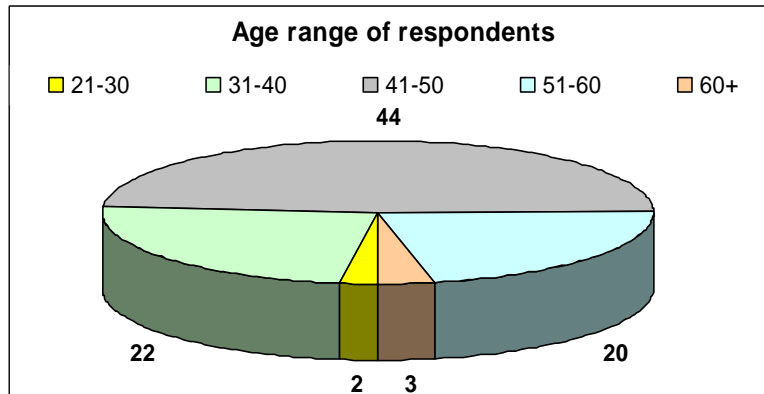
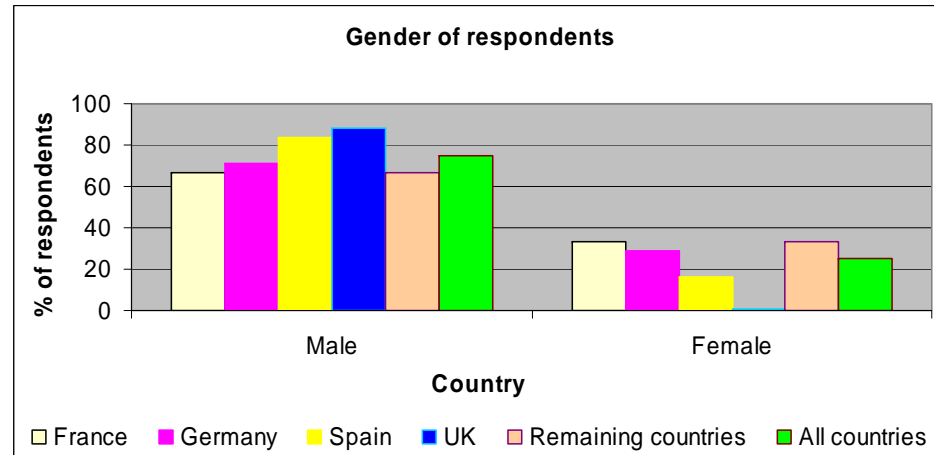
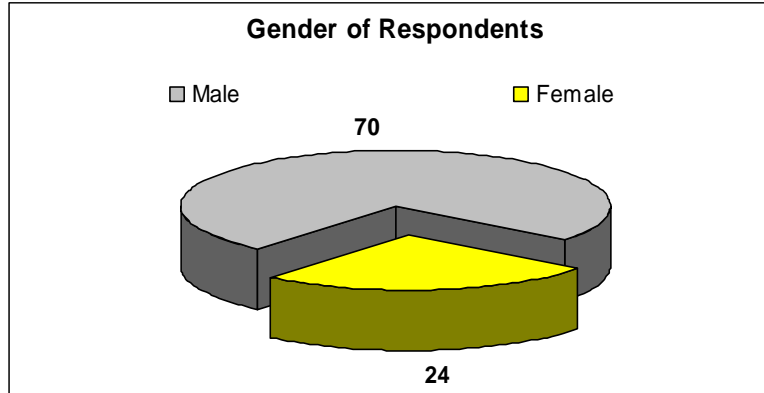
This questionnaire was designed for Principal Investigators (PI's) working with mouse models.

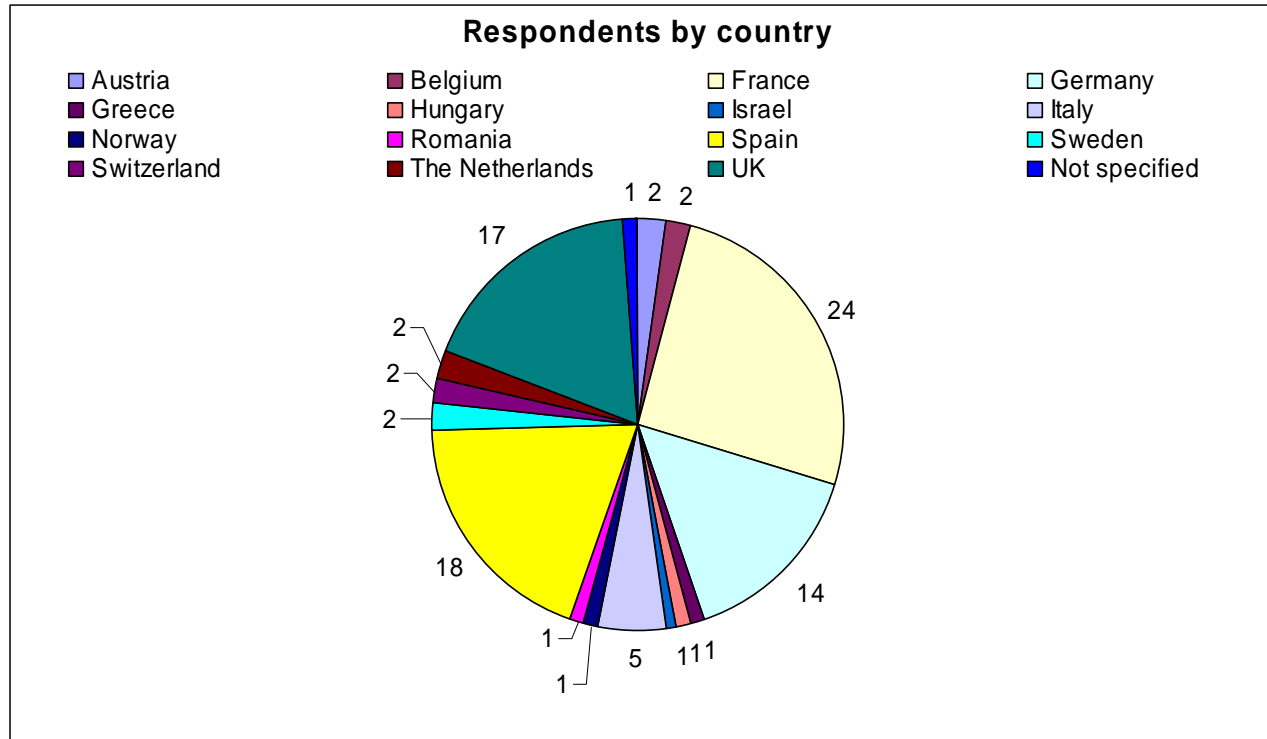
It was sent to 702 individuals. Of these 648 reached the recipient. A total of 105 responses were received. Of these, 94 were still working in the field and so completed the whole questionnaire. This is a response rate of 16%, with 14.5% providing useable data.

The questionnaire was sent by email to 702 individuals derived from EU funded mouse projects, people who expressed interest, institutes and nominated scientists. The email also contained a request that anyone receiving the information would pass it on to relevant contacts and also tell their pathologists about the pathologists' questionnaire. Of the 702 contacts, 43 email addresses were incorrect.

After four weeks 63 responses had been received; 33 of these were individuals specifically contacted, the rest came from other sources. A further request was sent to individuals who had not returned the questionnaire, as well as seven new nominations. Eleven of these did not reach the recipient. This second round of invite prompted a further 45 replies before the survey closed.

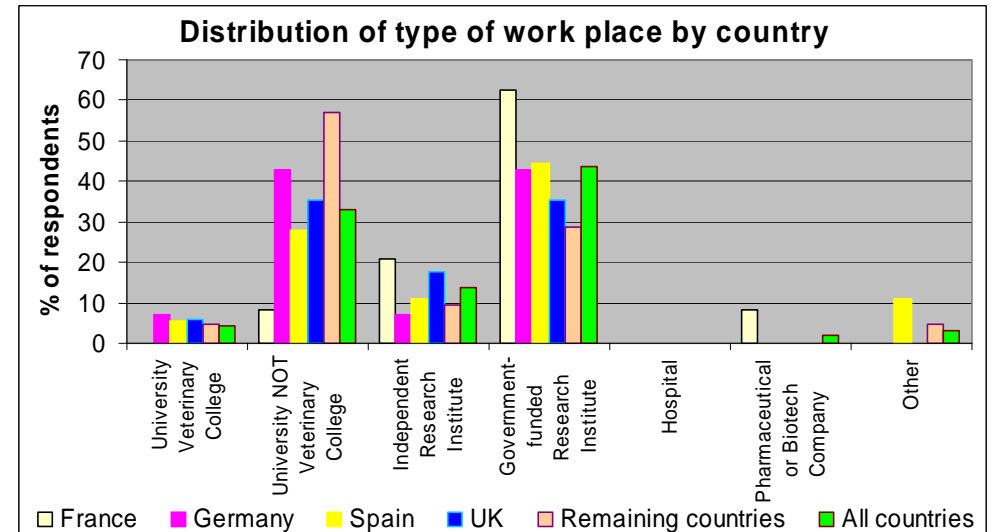
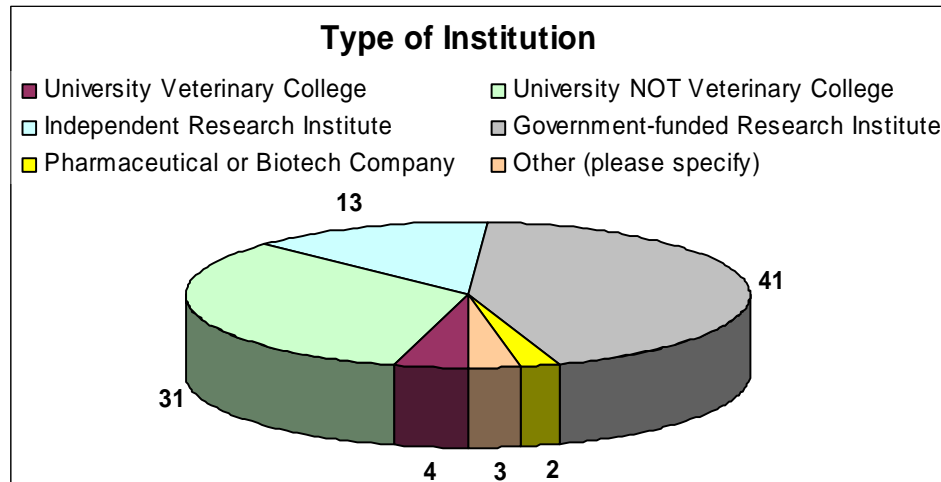
Section A: Analysis of Respondents



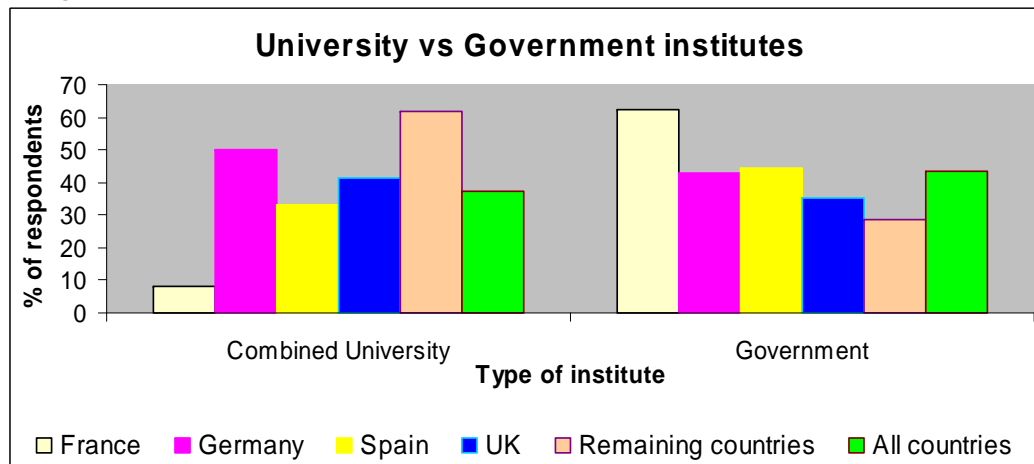


France, Spain, the UK and Germany all had 14 or more respondents from each country (greater than 15% of the total number of respondents). They were therefore used for a breakdown analysis to establish if the views held overall were the same or if they varied for each country. The access to pathology services was the only point that varied significantly between countries.

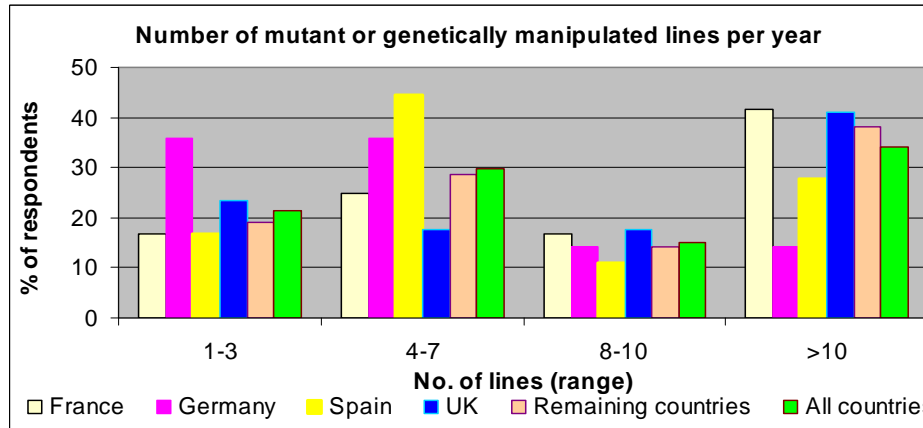
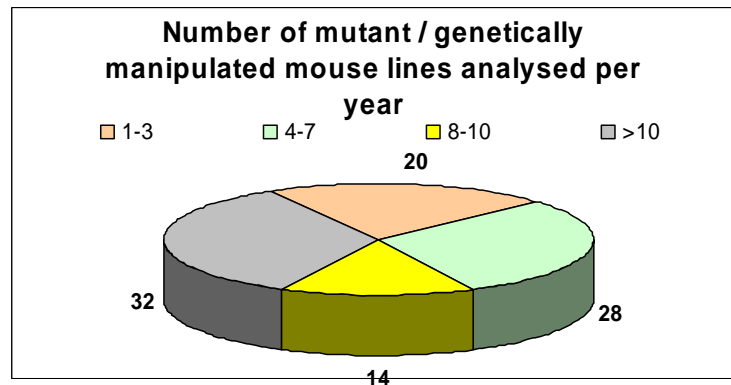
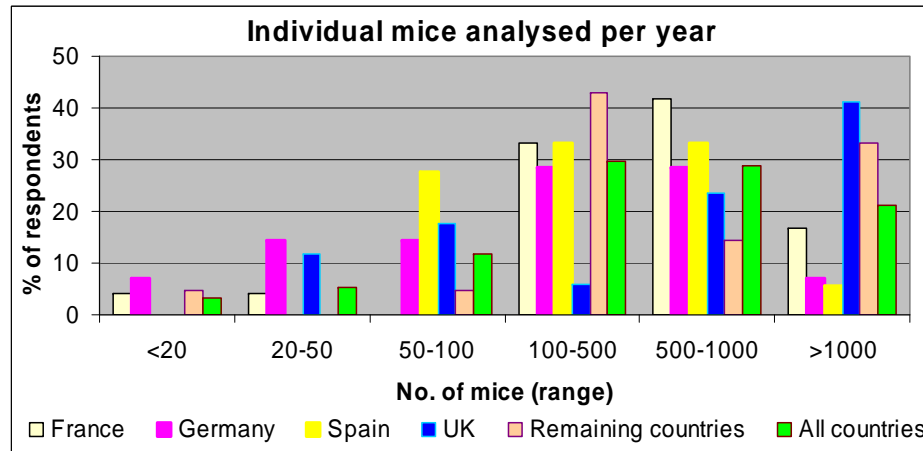
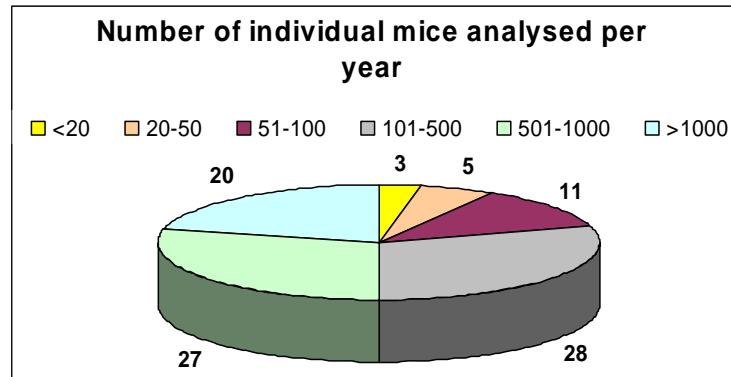
Section B: Professional Position



The largest proportion of responses (43.6%) came from Government-funded Research Institutes, followed by Universities that are not Veterinary Colleges (13.8%).

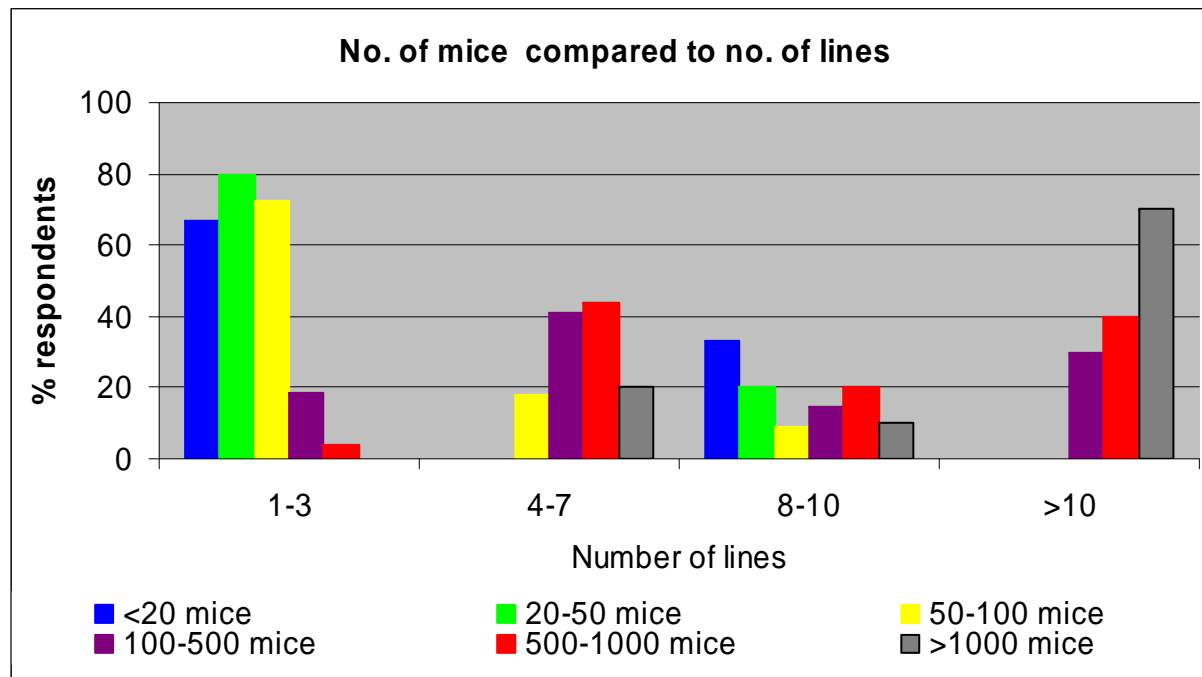
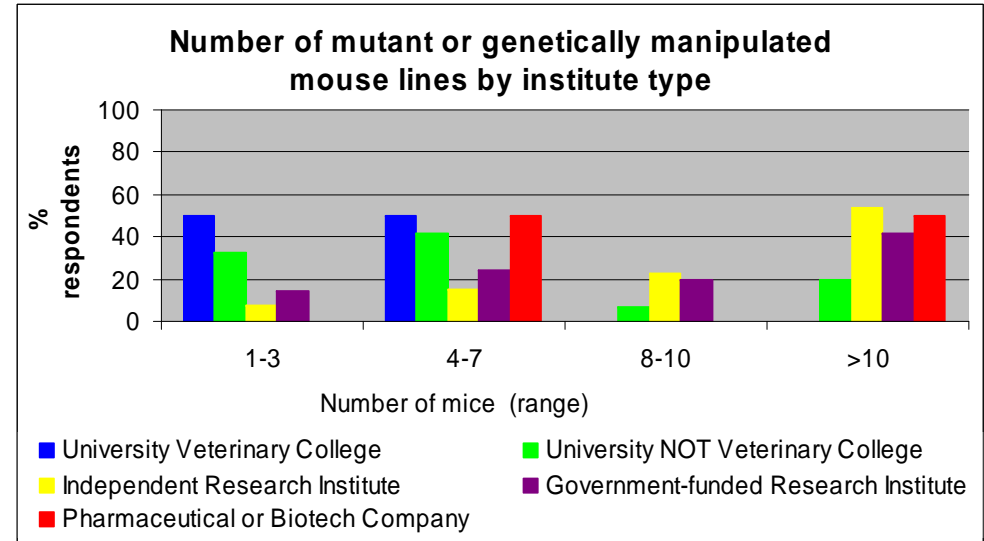
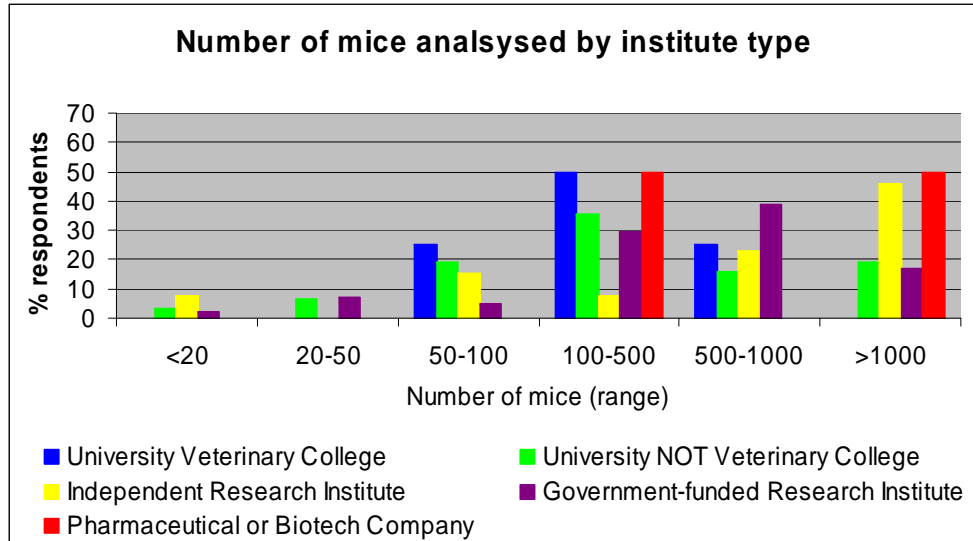


Section C: Turnover of Mouse Samples

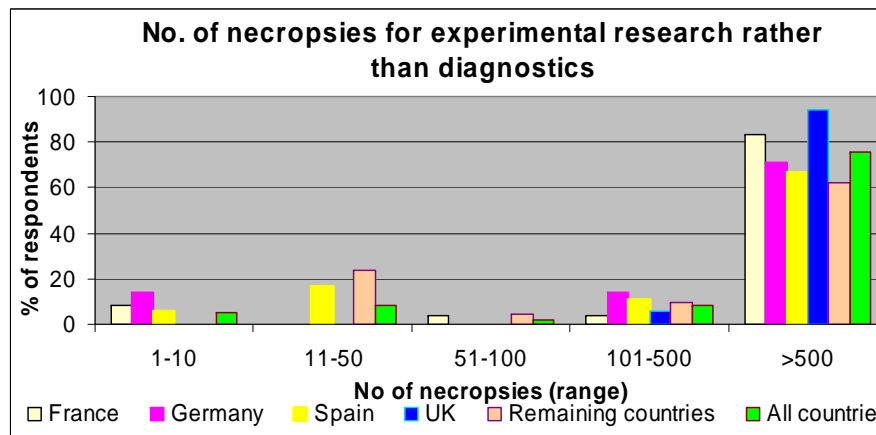
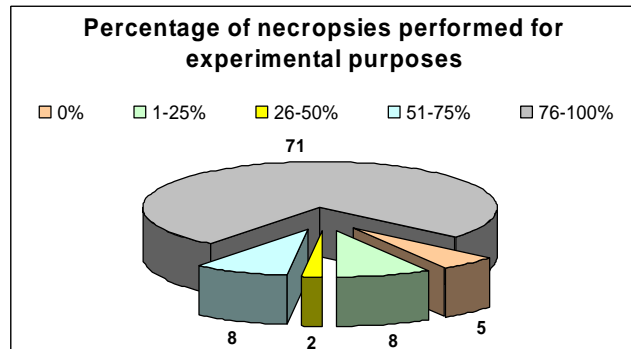
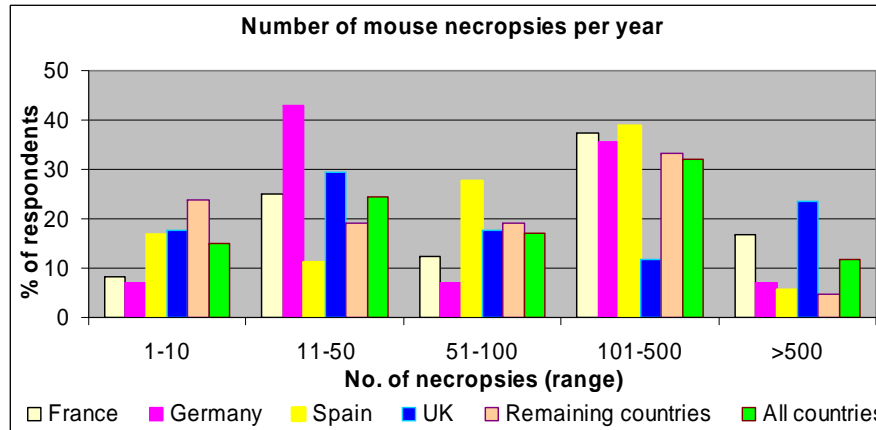
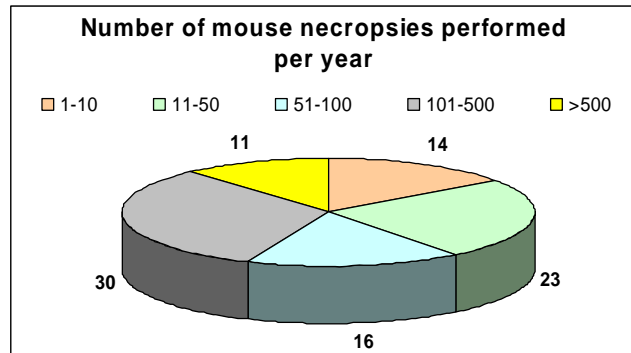


29.8% of respondents analyse 101 – 500 and 28.7% of respondents analyse 501 – 1000 individual mice in their laboratory each year.

Of the 20 respondents who analyse more than 1000 mice per year, the majority analyse 2000 – 5000 individual mice in their laboratory each year.

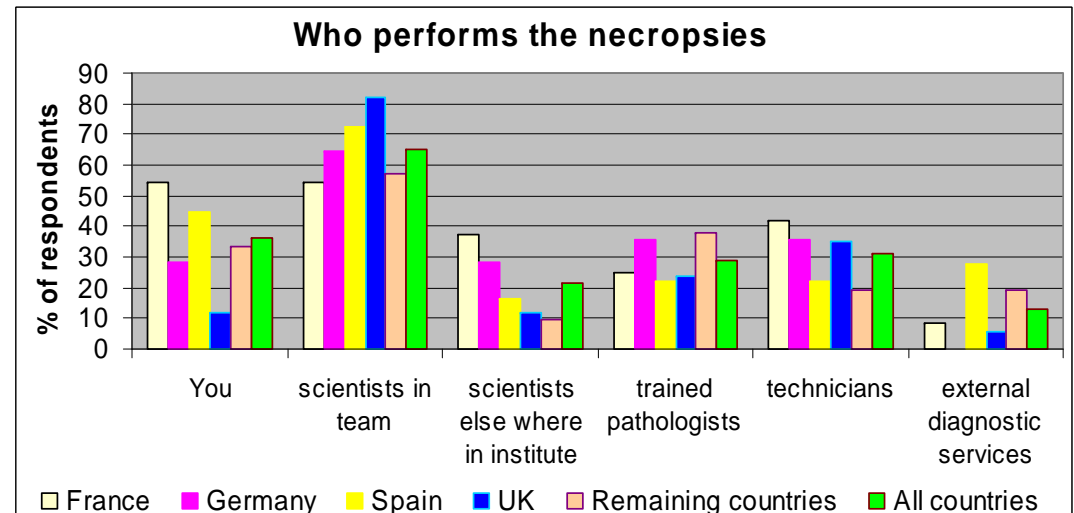
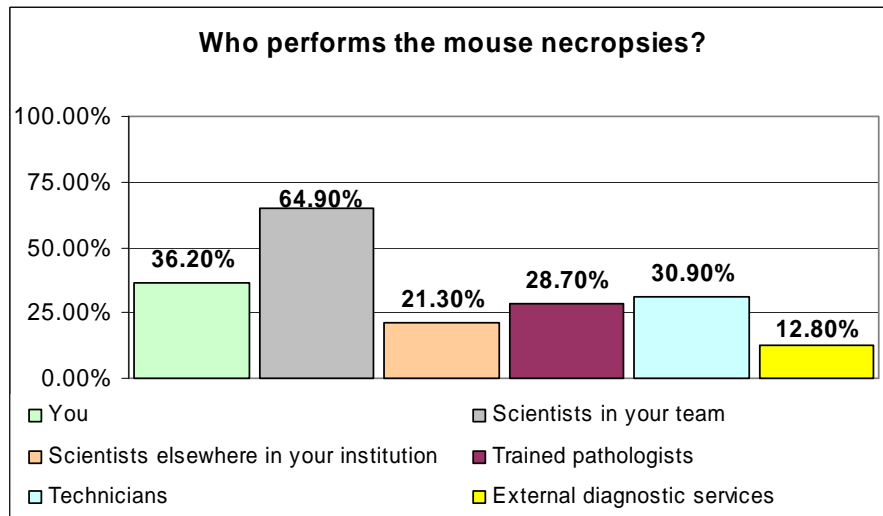
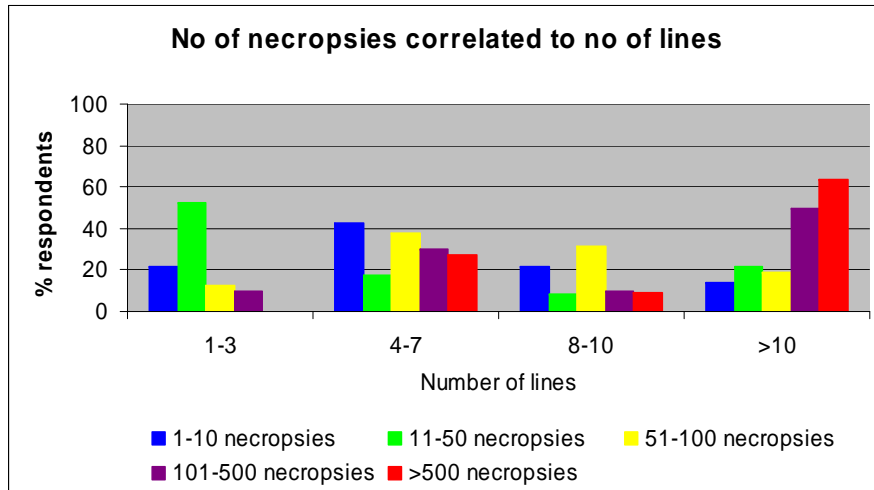


Mouse Necropsies



There was a good distribution of respondents covering the range of number of necropsies performed per year.

75.5% of respondents perform 76-100% of their mouse necropsies for experimental purposes (as opposed to health surveillance).

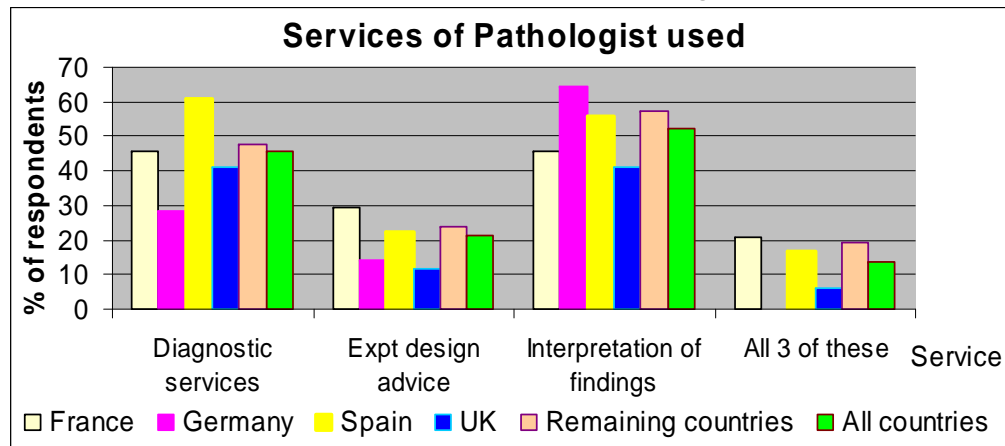


64.9% of respondents said their mouse necropsies were performed by scientists in their team. Only 28.7% use trained pathologists.

Section D: Pathology Requirements

Pathologist Services

45.7% of respondents use the services of a pathologist in their research on mice to provide diagnostic services for experimental animals.



21.3% of respondents use the services of a pathologist in their research on mice to provide advice in the design of experiments.

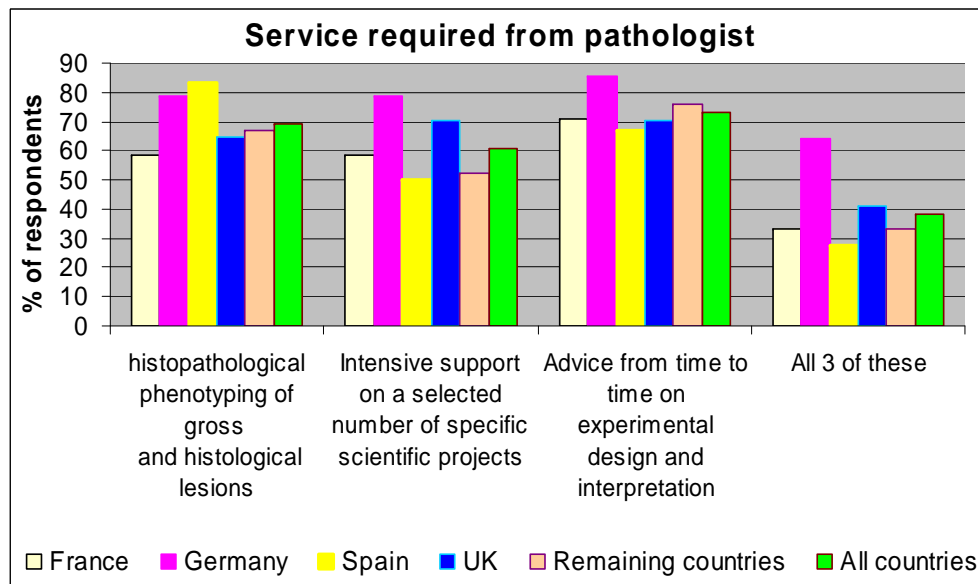
52.1% of respondents use the services of a pathologist in their research on mice to provide interpretation of findings.

Histopathology Support

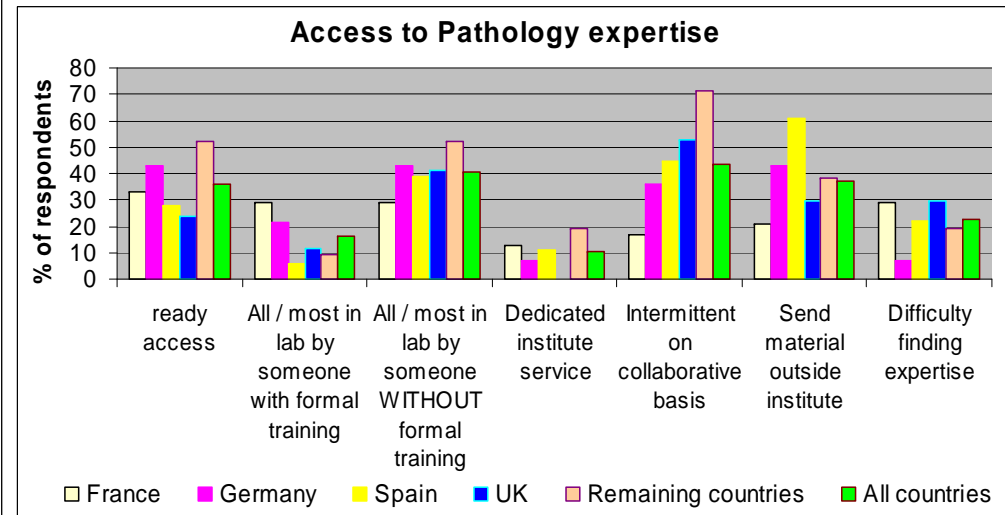
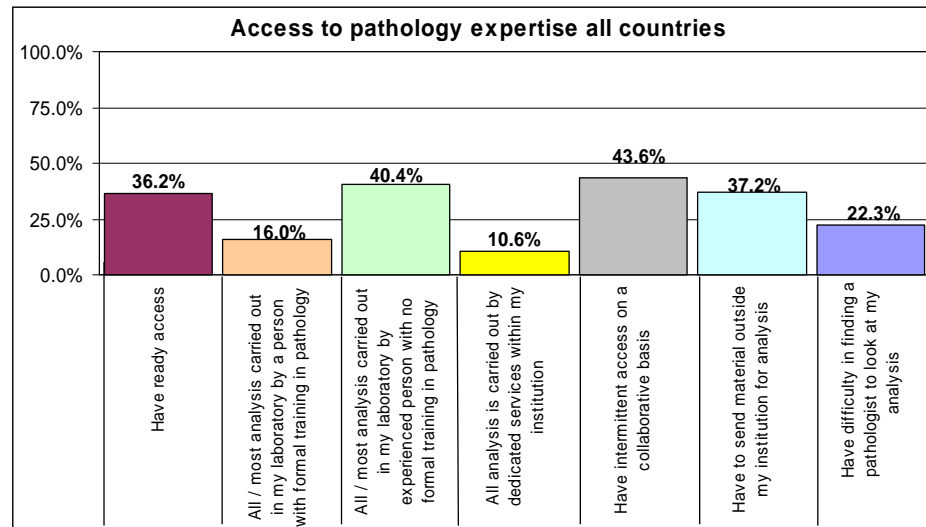
69.1% of respondents need complete histopathological phenotyping of gross and histological lesions.

60.6% of respondents need intensive support on a selected number of specific scientific projects.

73.4% of respondents need advice from time to time on experimental design and interpretation.

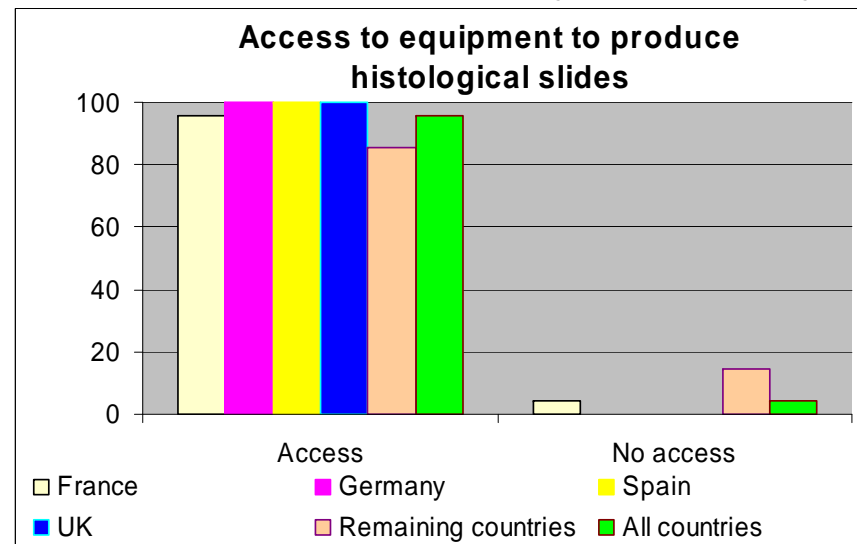


Access to Pathology Expertise



The three top responses when asked about their access to pathology services were:

1. Have intermittent access on a collaborative basis (43.6%)
2. All / most analysis is carried out at my laboratory by an experienced person with no formal training in pathology (40.4%)
3. Have to send materials outside my institute for analysis (37.2%)

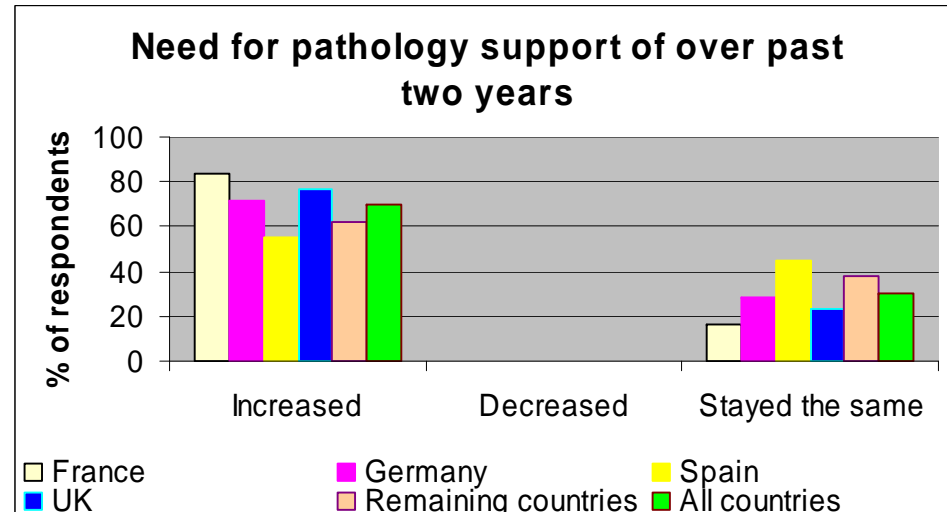
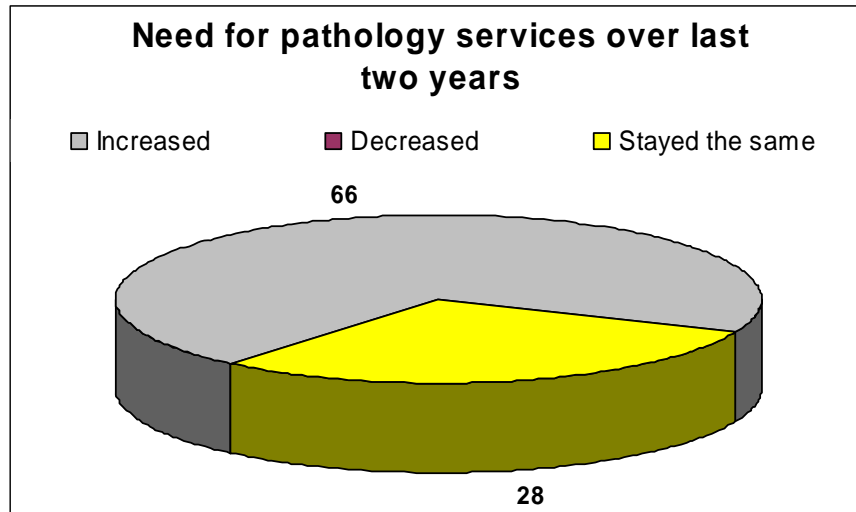


95.7% of respondents are able to access equipment for histological slide preparation.

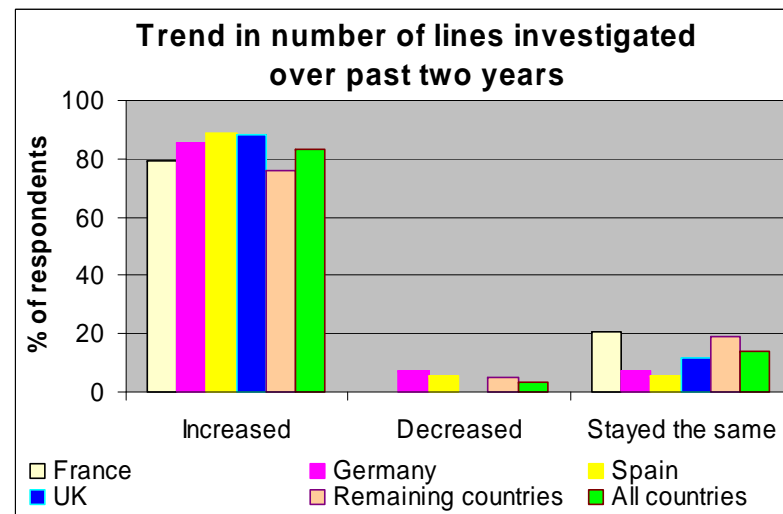
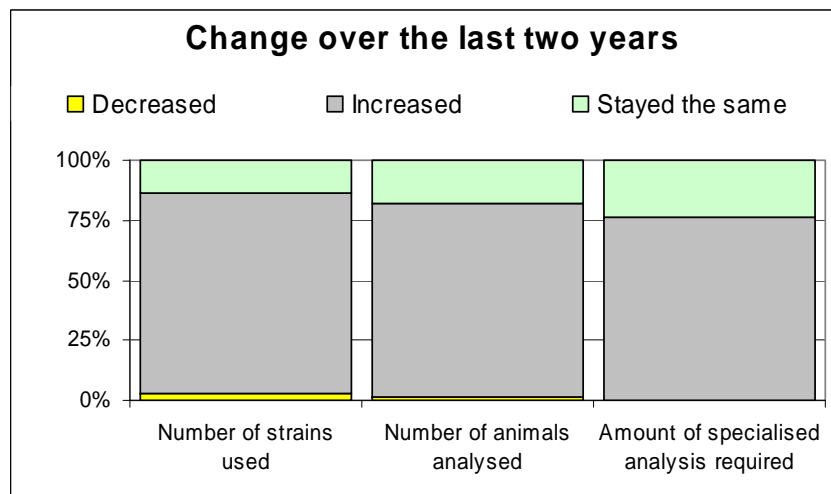
“The lack of specialised mouse pathology services is a severe handicap in the field. A number of potentially interesting phenotypes are missed as we only have routine access to basic veterinary services which are insufficient to provide publication quality assessments of pathology.”

Section E: Trends and the Future

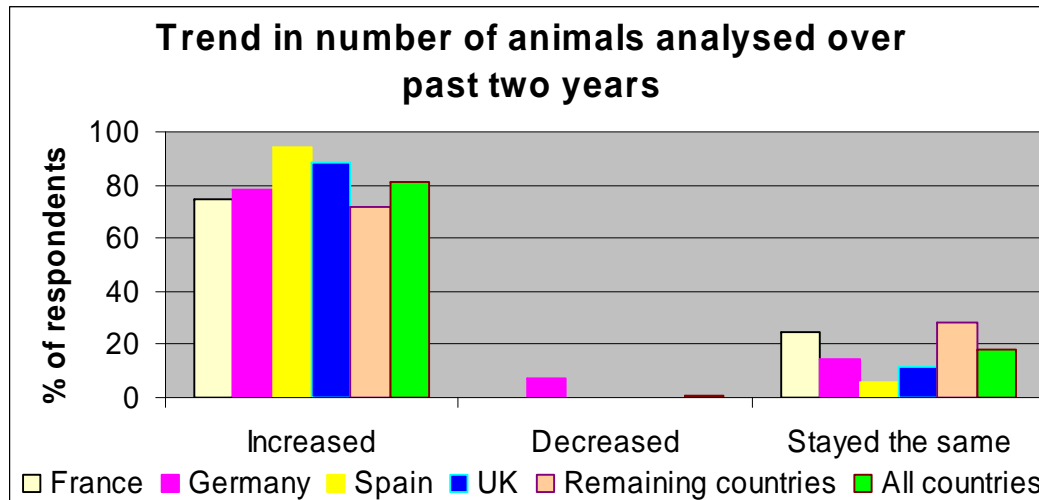
Workload



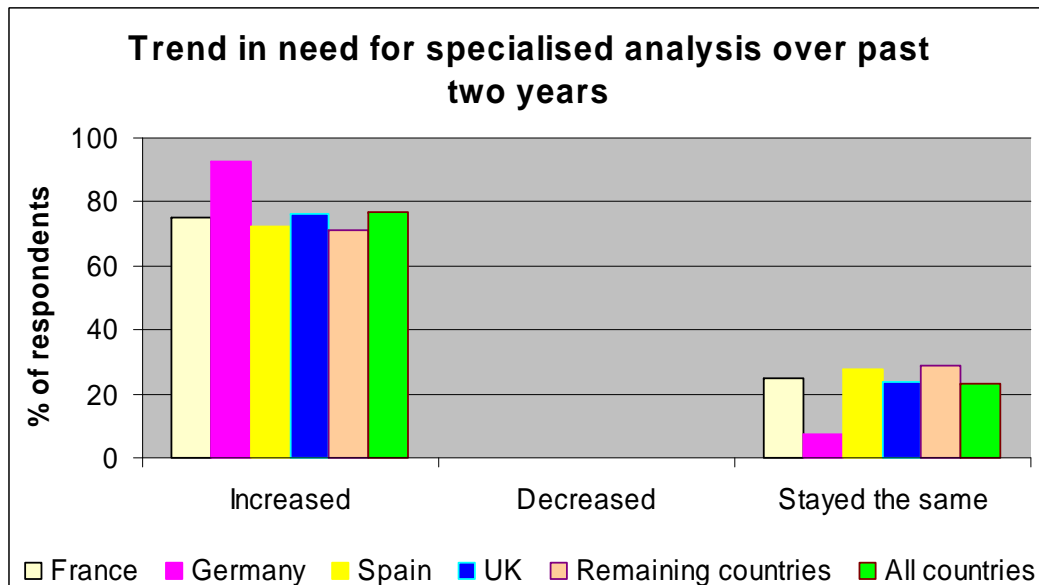
70.2% of respondents said that their need for pathology support has increased over the last two years. None of the respondents said their need had decreased.



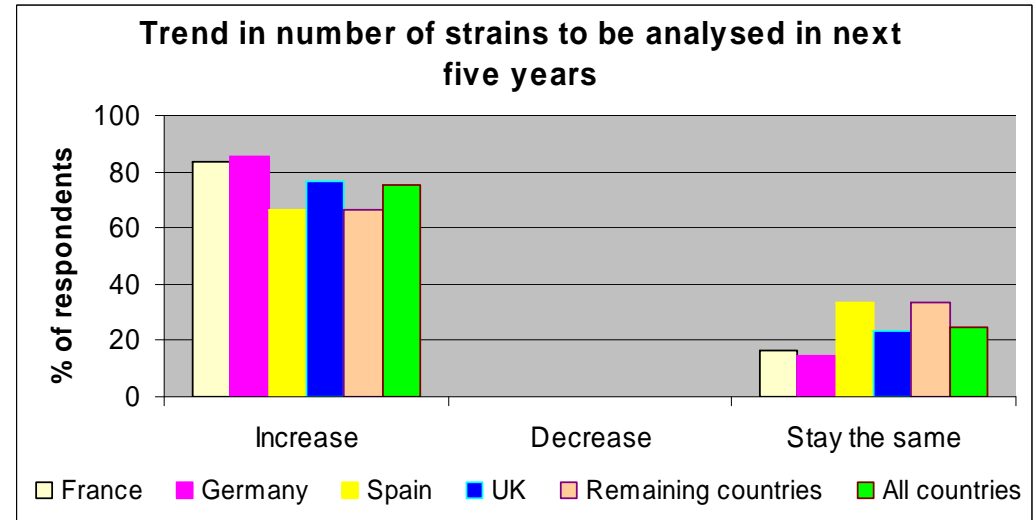
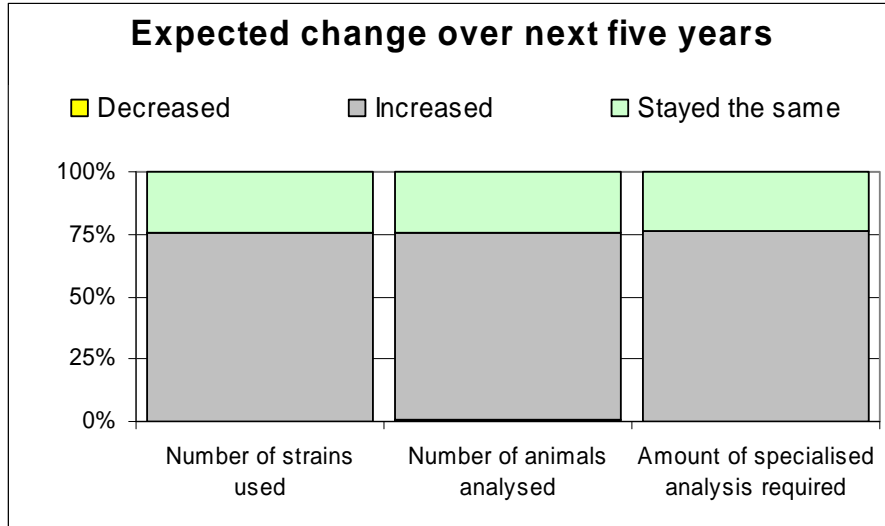
83.0% of respondents said that there has been an increase in the number of strains used.



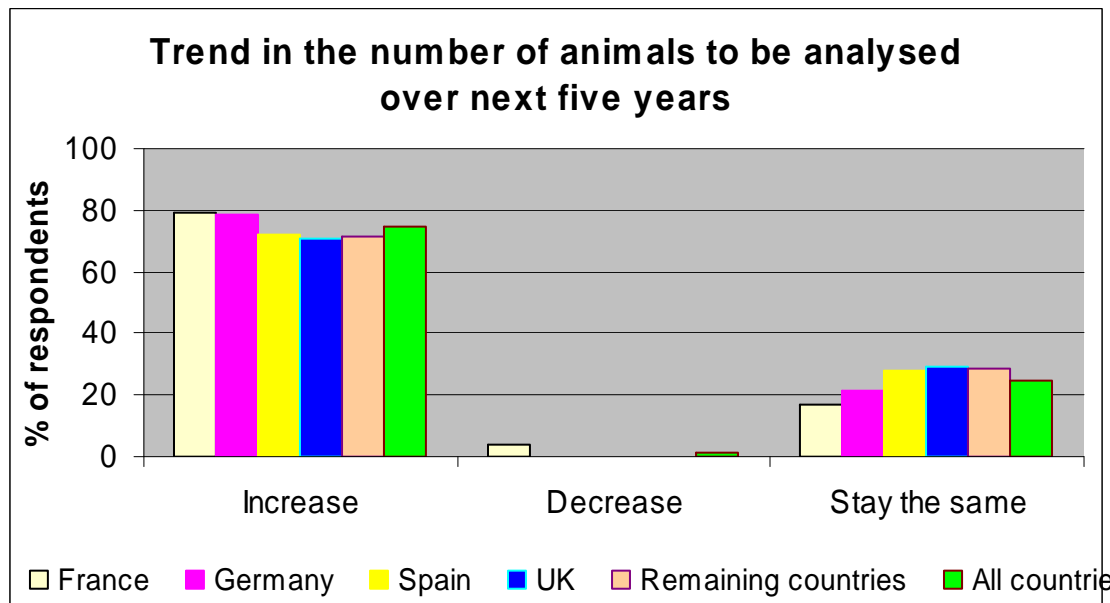
80.9% of respondents said that there has been an increase in the number of animals to be analysed. Only one said there has been a decrease.



76.6% of respondents said that there has been an increase in the amount of specialised analysis required. None said there has been a decrease.

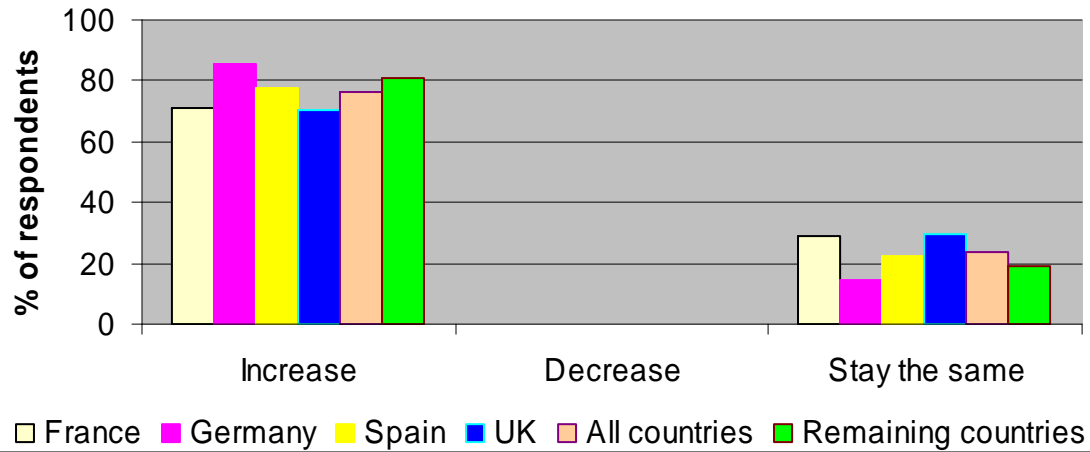


75.5% of respondents expect an increase in the number of strains used. None expect a decrease.



74.5% of respondents expect an increase in the number of animals to be analysed.

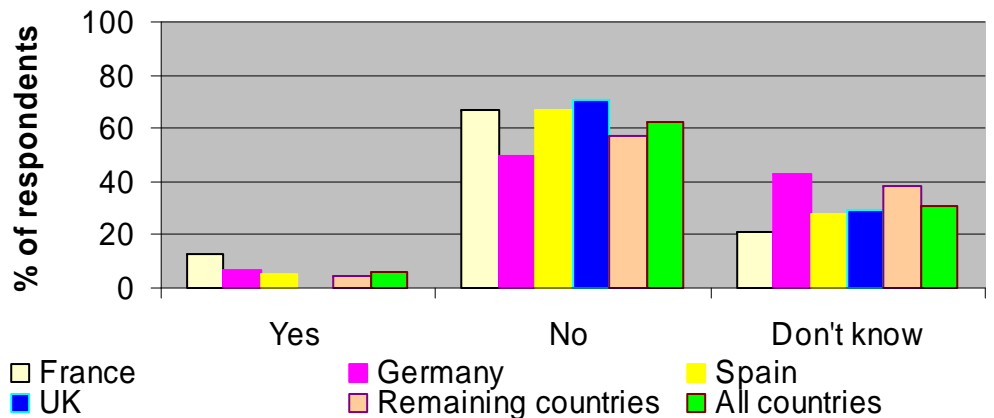
Trend in need for more specialised analysis over the next five years

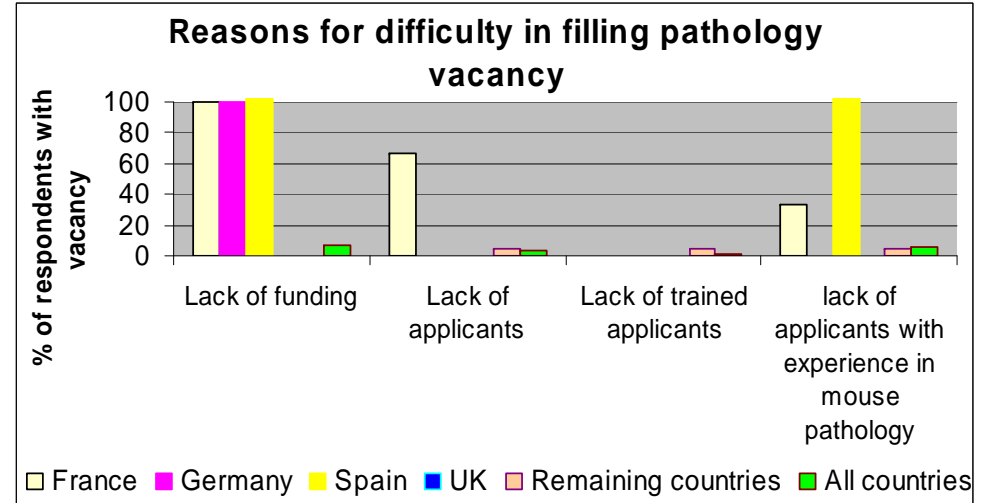
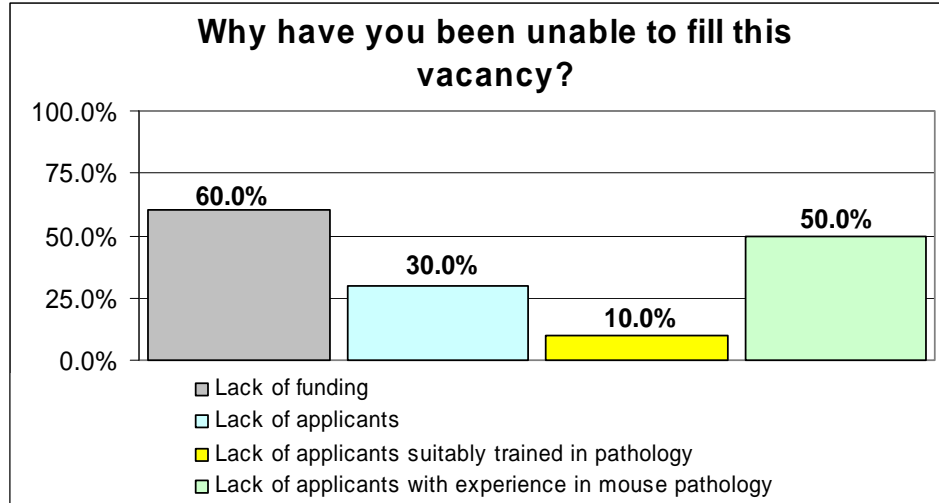


76.6% of respondents expect an increase in the amount of specialised analysis required. None expect a decrease.

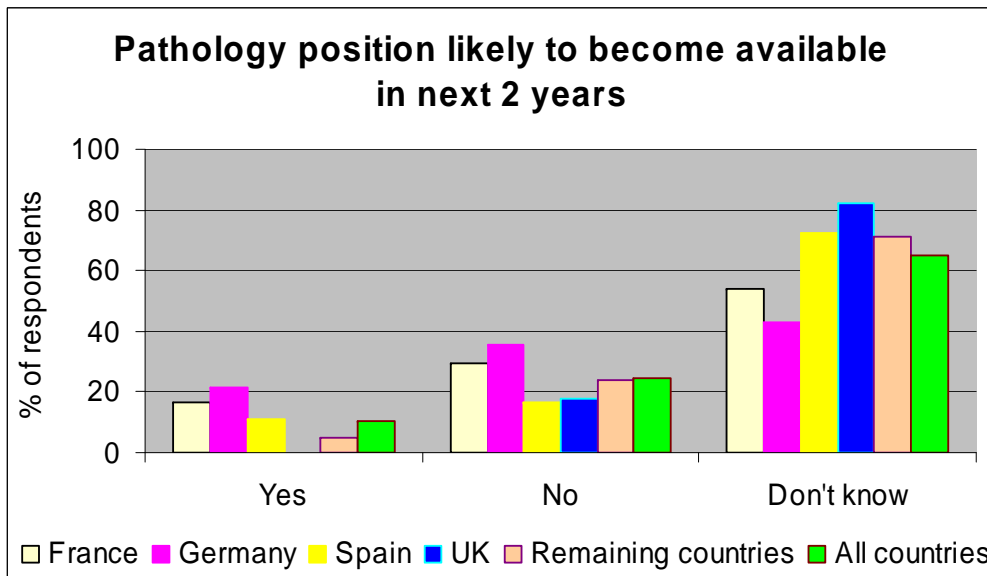
Vacancies

Current vacancy





6 of the 10 felt that they are unable to fill the vacancy due to lack of funding and 5 out of 10 because there is a lack of applicants with experience in mouse pathology.

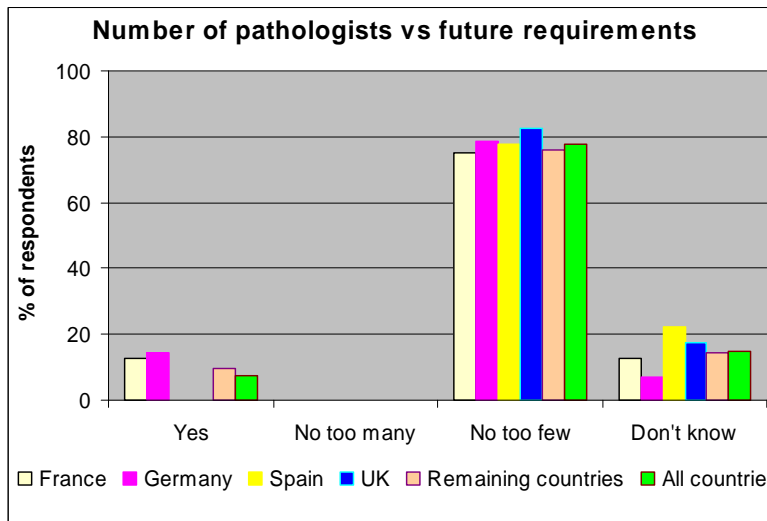
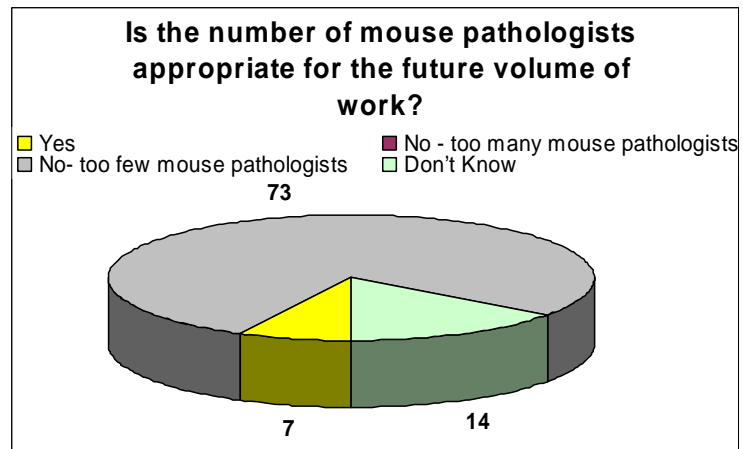
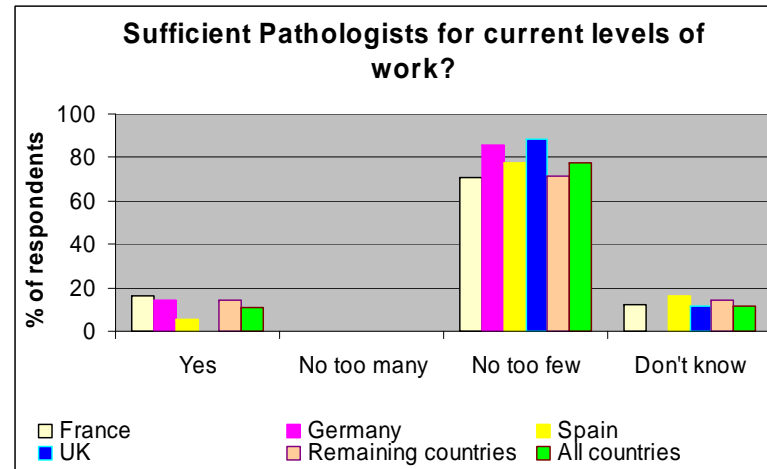
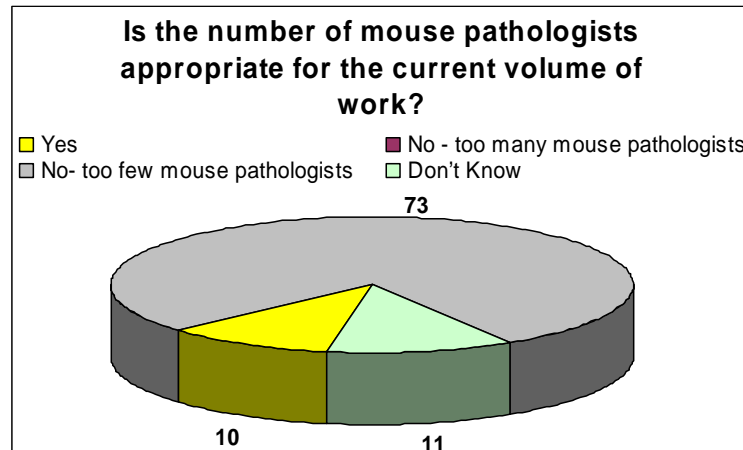


10.6% of respondents said that a position will be advertised in the next two years.

Number of Mouse Pathologists

77.7% of respondents felt that there are too few mouse pathologists for the current volume of work. None of the respondents felt that there are too many mouse pathologists.

When asked about the future the same number felt that there will be too few mouse pathologists for the future volume of work. Again, none felt that there will be too many mouse pathologists.



"Many of our experts in pathology have left the UK in recent years."

Conclusion

This report has been produced by Innervate Limited in collaboration with PRIME. The results will be made available on PRIME's website (www.prime-eu.org).

The data contained in this report will be used by PRIME to produce a strategy for possible future training programs and integration of resources in the European Union.

Committee

PRIME Pathology Committee:

Marco Breuer – The Netherlands Cancer Institute, The Netherlands

Pierre Dubus – University of Bordeaux, France

Laurence Fiette – University of Geneva, Switzerland

Leticia Quintanilla-Fend – GSF - National Research Center for Environment and Health, Germany

Marcello Raspa – Consiglio Nazionale delle Ricerche - Istituto di Biologia Cellulare, Italy

Björn Rozell – Karolinska Institutet, Sweden

Paul Schofield – University of Cambridge, UK

Madhuri Warren – The Wellcome Trust Sanger Institute, UK

PRIME Project Office:

Hilary Gates – Medical Research Council MGU, UK

Mandy Studley – Medical Research Council MGU, UK – prime@har.mrc.ac.uk

Innervate Ltd.:

Neil Bindemann – www.innervate.co.uk/consultancy.asp

Holly Small

Appendix 1 Questionnaires

<p>QUESTIONNAIRE FOR PATHOLOGISTS 2006</p>

Objectives

The objectives of this questionnaire are to collect information about the provision of mouse histopathology expertise in Europe with the aim of assessing how far demands for mouse diagnostic pathology are being met. This information will be used to prepare a strategy for possible future training programs and integration of resources. We are asking for information about your current position and activities and also about your training background. This information is strictly confidential and will be anonymised during the analysis of this survey so no one will be able to trace any specific answers back to you. By giving your time to answer this survey you are contributing to the future development of mouse pathology services especially mouse functional genomics and pathology training in Europe; the pathology and scientific community will be very grateful for your input.

*All information provided is confidential and will be protected
under the UK Data Protection Act 1998 governing access to private information*

A. YOUR SPECIALTY

1. Do you work in mouse pathology?
- | | |
|-----------|-----------------------|
| A.1.1 Yes | <input type="radio"/> |
| A.1.2 No | <input type="radio"/> |

If you have answered no to this question, please send this questionnaire to any colleagues who do work in this field

In order to assist us in targeting appropriate respondents it would be very helpful if you could supply the e-mail address of any other colleagues who carry out experimental pathology in your laboratory or pass on a copy of this questionnaire for them to complete. Thank you.

B. INFORMATION ABOUT YOUR PROFESSIONAL POSITION

IF YOU HOLD MORE THAN ONE APPOINTMENT, PLEASE SUPPLY INFORMATION ABOUT YOUR PRIMARY APPOINTMENT

- B.1** Name of your Institution:.....
- Type of Institution (please tick all that apply)
- B.1.1 University Veterinary College
- B.1.2 University NOT Veterinary College
- B.1.3 Independent Research Institute
- B.1.4 Government-funded Research Institute
- B.1.5 Hospital
- B.1.6 Pharmaceutical or Biotech Company
- B.1.7 Other. Please specify.....
- B.2** Do you belong to a department or unit of Pathology?
- B.2.1 Yes
- B.2.2 No
- B.3** Is your position :
- B.3.1 Permanent
- B.3.2 Fixed term contract
- B.3.3 Temporary
- B.3.4 Student/trainee
- B.3.5 Other – please specify.....
- B.4** For how long have you occupied this position?
- B.4.1 < 1 yr
- B.4.2 1-3 yrs
- B.4.3 3-6 yrs
- B.4.4 > 6 yrs
- B.5** Are you a
- B.5.1 Full-time employee
- B.5.2 Part time employee
- B.6** If you are part-time do you hold another pathology post?
- B.6.1 Yes
- B.6.2 No
- B.7** For how long have you worked in pathology overall (including this appointment)?
- B.7.1 < 1 yr
- B.7.2 1-3 yrs
- B.7.3 3-6 yrs
- B.7.4 > 6 yrs

C. WHAT IS YOUR TRAINING BACKGROUND

C.1 Primary Academic qualification (First Degree)

- C.1.1 Veterinary Clinical
- C.1.2 Medical Clinical
- C.1.3 Biology
- C.1.4 Genetics
- C.1.5 Biochemistry/molecular genetics
- C.1.6 Other – please specify.....

C.2 Higher qualifications. Please tick all that apply.

- C.2.1 Doctor of Philosophy (PhD/ D Phil)
- C.2.2 Certification by, or Membership/Fellowship of, a National or International Specialist Accreditation Body for pathology e.g. the Royal College of Pathologists (MRCPATH), European College of Veterinary Pathologists (ECVP) or similar.

C.2.3 Please give details if you are happy to do so.....

C.3 How many years of experience do you have (post qualification)?

	<2 yrs	2-5 yrs	6-10 yrs	>10 yrs
C.3.1 In basic science/molecular biology/genetics:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C.3.2 In clinical/veterinary medicine:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C.3.3 In veterinary/medical pathology:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C.3.4 In lab animal pathology:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C.3.5 In mouse pathology only:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

C.4 Do you believe that your work in mouse pathology requires specialised continued education in addition to your qualifications?

- C.4.1 Yes
- C.4.2 No

C.5 Have you received such training during the tenure of your post to date?

- C.5.1 Yes
- C.5.2 No

D. ACTIVITIES AS A PATHOLOGIST

D.1 What activity occupies the majority of your time?

- D.1.1 Human routine diagnostic pathology
- D.1.2 Veterinary routine diagnostic pathology
- D.1.3 Toxicologic pathology
- D.1.4 Basic Research involving experimental mouse pathology
- D.1.5 Other – please specify:.....

D.2 What kind of mouse pathology support do you offer? (Please tick all that apply)

- D.2.1 Complete pathology workup for high throughput phenotyping

- D.2.2 Diagnostic pathology on a selected number of collaborative scientific projects
- D.2.3 Periodic advice to other researchers
- D.2.4 You carry out diagnostic work mainly on your own scientific projects
- D.2.4.1 If you selected D.2.4 are you the principal investigator?
- D.2.4.1.1 Yes
- D.2.4.1.2 No
- D.2.5 Other – please specify.....
- D.3** Do you consider yourself to have special expertise in one particular organ system or specific pathology
- D.3.1 Yes
- D.3.2 No
- D.3.1.1 If “Yes” please give brief details.....
- D.4** Please estimate what percentage of your time you spend practicing mouse pathology (Necropsies, reading slides etc.) in spontaneous disease monitoring (health surveillance).
- D.4.1 < 25%
- D.4.2 25-50%
- D.4.3 50-75%
- D.4.4 > 75%
- D.5** Please estimate what percentage of your time you spend working on experimental mouse pathology?
- D.5.1 < 25%
- D.5.2 25-50%
- D.5.3 50-75%
- D.5.4 > 75%
- D.6** How many mutant or genetically manipulated mouse lines do you see per year?
- D. 6.1 1-3
- D. 6.2 4-7
- D. 6.3 8-10
- D. 6.4 >10
- D.7** How many mouse necropsies do you perform per year for experiment related purposes?
- D.7.1 1-10
- D.7.2 11-50
- D.7.3 51-100
- D.7.4 101-500
- D.7.5 >500
- D.7.6 Unsure
- D.7.5.1 If you ticked “D.7.5 >500” – please specify an approximate number.....
- D.8** How many mouse organs (or whole embryos) do you examine per year?
- D.8.1 <100
- D.8.2 101-200
- D.8.3 201-1000

- D.8.4 1001-5000
- D.8.5 5001-10000
- D.8.6 >10000
- D.8.7 Unsure

D.9 How many slides from mice do you read per year?

- D.9.1 <100
- D.9.2 101-500
- D.9.3 501-1000
- D.9.4 1001-2000
- D.9.5 2001-5000
- D.9.6 >5000
- D.9.7 Unsure

D.10 Do you believe that you would benefit from additional training?

- | | Yes | No |
|--|-----------------------|-----------------------|
| D.10.1 In mouse genetics: | <input type="radio"/> | <input type="radio"/> |
| D.10.2 In mouse husbandry: | <input type="radio"/> | <input type="radio"/> |
| D.10.3 In mouse biology: | <input type="radio"/> | <input type="radio"/> |
| D.10.4 In strain specific background pathology: | <input type="radio"/> | <input type="radio"/> |
| D.10.5 In the special pathology of selected organ systems: | <input type="radio"/> | <input type="radio"/> |
| D.10.6 Other related training | | |
| D.10.6.1 Please specify..... | | |

D.11 Is training in mouse pathology currently being offered in your institution?

- D. 11.1 Yes
- D. 11.2 No

D.12 Might your institution be in a position to offer training in mouse pathology at some point in the next five years?

- D. 12.1 Yes
- D. 12.2 No

If you selected D.12.2 “No” please proceed to section E, otherwise please continue below

D.13 What might be the source of funding for the mouse pathology training?

- D.13.1 Funds from within your institution
- D.13.2 Specific external grant for training courses
- D.13.3 As part of a wider grant (e.g. an EU-funded project)
- D.13.3 University/vet school/medical school funding
- D.13.4 Government/public/research council funding
- D.13.5 Other-please specify.....

E. TRENDS AND THE FUTURE

E.1 How has your workload changed over the last two years?

- E.1.1. Increased

- E.1.2. Remained at the same level
- E.1.3. Decreased
- E.2** Do you expect it to increase over the next five years?
- E.2.1 Yes
- E.2.2 No
- E.2.3 Don't know
- E.3** Is there currently a vacant position for a pathologist to work part or full-time on mouse pathology in your Company/Institution?
- E.3.1 Yes
- E.3.2 No
- If you answered No please continue at question 6. Otherwise continue below:
- E.4** For how long has this position been vacant?
- E.4.1 < 6 mths
- E.4.2 6 mths-1 yr
- E.4.3 > 1 yr
- E.5** Why have you been unable to fill this vacancy?
- E.5.1 Lack of funding
- E.5.2 Lack of applicants
- E.5.3 Lack of applicants suitably trained in pathology
- E.5.4 Lack of applicants with experience in mouse pathology
- E.5.5 Unattractive salary or conditions of work
- E.6** Will such a position be advertised in the next two years?
- E.6.1 Yes
- E.6.2 No
- E.6.3 I don't know
- E.7** In your opinion, what are the minimum qualifications for the practice of mouse pathology? (Please tick all that apply)
- E.7.1 Veterinary Degree
- E.7.2 Medical Degree
- E.7.3 Biological science degree
- E.7.4 Post graduate specialization in pathology
- E.7.5 Specialist qualification in Human Pathology
- E.7.6 Specialist qualification in Veterinary Pathology
- E.7.7 PhD
- E.8** In your opinion is the number of mouse pathologists currently active in your field appropriate for the current volume of work?
- E.8.1 Yes
- E.8.2 No - too many mouse pathologists
- E.8.3 No - too few mouse pathologists
- E.8.3 Don't know

If you selected E.8.3 “Too few mouse pathologists” what do you think the reasons are. Please tick all that apply

- E.8.3.1 Too few pathologists available
- E.8.3.2 Too few pathologists with appropriate qualifications available
- E.8.3.3 Insufficient funding or posts available
- E.8.3.4 Salary uncompetitive
- E.8.3.5 Demands/workload of the job too high
- E.8.3.6 Job is undemanding
- E.8.3.7 Insufficient opportunities for career development
- E.8.3.8 Insufficient opportunities to pursue a research career as well as perform routine/service pathology investigations
- E.8.3.9 Too many formal requisites to be acknowledged as a mouse pathologists
- E.8.3.10 Lack of visibility of pathology as a “modern” scientific branch
- E.8.3.11 Other - please specify

E.9 In your opinion will the number of mouse pathologists currently active in your field be appropriate for the future?

- E.9.1 Yes
- E.9.2 No - too many mouse pathologists
- E.9.3 No - too few mouse pathologists
- E.9.3 Don't know

If you selected E9.3 “Too few mouse pathologists” what do you think are the reasons are?

- E.9.3.1 Too few pathologists available
- E.9.3.2 Too few pathologists with appropriate qualifications available
- E.9.3.3 Insufficient funding or posts available
- E.9.3.4 Salary uncompetitive
- E.9.3.5 Demands/workload of the job too high
- E.9.3.6 Job is undemanding
- E.9.3.7 Insufficient opportunities for career development
- E.9.3.8 Insufficient opportunities to pursue a research career as well as perform routine/service pathology investigations
- E.9.3.9 Too many formal requisites to be acknowledged as a mouse pathologists
- E.9.3.10 Lack of visibility of pathology as a “modern” scientific branch
- E.9.3.11 Other - please specify.....

F. COMMENTS

We would be grateful for any further comments you may wish to make on any issues raised in this questionnaire:

.....

.....

.....

.....
.....
.....

G. GENERAL INFORMATION

Please complete the following information for some general statistical analysis. All information is confidential and protected under the UK Data Protection Act 1998 governing access to private information.

Name

Surname.....

Male Female

Year of birth 19..

Nationality: [\(pop-up menu\)](#)

Country of residence : [\(pop-up menu\)](#)

E-mail:

We thank you very much for answering this questionnaire.

You will soon find the results of this survey on the PRIME website - www.prime-eu.org

QUESTIONNAIRE FOR
PRINCIPAL INVESTIGATORS

2006

Objectives

The objectives of this questionnaire are to collect information about the provision of mouse histopathology expertise in Europe with the aim of assessing how far demands for mouse diagnostic pathology are being met. We are asking for information about the volume of diagnostic work you are generating and how readily you are able to access the services of a trained pathologist. This information will be used to prepare a strategy for possible future training and integration of resources. The information is strictly confidential and will be anonymised during the analysis of this survey, so no answers will be traceable back to you. By giving your time to answer this survey you are contributing to the future development of mouse functional genomics in Europe, and the pathology and scientific community will be very grateful for your input.

*All information provided is confidential and will be protected
under the UK Data Protection Act 1998 governing access to private information*

A. YOUR SPECIALTY

A.1 Does your research involve the analysis of mutant or genetically manipulated mice?

A.1.1 Yes

A.1.2 No

If not, it would help our planning if you could send this questionnaire to any colleagues who do work in this field or supply their e-mail details so we may contact them directly

B. INFORMATION ABOUT YOUR PROFESSIONAL POSITION

B.1 Name of your Institution:.....

B.2 Type of Institution

- B.2.1 University Veterinary College
- B.2.2 University NOT Veterinary College
- B.2.3 Independent Research Institute
- B.2.4 Government funded Research Institute
- B.2.5 Hospital
- B.2.6 Pharmaceutical or Biotech Company
- B.2.7 Other please specify.....

C. INFORMATION ABOUT YOUR LABORATORY’S TURNOVER OF MOUSE SAMPLES

C.1 How many individual mice does your laboratory analyze per year?

- C.1.1 <20
- C.1.2 20-50
- C.1.3 50-100
- C.1.4 100-500
- C.1.5 500-1000
- C.1.6 >1000

C.1.6.1 If you have selected C.1.6 “>1000”, please specify an approximate number.....

C.2 How many mutant or genetically manipulated mouse lines do you need to analyze per year?

- C.2.1 1-3
- C.2.2 4-7
- C.2.3 8-10
- C.2.4 >10

C.3 How many mouse necropsies do you need to perform per year?

- C.3.1 1-10
- C.3.2 11-50
- C.3.3 51-100
- C.3.4 101-500
- C.3.5 >500

C.4 Of these how many are for experimental purposes (as opposed to health surveillance)?

- C.4.1 1-10
- C.4.2 11-50
- C.4.3 51-100
- C.4.4 101-500
- C.4.5 >500

C.5 Who performs the mouse necropsies?

- C.5.1 You
- C.5.2 Scientists in your team
- C.5.3 Scientists elsewhere in your institution
- C.5.4 Trained pathologists
- C.5.5 Technicians
- C.5.6 External diagnostic services

D. INFORMATION ABOUT YOUR PATHOLOGY REQUIREMENTS**D.1 Do you routinely use the services of a Pathologist in your research on mice to (please tick all that apply)**

- | | Yes | No |
|---|-----------------------|-----------------------|
| D.1.1 Provide diagnostic services for experimental animals: | <input type="radio"/> | <input type="radio"/> |
| D.1.2 Provide advice in the design of experiments: | <input type="radio"/> | <input type="radio"/> |
| D.1.3 Provide interpretation of findings: | <input type="radio"/> | <input type="radio"/> |

D.2 What kind of histopathology support do you need? Please tick all that apply

- | | Yes | No |
|--|-----------------------|-----------------------|
| D.2.1 Complete histopathological phenotyping of gross
and histological lesions: | <input type="radio"/> | <input type="radio"/> |
| D.2.2 Intensive support on a selected number of
specific scientific projects: | <input type="radio"/> | <input type="radio"/> |
| D.2.3 Advice from time to time on experimental design
and interpretation: | <input type="radio"/> | <input type="radio"/> |

D.3 Are you able to access pathology expertise? Please check all of the following which apply:

- D.3.1 I have ready access
- D.3.2 All or most of my analysis is carried out by a person/people in my own laboratory with a formal training in Pathology
- D.3.3 All or most of my analysis is carried out in my laboratory or Institute by an experienced person who does not have formal training in Pathology
- D.3.4 All my analysis is carried out by dedicated services within my Institution
- D.3.5 I have intermittent access on a collaborative basis
- D.3.6 I have to send material outside my institution for analysis
- D.3.7 I have difficulty in finding a pathologist to look at my animals

D.4 Are you able to access equipment for histological slide preparation?

- D.4.1 Yes
- D.4.2 No

E. TRENDS AND THE FUTURE

E.1 Has your need for pathology support changed over the last two years?

- E.1.1 Increased
- E.1.2 Decreased
- E.1.3 Stayed the same

E.2 How have the following changed?

- | | Increased | Decreased | Stayed the same |
|---|-----------------------|-----------------------|-----------------------|
| E.2.1 Number of strains used: | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| E.2.2 Number of animals to be analyzed: | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| E.2.3 More specialized analysis: | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

E.3 Do you expect the following to change over the next five years?

- | | Increase | Decrease | Stay the same |
|--|-----------------------|-----------------------|-----------------------|
| E.3.1 Number of strains used: | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| E.3.2 Number of animals to be analyzed: | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| E.3.3 Amount of specialized analysis required: | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

E.4 Does your company/institution currently have a vacant position for a pathologist?

- E.4.1 Yes
- E.4.2 No
- E.4.3 Don't know

If you answered 'No' or 'Don't know' to question 4, please go straight to question 7

E.5 For how long has this position been vacant?

- E.5.1 < 6 mths
- E.5.2 6 mths-1 yr
- E.5.3 > 1 yr

E.6 Why have you been unable to fill this vacancy? Please tick all that apply

- E.6.1 Lack of funding
- E.6.2 Lack of applicants
- E.6.3 Lack of applicants suitably trained in pathology
- E.6.4 Lack of applicants with experience in mouse pathology

E.7 Will such a position be advertised in the next two years?

- E.7.1 Yes
- E.7.2 No
- E.7.3 I don't know

E.8 Do you think the number of pathologists currently in your field is appropriate for the current volume of work?

- E.8.1 Yes
- E.8.2 No - too many mouse pathologists
- E.8.3 No - too few mouse pathologists
- E.8.4 I don't know

E.9 Do you think the number of pathologists currently in your field is appropriate for the future volume of work?

- E.9.1 Yes

- E.9.2 No - too many mouse pathologists O
 - E.9.2 No - too few mouse pathologists O
 - E.9.4 I don't know O
-

COMMENTS

We would be grateful for any further comments you may wish to make on the above:

.....

.....

.....

.....

.....

.....

G. GENERAL INFORMATION

Please complete the following information for some general statistical analysis. All information is confidential and protected under the UK Data Protection Act 1998 governing access to private information.

Name

Surname.....

Male Female

Year of birth 19..

Nationality: [\(pop-up menu\)](#)

Country of residence : [\(pop-up menu\)](#)

E-mail:

In order to assist us in targeting appropriate respondents to a more detailed questionnaires about mouse pathology it would be very helpful if you could send the email address of the person who carries out most of your pathology to the PRIME Secretariat, or pass this email address (prime@har.mrc.ac.uk) to them and ask them to contact us if they are happy to do so. Thank you.

We thank you very much for answering this questionnaire

You will soon find the results of this survey on the PRIME website – www.prime-eu.org

Appendix 2

Mouse Pathologists' Qualifications

Of the national pathology body qualifications 44 respondents specified their higher qualifications as follows:

ACVP member
 AIP
 Certified Veterinary Pathologist (Germany)
 DESV
 DESV in Pathology
 DESV in Pathology, MSc biotechnology, EVCP certified
 DESV in Veterinary Pathology x2
 DVM
 ECVP x9
 ECVP, FRCPath, BVMS, DVM
 ECVP, MRCPath
 ECVP, RCPPath
 Facharzt für Pathologie x2
 FIATP
 FRCPath x8
 FRCPath (tox)
 FRCPath, MRCVS
 French diploma of veterinary specialist of pathology
 MBChB
 MD x2
 MPCPath
 MRCPath
 MS (pathology), MPH, ACVP
 Residency in Veterinary Pathology (Paris, France)
 Specialist in Pathology
 Spezialtieraerzt FVH für Pathologie, Schweizerische Vereinigung für Tierpathologie

Key:

ACVP	American College of Veterinary Pathologists
AIP	Associate in Pathology
BVMS	Bachelor of Veterinary Medicine and Science
DESV	Diploma in Higher Veterinary Studies
DVM	Doctor of Veterinary Medicine
ECVP	European College of Veterinary Pathologists
FIATP	Fellow of the International Academy of Toxicologic Pathology
FRCPath	Fellow of the Royal College of Pathologists
MBChB	Bachelor of Medicine and Bachelor of Surgery degrees
MD	Doctor of Medicine
MPH	Masters in Public Health
MRCPath	Member of the Royal College of Pathologists
MRCVS	Member of the Royal College of Veterinary Surgeons
MS	Master of Science
PhD	Doctor of Philosophy

Appendix 3

Mouse Pathologists' Special Expertise

Animal models of inflammation, investigative toxicology
Atherosclerotic lesions, gastrointestinal pathology
Blood neoplasms
Bone marrow
Brain
Breast cancer and lung cancer
Cancer pathology but actually I do a lot of non cancer pathology including cardiovascular system and neuropathology.
Cancers
Carcinogenicity studies
Cardiovascular system
Central nervous system
Chronic bioassays and cardiac pathology
Developmental biology in transgenic mice (gain of function and loss of function mutations), development of melanocyte lineage, interstitial cells of Cajal of the intestine and others.
Developmental defects and pathology of reproduction
Domestic animal pathology
Drug induced lesions
Endocrine
Eye and ear, brain
Foetopathology, reproductive disorders
Gastrointestinal tract
General and Toxicopathology, Neuropathology, ISH, IHC
Genetically engineered mice
GI, immune, kidney
Grafts
Haematopathology, Gastrointestinal tract, Gynaecopathology, skin diseases, bone
Haemolymphatic system
Hematopathology x2
Human: aspiration cytopathology; Mouse: thyroid pathology
Immunology
Kidney and urinary system
Lab animals models of infectious diseases
Liver Pathology/Carcinogenesis
Liver, prostate, skin
Liver, GI tract
Lung
Male reproductive tractus
Mammary gland in particular but the whole body in general
Mammary tumours x2
Middle ear
Muscle x2
Nervous system x3
Neuropathology
Neuropathology and lymphoid system x2
Pancreatic pathology
Pathology of the diffuse endocrine system
Poultry pathology and skeletal muscle pathology
Respiratory
Respiratory system, general tumor pathology
Respiratory tract x2
Skin x2
Thyroid development
Thyroid, Biopharmaceuticals
Tumors; models

Appendix 4

Full comments received from Mouse Pathologists

"Most experimental pathologists are in the pharmaceutical industry, where the job is well rewarded and interesting although they have less time to publish a lot of material. Academia is not really willing to provide the infrastructure needed to make it an interesting job in academic institutes - except in some US colleges. Very few medics have the time. There is less interest among medical pathologists in the UK because of all the Home Office issues to get a project licence and Universities do not make it easy by providing the infrastructure - so they just don't bother. Basic research workers often don't see the need and therefore are unwilling to support the costs. Academic salaries usually do not compete with those in the pharmaceutical industry (where there is also a shortage of good mouse pathologists - particularly as now many are reaching retirement age)."

"Someone such as myself, training for certification, but from a biology background, falls between some of the questions."

"I feel the issue is broader than just mouse pathology. Europe should have mechanisms in place to see that the training of pathologists is as vital to research as the training of a person to PhD level. I have been looking at Marie Curie's as potentials to address this issue but always stumble as pathology is considered a "professional training" unlike someone who may be trained in "neurosciences or neuroinflammation". We have structures within Europe (i.e. training site) which would gladly cooperate to train a specialist in pathology and focus these people in relevant areas such as mouse pathology. But to solely train a pathologist through mouse pathology alone, I personally don't believe is desirable."

"In my opinion, we have to preserve absolutely the diversity of Primary Academic qualification i.e. veterinary, biology or medical because all three need experimental pathologists, because they have complementary backgrounds & approaches. But in pharmaceutical industry we observe, unfortunately, a reinforcement of veterinary Primary Academic qualification as the single one. Corporatism of recruiters obliges..."

"I think it is very difficult to get the appropriate training as a human pathology trainee. Animal rights activity does put me off a bit."

"Human pathologists are precious for analyses of mice modelling human diseases."

"I would be very interested in participating in such debates. I would be very interested in knowing the results of such questionnaires. I would really appreciate being informed on the following events. I really love my job and could participate in receiving students to form them. Your initiative is a very good one!"

"In my institution you are supposed to cover rat, mice and dog toxico-pathology, therefore, some of the questions regarding "mouse pathologist" were difficult to answer."

"We largely perform electron microscopy of murine Prion diseases. This form largely reports numbers of necropsies/tissue slides performed and therefore does not accurately reflect the amount of effort we deploy on murine research."

"The primary reason for an absence of mouse pathologists in British biomedical research is that as a discipline it falls between veterinary and human pathology. Vets are not exposed to species used in biomedical research and view them as the domain of human biomedical research. Human pathologists view them as animals and therefore the domain of vets. Hence there is no pool of interested pathologists."

"In the next 5 year plan my institute is to implement high throughput pathology (within a primary phenotyping programme as pathology screening rather than detailed pathology). This will mean that the current workload figures will increase by 10 fold - estimated 10,800 necropsies/year starting from 2006 rising to 17,900 necropsies in 2011. Blocks will increase from 28,000 from 2006 to 50,000 in 2011; and sections to ~41,500 in 2006 to 68,000 in

2011. There will also be additional immunohistochemistry and in situ hybridisation requirements. In 2005 within our current unit we performed 1128 necropsies processed tissues to 6734 paraffin blocks and cut 9524 sections. I operate a group with one part time in house pathologist (myself) plus two FTE worth of technical staff (biomedical scientists) - one is my lab manager who is also part time. We offer expertise in all histochemical techniques, including special stains, immunohistochemistry and tissue array manufacture as well as routine processing. We are currently understaffed for our current workload compared with workload/staffing levels in other mouse pathology units in Europe and the US. My institute is currently reviewing the pathology situation and is looking to expand pathology throughput to the levels above by internal movement of staff between teams rather than recruitment of additional staff, plus outsourcing of both necropsies technical processing and annotation of slides to private companies both in the UK and abroad. There is currently no firm commitment from the institute in offering in house training posts for pathologists or providing financial backing and it is unclear whether funding is to be made available for additional in house pathologists to be recruited. All the mouse pathologist colleagues that I have spoken to both in Europe and the US feel that the cost/benefit ratio of pathology as primary screening is not worthwhile. We and others have shown however that detailed pathology as secondary phenotyping is highly worthwhile and that it contributes significantly to high quality publications. The best short term solution to the staffing crisis seems to be through training - I have had 4 trainees in the last few years that are keen to train in mouse pathology and are suitably qualified but I have had to turn them all down since there is no interest or financial backing to set up training positions at my institute. Similarly there are qualified medical pathologists who are willing to look at slides for financial payment, but they are not attracted to an in-house pathology position because they see even the current workload levels as being too demanding, and the environment to be negative. Another serious issue is lack of career development or support for (mouse) pathologists to set up their own research programme alongside doing routine service work. This is the only attraction for career academics to continue in research pathology. There has been a resurgence of interest and support from funding agencies e.g. CRUK to support academic/research pathology in order to train senior clinical academics who can run their own research group, but there seems to be no precedent to combine this with mouse pathology, probably due to the huge demands of the latter. The solutions are achievable - however what is needed is a change in attitude from the scientific community, to parallel the support given to pathologists, both financially and otherwise, in the clinical setting or industry. Otherwise there will be a continued loss of exceptionally trained staff from academia to well paid jobs in the NHS or biotech industry in this country and abroad."

"I think that the number of slides read per year should be considered carefully. There is the aspect of morphometry which was not taken into account and the time spent on such a slide is 10 times the time spent on a "classical" slide."

"Not only the specialists per se are too few in my opinion, but even the relative texts, at least regarding murine models of leukemias, are rare and highly incomplete."

"The main problem we have in veterinary pathology is the overall lack of trained vet pathologists which will increase within the next years. This problem is not addressed adequately, in particular when the situation at training institutions is considered. In the UK, there is no government/University funding for training positions and funding is very limited and only available from e.g. charities, where pathology competes with clinical disciplines. There is a need to create funds (also or in particular from future employers, such as the pharmaceutical industry and research institutions) which can be provided to training institutions, such as Universities, to train veterinarians in the field. There are sufficient numbers of veterinarians who are interested in a career in vet pathology, including mouse pathology."

"I am considered not to have the proper training for a toxic pathologist, I just try to help since there is a demand not covered. I see also that there is rarely proper training for those who organise research outside of pharmaceutical society (universities, private societies...), which leads often to improper number of animals analysed and control group organisation..."

"Despite being trained as a phenotyping/mouse pathologist (PhD in experimental pathology post-graduate specialisation in pathology with > 10 years experience, Training and continuing

education in mouse GEM in Europe in 2001, toxicologic pathologist with a few studies using mice) I found very little opportunities in my current work environment to actually PRACTICE phenotyping activities or be part of a multidisciplinary team to perform experimental mouse pathology work - the bulk of my work being mainly rat and large animal toxicologic pathology. I feel a waste of resource in that regard. Opportunities to collaborate with universities in Europe should be increased/fostered. I think this should be increased."

"I experienced many cases in which inappropriate people wasted lots of time in trying to phenotype their mice instead of consulting expert pathologists. There is too little awareness of the potential and advantages of including pathologists in this business. In general pathologists in this field encounter too little appreciation of their work. Most mouse pathologists I know are frustrated. Larger research units need their own pathology unit but most are unwilling to pay for it."

"Thanks for this important initiative. I am looking forwards to hearing the results."

"Although I have 28 years experience in mouse pathology, I do not seem to quite fit your profile of an experimental mouse pathologist. In my position as a consultant, I can only participate in studies that are offered to me and I am not often asked to undertake phenotyping."

"One of the problems I had is the lack of good communication with principal investigators that do not know how pathologists work, what they can offer and what answers they can give. They must understand that it is a scientific collaboration more than a routine analysis not related to genomics macroscopy treatments time or any detail of the project."

"Definitively it is a question of formality in this field as to who is regarded as a pathologist and who not. Experience should be the key criteria not any passing of formal exams which too often do not have anything to do with the real life in the lab."

"In general there is a world wide lack of qualified veterinary pathologists."

"The Company that I represent employs 9 veterinary or other pathologists, all engaged in work on a variety of species, including mice. Work on genetically engineered mice and other models of human disease is a smaller part of our work than work on normal mice in regulatory toxicology testing."

"As a teacher involved in the formation of new pathologists I feel it would be beneficial that mouse pathology account for approx. 20% of the training of pathologists (the other 80% devoted to other species). I don't think it would be a good idea to form new pathologists specialised exclusively in mouse pathology; it is I believe, very important that pathologists have a basic knowledge of the pathology of many species, and be able to understand comparative pathology."

"There is a lot of expertise in mouse pathology in the contract research industry as the mouse has been a model in regulatory studies for many years. In my experience the background pathology of the genetically modified strains (excluding of course the pathology induced by mutation) is by and large the pathology of the backbone. I see little evidence of pathologists in CRO's getting involved in this type of work and given that such individuals probably have far and away the most experience in morphology this seems to be a pity. As such pathologists can be employed on a contract basis (usually around £2 a tissue) this would seem to be a cost effective way of plugging any immediate gaps. As it is usually possible to make a decent guess at the number of tissues you will generate as part of an investigation I would imagine you can plug a number for this into your grant application."

"Training in comparative pathology, which includes the pathology of genetically manipulated animal models of human disease, is essential for a strong research environment. Interpretation of laboratory animal pathology is best accomplished by veterinary pathologists with specialized training in the field."

“At the moment, we produce more than 200 different genetic modified mouse strains per year. None of them go through a proper pathology analysis unless there is a clinical problem with them. This tendency is due to the lack of pathologists and the view from scientists that pathology does not add to their science.”

“In general there will be a lack of experienced mouse pathologists in future and the demands will increase. However, at governmental institutes the cutback in expenditure of most (EU) governments will further reduce this discipline. Another problem is that working with laboratory animals is not a popular activity of veterinary and medical biology students, mainly due to the actions of animal right groups.”

“If there is scientific demand for more mouse pathology specialists I think it important for institutions to back that up with good employment opportunities. The small number of pathologists in this area is not simply a case of inadequate training opportunities. Too few see career opportunities in the area and take good jobs in academia and industry instead. The wide variation in background for most mouse pathologists (medics vets geneticists) suggests there is no need for a centrally imposed standard training program. Each country and institution has its own gold standard postgraduate training exams and these should be encouraged. As a trainer, I would not advise trainees to risk their future career and encourage them to get their national medical or veterinary histopathology speciality exams. People tend to change jobs throughout their careers and good basic training without narrow specialisation in the mouse is a much safer bet given the current lack of career opportunities in this narrow field.”

Appendix 5

Full comments received from Principal Investigators

"An important issue is how one creates career pathways for specialised mouse pathologists (outside large units that can support such a core service). It is difficult for human pathologists to do cutting edge research that is purely focussed on "traditional" pathology without other approaches (e.g. mouse work, cell biology, genetics). One possibility may be to increase the research possibilities for certain human pathologists by getting them more involved in mouse related projects. While enhancing academic human pathology is something lots of people talk about, it has been hampered by a number of factors (e.g. NHS cash crisis)."

"It's important that there exists more information about the importance of the histopathologic analyses in the experimentation animals more awareness by part scientific community."

"I would be grateful if you are able to supply contact details for trained mouse pathologists with expertise in cardiovascular pathology at UK institutions that I could contact for assistance and advice."

"Many of our experts in pathology have left the UK in recent years."

"We find it problematic to analyse for new unexpected phenotypes."

"I have not a laboratory to analyse mutated phenotypes of other mice than those of my own colony. And the analysis consists of external aspect description and the organ modifications observed by necropsy. I am only interested in hair-lacked mutant mice. Using an original mating scheme I obtained until now 4 novel mutations. Therefore in interpreting the data furnished by this questionnaire please take into account the above details."

"The questionnaire is too limited in scope. There is a general need for expert phenotyping services and/or advice throughout Europe. I am lucky to have access to a very qualified pathologist - but there are few if any other highly qualified mouse phenotyping facilities available in the Nordic countries. PRIME should aid setting up local mouse phenotyping services by providing clear outlines of the services and Standard Operating Procedures needed for select aspects of mouse phenotyping."

"I really welcome this initiative for getting a clear picture of the current situation as well as future demands for diagnostic pathology. I hope this helps the European Commission and other National Funding and Professional Organizations to take decisions for improving the current situation in Europe - a crucial starting point for being competitive."

"Histopathology and special analyses are an integral part of the mutant phenotype. We have a platform with all the modern equipment, but need one technician and pathologist."

"We are currently offering a service for the scientific community non invasive hearing tests. Please check: <http://www.iib.uam.es/servicios/nine/intro.es.html>"

"Caution: This evaluation originates from a core animal facility rather than from a research unit."

"To open up a position for a mouse researcher trained in pathology one needs grant money in the range of at least €60.000 for personal salary. We are currently having a pathologist working with us who has a large training in mouse pathology for 30% of his full time - the rest he spends with clinical pathology. A new training fellow would be good to get and in regard to funding we could open a vacant position in a year from now for a salary of a Ph.D. student but certainly not for a post doc easily."

"I am working as a mouse pathologist but would be very happy with whatever training would be provided."

"Am not exactly a principal investigator but just a PhD student on mouse genetics doing knockouts."

"I have never heard of anyone who has the complete skills to be a mouse pathologist/histologist with expertise in all aspects of embryonic and adult mouse pathology and who can communicate this in a research context. Our extensive needs for mouse pathology involve focusing on a particular tissue/organ systems and learning about the normal and mutant system ourselves from the literature from discussion with expert colleagues (of whom there are many in Cambridge) and from collaborative work with experts. We are then able to link the particular molecular genetic system we are analysing to the pathology and if appropriate to the physiology. In this way we have been able to conduct research in several organ/tissue systems while not being comprehensive experts. In our experience the only option open to us is to interact with different people with different expertise and read a range of literature. This has been a relatively positive experience for us. The provision of quality histological services for the preparation of material is a separate issue and we feel well supported in that regard."

"My answers may be a little deceptive as I am an embryologist and am not looking at adults but at embryos. We provide the vast majority of pathology expertise ourselves for this work or go in search of groups with that expertise. I am not aware of pathologists with significant embryology expertise and have answered questions from this standpoint."

"I am working on 1 laboratory from INSERM. There are several hundred of laboratory into whole INSERM institute (located in different areas in France). So I answered your questionnaire with only my limited point of view."

"I would love to see the outcome of this questionnaire."

"I think this is fundamental. Something I do not have clear is the profile of the pathologists either medics with interest in mice or vet pathologists or both...my approach would be a mixed approach.....but definitely this is a key aspect for future work with genetically modified animals..."

"The use of transgenics is expanding exponentially at our company. There is a significant need for extensive phenotyping that must either be done in-house or externally by competent contractors."

"Pathology analysis is the bottleneck of our work - too many phenotypes go unnoticed. We are happy to support any initiative to mend this important problem."

"The lack of specialised mouse pathology services is a severe handicap in the field. A number of potentially interesting phenotypes are missed as we only have routine access to basic veterinary services which are insufficient to provide publication quality assessments of pathology."

"A hand book or an internet site to assess or compare histological findings would be a great resource."