

FINAL REPORT



Aquatic Animal Health Subprogram: Current and future needs for aquatic animal health training and for systems for merit-based accreditation and competency assessments

**Matt Landos, Navneet Dhand, Brian Jones
and Richard Whittington**

March 2007

FRDC Project No. 2005/641



Australian Government
Department of Agriculture,
Fisheries and Forestry



Department of
Fisheries



Australian Government
Fisheries Research and
Development Corporation



Authors: Matt Landos, Navneet Dhand, Brian Jones and Richard Whittington.

Title: Aquatic Animal Health Subprogram: Current and future needs for aquatic animal health training and for systems for merit-based accreditation and competency assessments.

© Department of Fisheries, Government of Western Australia

This work is copyright. Except as permitted under the Copyright Act 1968 (Cth), no part of this publication may be reproduced by any process, electronic or otherwise, without the specific written permission of the copyright owners. Neither may information be stored electronically in any form whatsoever without such permission.

The Fisheries Research and Development Corporation plans, invests in and manages fisheries research and development throughout Australia. It is a federal statutory authority jointly funded by the Australian Government and the fishing industry.

The opinions expressed in this report are those of the authors and are not necessarily those of the Department of Fisheries. In addition, much of the report involved the use of a survey which, by its nature, gathers perceptions and opinions which may not totally reflect reality. The authors have drawn their conclusions based on these survey results and their own experience.

Printed by Department of Fisheries, P.O. Box 20 North Beach WA 6920. March 2007.

Fisheries Research Contract Report No. 18
ISBN: 1 921258 02 0



**Aquatic Animal Health Subprogram: Current and future needs
for aquatic animal health training and for systems for merit-based
accreditation and competency assessments**

**Matt Landos, Navneet Dhand, Brian Jones
and Richard Whittington**

March 2007

FRDC Project No. 2005/641



Australian Government
Department of Agriculture,
Fisheries and Forestry



Department of
Fisheries



Fish for the future



Australian Government
Fisheries Research and
Development Corporation

TABLE OF CONTENTS

TABLE OF ABBREVIATIONS	2
OBJECTIVES	3
NON TECHNICAL SUMMARY	3
OUTCOMES ACHIEVED	8
KEYWORDS	9
ACKNOWLEDGEMENTS	9
BACKGROUND	9
NEED	9
OBJECTIVES	9
METHODS	10
RESULTS	11
DISCUSSION	60
BENEFITS AND ADOPTION	68
FURTHER DEVELOPMENT	68
KEY RECOMMENDATIONS	69
COMMENT ADDED IN PROOF	70
CONCLUSION	70
BIBLIOGRAPHY	71
INTELLECTUAL PROPERTY	71
STAFF	71
APPENDIX 1:	72
Survey Questions to Aquaculture Industry stakeholders to assess current and future Aquatic Animal Health (AAH) education and training needs.	72
APPENDIX 2:	129
Additional NAAH-TWG survey of State and Commonwealth Government full time equivalent staff requirements to cover various legislative responsibilities for Aquatic Animal Health.....	129

TABLE OF ABBREVIATIONS

AAH	Aquatic Animal Health
AAH professionals	Includes laboratory and field diagnosticians, veterinary and non-veterinary and Government Aquatic Animal Health managers
AAHC	Aquatic Animal Health Committee
AAHL	Australian Animal Health Laboratory
ACIAR	Australian Centre for International Agricultural Research
AFS	Asian Fisheries Society
AHA	Animal Health Australia
BSc	Bachelor of Science
BVSc	Bachelor of Veterinary Science
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry
FRDC	Fisheries Research and Development Corporation
NAAHTWG	National Aquatic Animal Health Technical Working Group
NACA	Network of Aquaculture Centres in Asia-Pacific
OIE	World Organisation for Animal Health
PG	Post graduate
PIHC	Primary Industries Health Committee
PIMC	Primary Industries Ministerial Committee
PISC	Primary Industries Standing Committee
SCAHLs	Sub-committee of Animal Health Laboratory Standards
SITP	Seafood Industry Training Package
TAFE	Technical and Further Education
UTAS	University of Tasmania

PRINCIPAL INVESTIGATOR: Dr B. Jones
ADDRESS: Principal Fish Pathologist
Department of Fisheries, Western Australia
P.O.Box 20
North Beach WA 6151
Telephone: 08 9368 3649 Fax: 08 9474 1881

OBJECTIVES

To scope and clearly define current and future needs for aquatic animal health training and for systems for merit-based accreditation and competency assessments.

NON TECHNICAL SUMMARY

Provision of high quality aquatic animal health (AAH) services is a complex multi-disciplinary activity. Hence, training programs must address all discipline areas to achieve the desired outcome of robust service delivery to meet all stakeholder group needs. The current and future needs for AAH training have been identified across many sectors through survey work and direct interviews with key stakeholders. There is a shortfall in both total capacity and more prominently, in the availability of high skill level individuals within both laboratory and field service provision areas. It was widely recognised that many of the traditional pathways for training groups of such skilled individuals was through mentorship and self-education within State and Commonwealth Governments. These are now severely restricted due to a changing role of Government and ongoing tightening of resources.

A significant proportion of all stakeholders felt that current Australian training opportunities were either completely absent or of insufficient depth. Therefore, to meet the identified needs of the stakeholder groups for AAH service delivery, significant changes to current AAH training practices in Australia are required. 73% of survey respondents felt that the demands for AAH services were likely to increase over the next 5-10 years, which will only exacerbate the currently recognised shortages.

Through discussions with an array of industry stakeholders across Australia there appeared to be sufficient training available for farmer level individuals but not for specialised AAH diagnostic professionals. It was apparent that not all aquaculture industry sectors, particularly the smaller emerging industries, were aware of the training opportunities available, suggesting an improved extension effort was required by providers at the Technical and Further (TAFE) Education institutions and universities.

The experience that fisheries and aquaculture industries have had with animal health service provision is remarkably different to that experienced by the established terrestrial animal production industries. Health services to fisheries and aquaculture, in many jurisdictions and industries, have been viewed as a separate service area discipline to that of all other animal health services. This is an historical anomaly given the overlapping functions. Aquatic animal

health services are in reality, a subset of Australia’s animal health services. The reintegration into this larger area needs to begin with aquatic animal health training integrating with other animal health training, rather than being viewed as an entirely separate entity. The overlap of the skill sets is simply too great to justify entirely separate training programs for the range of disciplines involved.

Surveys were designed to clarify stakeholder expectations of various providers of aquatic animal health services. Some of the major findings are listed below and supported with data in the main body of the report. The categories of service providers are outlined in Table 1 with their wide ranging specialities.

Table 1. Service providers that deliver AAH services in Australia

Laboratory Based Personnel	Academic Based Personnel
Veterinary pathologists	Veterinary pathologists
Aquatic animal pathologists (non-veterinary)	Aquatic animal pathologists (non-veterinary)
Bacteriologists	Bacteriologists
Virologists	Virologists
Parasitologists	Parasitologists
Molecular biologists	Molecular biologists
Immunologists	Immunologists
Nutritionists	Nutritionists
Toxicologists	Toxicologists
Field Based Personnel	Administration Based Personnel
Private veterinary consultants	State and Commonwealth policy staff
Clinicians	Epidemiologists
Aquaculture technicians	Biosecurity and policy
Farm managers	

Laboratory based personnel issues

1. Perceptions of sub-optimal performance

72% of laboratory respondents expressed a view that their abilities in at least one of the major disciplines was lacking. 81% stated that the quality of service delivered to aquatic animal cases was below that provided for terrestrial animals in their laboratory. However, while individuals may lack certain skills, the service to the client is provided by the laboratory as a whole. Industry and Government expectations are for very high levels of competency across all areas. The establishment of a “network” among laboratories further enhances Australia’s capability.

2. Minimal training options to up-skill personnel

48% of laboratory respondents expressed a need for post-graduate training to attain the required competency across all discipline areas surveyed. Research stakeholders expressed similar views about the inadequacies of current training. Such in-depth training opportunities do not exist in Australia at this time. The reality is that new graduates are not able to provide the high level AAH services demanded by clients.- it is simply beyond the scope of undergraduate courses. The solution lies in greater interaction between the veterinary and non-veterinary aquatic animal health training institutions, creation of mentorship/traineeship opportunities in operating diagnostic laboratories, and access to common curriculum and educational resource materials for undergraduate and post-graduate AAH training.

Current expectations of laboratory staff exceed their capacity to deliver due to lack of

field (primarily veterinary) services

The survey results indicated that both industry and Government expect aquatic animal diagnostic laboratories to provide the bulk of the high level AAH services that are perceived to be required. Both groups of stakeholders frequently sought the services of AAH diagnostic laboratories. When examining the operation of animal health services in other production animal industries in Australia, the intermediate step of involvement of field veterinarians is an obvious omission in the operation of many aquaculture/fisheries sectors. Field experience is a critical precursor to sample submission with sample selection clearly affecting the ability of a laboratory to select appropriate tests and provide meaningful results.

3. An aging population of high level AAH Professionals

Governments and industry recognise that many of the high level aquatic animal health professionals are employed by State and Commonwealth Government Laboratories. This is evidenced by their participation in the NAAH-TWG and the heavy use of these individuals to provide technical advice for State Government policy development. A recent survey as part of the Fisheries Research and Development Corporation (FRDC) project 2005/621 to establish a national network of AAH diagnostic laboratories, found that >70% of AAH laboratory diagnosticians are approaching retirement within a 10 year time frame (70% are >50 years of age). Similar findings about the demography of highly skilled terrestrial animal laboratory diagnosticians have been recently noted in the Frawley Review into Rural Veterinary Services 2003 and in relation to field veterinary services by Heath and Niethe (2001). The lack of training pathways and projections for increased service demand are likely to leave AAH stakeholders in a parlous situation, unless steps are taken in succession planning for the loss of these skilled professionals. Significant new resources are required to avoid this demographic failure for AAH service provision in Australia.

Field-based personnel issues

1. Low level of understanding of the complexity of delivering high level skills and services in Aquatic Animal Health by many industry sectors.

Surprisingly respondents from the majority of aquaculture industry sectors and researchers demonstrated a very limited understanding of the complexity of skills and disciplines that are required to reach a diagnosis, select and apply a treatment and control/plan for diseases in aquatic animals. A list of the professional disciplines that combine to provide a diagnosis, treatment and control plan are encompassed in table 1 above; there may be further disciplines utilised in some circumstances. It is apparent that not all of these skills are likely to be possessed by one person, necessitating a multi-disciplinary approach. The lack of understanding of this complexity is intrinsic to the perception of the industries' needs for service. Many aquaculturalists (49% of respondents) were of the opinion that through less than one week of training they could acquire very high competency levels across a range of AAH skills needed for optimal farm operations, thereby, undervaluing AAH management compared to other farm activities. From farm managers, through to service providers, there was support for improved and increased training opportunities. There was also a need highlighted for improved extension information on the courses that are currently offered- as general awareness amongst industries varied considerably. Not surprisingly, industries such as salmonids in Tasmania, which have benefited from engagement in the most rigorous AAH programs, were the most aware of training opportunities.

In contrast, aquaculturalists and Government expect very high skill and competency levels from AAH professionals engaged to deliver AAH services. However, there is little recognition of the required integration of such professionals into regular engagement with industry so they can develop and maintain the high skill levels demanded. Industry utilises private suppliers of AAH on average just over once a year. Few opportunities exist in Australia currently for AAH professionals to obtain the required exposure to develop high level diagnostic skills. One mechanism proposed to overcome this lack of engagement is to foster greater integration of AAH research programs with Veterinary schools and established AAH laboratories, and link them directly with industry, to demonstrate to industry the intrinsic value of high quality AAH service.

2. Field AAH under-servicing

As described above a lack of input from AAH professionals at the field level impacts on the ability of AAH laboratories to deliver meaningful results. Further, for farms to derive the greatest benefit from laboratory tests, they require the creation and implementation of prevention and control strategies back at the farm, by field AAH professionals. This activity requires a deep understanding of disease processes and the culture system which is beyond the scope of most aquaculturalists' training. One key component cause for the failure of development of these field AAH services has been the apparent reluctance of Veterinary schools to integrate specific aquatic animal material into their undergraduate degrees.

3. Impediments to improved AAH service provision.

Several other factors have hindered the development of AAH services including: the vast geographic spread of industry and associated high travel costs to provide service; the relatively small size of the industry overall; the low level uptake/recognition by industry of AAH professionals; the diversity of culture systems; the diversity of species under culture; and the small number of people engaged full-time in AAH service provision, both private and government, barely sustains the critical mass required to successfully institute mentorship programs and training positions. Animal health provision to all other production animal sectors in Australia does not operate in this fashion, and neither should it for Aquatic Animals. Survey results indicated that where Government extension veterinarians were resourced and available they were heavily utilised and personal communications with the few non-government veterinarians active in Australia, indicated when interviewed that they were continuing to slowly expand their services.

Academic personnel issues

1. Insufficient specific aquatic animal content in veterinary science undergraduate education.

Through discussions with deans or senior staff from the following Australian veterinary faculties: University of Sydney; Melbourne University; Murdoch University; university of Queensland; Charles Sturt University and James Cook University, it is clear that both historically and currently, the veterinary profession has been very slow to respond to the emergence of this new production animal sector, and as a result aquatic animal health has developed without specific Veterinary undergraduate training in either aquatic animal diseases and physiology, or in aquatic animal production systems. However, the breadth and depth of animal health skills taught within a veterinary degree are not only highly relevant, but are the essential background, to which the specific aquatic skills need to be added, to provide the veterinary element of a comprehensive health service. As the undergraduate curriculum is already overflowing, only minor improvements in specific

aquatic animal health content are likely. The inclusion of aquatic animal case material across all areas of the degree courses is encouraged and in many cases, notably the University of Sydney and Queensland University, is currently underway. Such inclusions as aquatic pathogens in microbiology (bacteria, viruses and fungi), diagnostic aquatic case material in pathology, aquatic disease examples in epidemiology, important differences in aquatic animal physiology, inclusion of basic fish nutrition within broader nutritional training and the inclusion of some common aquatic parasites in parasitology. However, it is both appropriate and necessary that many of the key skills are taught through the creation of post-graduate training opportunities in conjunction with veterinary and non-veterinary schools and established diagnostic laboratories with aquatic animal health expertise.

2. Lack of succession planning within diagnostic laboratories to act as an educational resource

A significant proportion of the national AAH knowledge resides within highly experienced fish pathologists in State Government laboratories. The average age of these individuals exceeds 50. At present none of these laboratories have sufficient resources to implement a trainee program to assist with succession planning. Mentorship from experienced pathologists is widely recognised as one of the best techniques to transfer the high level skills.

Administrative personnel issues

1. State Government's unable to fill their own needs

Surveying across all State Governments revealed a current shortage of staff attempting to cover AAH issues and predicted ongoing shortages into the future, compounded by the predicted increase in demand. The impacts on the quality of policy and surveillance capacity can only be deleterious. In the last 3 years State Governments in Victoria, South Australia, NSW and Northern Territory have been forced to undertake protracted advertising nationally and in some cases internationally to find experienced AAH professionals to fulfil vital administrative and laboratory functions. It has been common for these positions to be vacant for greater than 12 months whilst suitable candidates are sought.

2. Adequate skill levels but still demand for more training across a range of AAH areas

In general, surveyed Government AAH managers felt they possessed sufficient levels of AAH skills to perform adequately in their positions. However it was noted that >60% of respondents felt that more training would be supported and attended.

Competency standards

Veterinarians are registered and regulated through legislation to provide competent animal health services. However, they are currently a minority in all areas of AAH service provision, except pathology, in Australia. Veterinarians have not distinguished themselves with all industry groups as having particular competencies, perhaps due to their lack of engagement. The Australian College of Veterinary Scientists, Chapter of Aquatic Animal Health is undergoing rapid expansion in membership which will assist in providing demonstrable proof of a competency standard. Formal links are being established by the Chapter with specialist veterinary groups in the USA and the United Kingdom. However other AAH professionals with specialist level skills currently go officially unrecognised and still others with potentially

less experience and qualifications are operating in the market. There was recognition of a need for a competency standard by 60% of all respondents across all stakeholder groups.

RECOMMENDATIONS

- 1. That Australian universities be encouraged to incorporate a greater component of aquatic animal health into undergraduate training courses, through the development of a National Aquatic Animal Health Curriculum and educational resource material.**
- 2. That Australian universities be encouraged to develop post-graduate training opportunities with formal international linkages e.g. Network of Aquaculture Centres in the Asia-Pacific (NACA), Australian Centre for International Agricultural Research (ACIAR), Asian Fisheries Society (AFS) to encourage overseas students to participate and support the running of such courses. Such training opportunities should include some direct field experience with industry.**
- 3. That funding be sourced to support traineeships in aquatic animal pathology at Government and University Aquatic Animal Health Laboratories around Australia.**
- 4. That Australian college of veterinary science approach providers to assess potential for endorsed graduates of tertiary undergraduate degree programs to undertake a program of mentoring, training and examination and continuing professional development in AAH which could then be recognised as the competency standard across Australia.**
- 5. That State Governments be asked to subsidise the cost of investigations of novel aquatic animal disease outbreaks, to underpin development of improved understanding of key pathogens and processes whilst the aquaculture industries are developing to maturity.**
- 6. That nationally funded research projects with AAH components should include links to a Veterinary school, a State Government AAH diagnostic laboratory and with industry.**
- 7. That a nationally coordinated extension program be funded to ensure key stakeholders are aware of all the training opportunities that currently exist.**

OUTCOMES ACHIEVED

An initial scoping workshop was conducted with the National Aquatic Animal Health Technical Working Group (NAAH-TWG) in Melbourne 2005.

A survey of aquatic animal health stakeholders including members of RecFish Australia, State and Territory Agencies and the veterinary universities and other educational facilities that currently supply training in aquatic animal health was undertaken.

The supply and demand for AAH services has been analysed based on current usage and projected growth in service needs. The recommendations flowing from this analysis have been prepared and will be submitted to Aquatic Animal Health Committee in the form of an issues paper that identifies the problems(s) but also solutions, with respect to current and future needs for aquatic animal health training and for systems for merit-based accreditation and competency assessments for further consideration.

KEYWORDS

Aquaculture, Laboratory, Survey, Teaching, Training, University, Veterinary

ACKNOWLEDGEMENTS

We would like to thank all those who participated in telephone, email and in-person surveys, interviews and workshops around Australia. We are grateful for the input into the draft from the National Aquatic Animal Health Technical Working Group.

BACKGROUND

The National Aquatic Animal Technical Working Group identified the need for succession planning and training and this was strongly supported by stakeholder input into the AQUAPLAN 2005-2010 initiative.

The funding is seed money for the AQUAPLAN 2005-2010 strategy 4 vision of “Enhanced education and training in aquatic animal health at all levels of teaching to support continuing growth, profitability and sustainability of Australia’s aquaculture industries.

The objective of this project is consistent with the objectives of the “Securing the Future...” federal budget initiative.

NEED

Aquatic animal health service providers have expressed concern that there is a shortfall of aquatic animal health professionals servicing Australia’s aquaculture industries. Despite this need, most current Australian education systems/institutions do not adequately cover aquatic animal health. In addition to the need for inclusion of aquatic animal health content in formal education courses, there is also a need for continuing education.

Identifying accreditation mechanisms to ensure competency in professionals providing aquatic animal health services to the aquaculture sector is another component of this strategy. This need must go beyond the provision of veterinary services (which also provide limited training in aquatic animal health). For example, there is a need for research and training in subjects such as invertebrate immunology, identification of nutritional disorders, water quality issues, taxonomy of pathogens, development and implementation of modern diagnostic methods and development of vaccines. As an example of this wider educational approach, the University of Tasmania currently provides a training course in histopathology of aquatic animals that is targeted at, and in part run by, non-veterinarians and this type of training should also be captured.

OBJECTIVES

To scope and clearly define current and future needs for aquatic animal health training and for systems for merit-based accreditation and competency assessments.

METHODS

In order to determine the training needs for aquatic animal health service delivery and competency standards, a consultant was employed to create and conduct surveys of stakeholders (listed in Table 2). The surveys were conducted through face-to-face and telephone interviews, and by email/post. Many of the post/email respondents were also contacted by phone for general interview as noted in Table 2. Copies of the survey applicable to each stakeholder group are provided as Appendix 3.

For those participants whose email addresses were obtained by the consultant, they received a follow-up email reminder to complete the surveys. For industry groups who forwarded email surveys to members, the group received the reminder emails and was asked to pass it onto members.

236 individual stakeholders were contacted directly by the consultant by email. Major industry peak bodies (both members and non-members of the National Aquaculture Council) were also contacted including Recfish Australia, Tuna Boat Owners Association, Australian Prawn Farmers Association, Australian Barramundi Farmers Association, Silver Perch Growers Association, NSW Aquaculture Association, Seafood Industry Councils in all States, Oyster farmers Associations in several states and Pearl industry representatives. Many of these groups enhanced the penetration of the survey by distributing it to their relevant memberships.

Stakeholders in Government and private laboratories were personally briefed on the project to explain the survey's intent and to answer any enquiries about individual questions by the consultant.

Key academic staff from all of the Veterinary Faculties around Australia were interviewed, as were key staff from Universities offering aquaculture degrees which incorporate aquatic animal health material. (UTAS and Flinders University). Deakin University was unable to be contacted. An interview was also held with staff from Challenger TAFE to review the input by this institution to delivery of the Seafood Industry Training Package.

A database was created to facilitate analysis of survey responses, and graphical outputs were developed to simplify presentation of data.

A draft report was presented to the NAAH-TWG in May 2006, and feedback from this meeting was used to refine data analysis and interpretation.

Table 2. Stakeholders consulted by group and number.

Stakeholder group	No. of survey post/email responses	No. interviews
Aquaculture industry (typically farm managers)	29	40
Government Aquaculture and Fisheries Management staff	14	18
Aquatic animal health diagnostic laboratory staff	31	120
Aquatic animal researchers	13	12
Recreational fishing industry	3	12
Commercial fishing industry	2	8
Aquaculture feed manufacturing industry	3	4
Ornamental fish industry	1	1
Educational institutions	6	14

RESULTS

Within each of the AAH service provider areas there is a variety of disciplines which combine to provide services to industry and Government. These multi-disciplinary groups represented in Table 2 are ultimately where current and future AAH education and training need to be directed.

Table 1. Service providers that deliver AAH services in Australia.

Laboratory Based Personnel	Academic Based Personnel
Veterinary pathologists	Veterinary pathologists
Fish pathologists (non-veterinary)	Fish pathologists (non-veterinary)
Bacteriologists	Bacteriologists
Virologists	Virologists
Parasitologists	Parasitologists
Molecular biologists	Molecular biologists
Immunologists	Immunologists
Nutritionists	Nutritionists
Toxicologists	Toxicologists
Field Based Personnel	Administration Based Personnel
Private veterinary consultants	State and Commonwealth fish health staff
Non-veterinary AAH Professionals	Epidemiologists
Aquaculture technicians (farm hands)	Biosecurity and policy
Farm managers	

Of 236 stakeholders who directly received the surveys, from the nine stakeholder groups, completed responses were received from 43% using email, face-to-face, telephone and postal communication. (Table 2). Interview discussions were held with 229 stakeholders over the course of the project.

Results of aquaculture industry stakeholder survey (see Appendix 1 for copies of the survey questions)

Responses (see Figures 1 and 3) show that over 90% of respondents (mostly farm managers) see a need for at least a basic understanding of aquatic animal health themselves and for their farm hands across all areas surveyed. This training need was emphasised with 30-40% of respondents believing that more aquatic health training is required across all areas for both farm hand staff and managers (see Figures 2 and 4). The only area where less than 30% of

respondents saw more training for managers was required was in the application of vaccination programs (See Figure 4).

The aquaculture stakeholders' perceptions of the level of skill required by laboratories recognised their need for advanced skills was strong (see Figure 5). This result was common also to Government managers and private veterinarians and non-veterinary AAH professionals (see Figure 7 and 9). In specific areas, where it was perceived that more training was required at the laboratory level, disease diagnosis and parasite identification rated highest (see Figure 6). Aquaculture respondents were more uniform in their belief that more training, in all identified areas, was required by government licencing/policy authorities compared with laboratories (see Figure 8). This desire to see more training also applied to AAH veterinarians and non-veterinary AAH professionals (see Figure 10).

In assessing the current use of AAH training it was recognised by more than 50% of respondents that AAH training at a TAFE or university level had been utilised by their farm hand staff. This percentage was increased to 80% for aquaculture managers and 90% for AAH veterinarians (see Figure 11). Aquaculture stakeholders felt that this current off-farm AAH education was relevant, but lacked detail and required modification to be of practical value on the farm in the majority of cases. This was true of TAFE, Seafood Industry Training Package (SITP) and University degree graduate courses in particular (see Figure 12). Another insight into the current AAH training was the perception of 50% of respondents that TAFE, SITP, BSc (Marine biology), BSc (Aquaculture) course graduates had expectations which were too high. This compared to only 20% of respondents feeling veterinary graduate job expectations were too high (see Figures 13 and 14).

Respondents were asked to score the frequency of use, and the level of skills required by: farm hands; farm managers; and AAH veterinarians or non-veterinary AAH professionals (see Figure 15). Aquaculture stakeholders generally noted that farm hands were expected to have only basic skills which they expected would be used infrequently, managers required basic skills which were likely to be used regularly, and AAH professionals required advanced skills to be used frequently. To attain the required level of skills respondents noted farm hands required two-day to one-week training courses, farm managers required up to one semester courses for skills such as undertaking a rigorous investigation of a health problem, and AAH professionals generally were perceived to require more than a one-year diploma to be proficient in the range of required skills (see Figure 16).

The ranking of service providers in order of frequency of use highlighted most frequent use of Government veterinary officers and private veterinarians (see Figure 17). Around two thirds of respondents rated Government laboratories and veterinary officers as excellent in provision of adequate diagnostic technical advice (see Figure 18). This compared to 45% for private AAH veterinarians, 20% for non-vet AAH professionals and only 15% for other farmers. This was in contrast to the ability of service providers to deliver treatment advice (see Figure 19). In this category 29% of respondents found government laboratories to be of a poor standard and private labs even worse (33%). The Government Veterinary Officers again performed favourably with 58% of respondents describing their treatment advice as excellent and only 11% finding it to be poor. A similar positive picture was provided for private AAH professionals who were found to adequate or excellent by 14/14 respondents. The issue of timeliness of service identified some differences between the private and public sector service providers (see Figure 20). 90% of respondents found the service from private AAH veterinarians to be timely, with 80% finding the same of private labs. This is in contrast

to only 42% for Government laboratories, 40% for Government managers, and 63% for Government veterinary officers.

The use of service providers was unsurprisingly weighted towards those who offer work for free. In terms of the cost of services, less than 20% of all respondents felt any of the providers were too expensive (see Figure 21). That said, this figure could rise as high as 47% should free services become fully cost recovered in Government laboratories.

A surprisingly high proportion (13/29) of respondents felt there was currently no training available for them to acquire AAH skills (see Figure 22). All but 6% of respondents believed that their business would benefit from improved AAH input (see Figure 23). 90% of aquaculture respondents felt this could best be achieved through training existing staff (see Figure 25). As a stakeholder group there was a clear indication (87% agreement) that their use of AAH services would likely increase over the next 5-10 years (see Figure 26).

The broad outcomes sought by respondents from AAH activities were strongly supported in all cases across all industries within the aquaculture stakeholder group (see Figure 24). This strong support may well reflect the finding that 73% of respondents had suffered significant losses due to disease (see Figure 26).

For AAH service providers, 73% of respondents would like to see minimum competency standards introduced (see Figure 26), although through interviews with the consultant many of the respondents commented that this would not be the primary criteria for selecting individuals to be used. Proximity to the farm and recommendations from other farmers were viewed as more likely to influence the decision of who to engage for field and laboratory health services. Accreditation was perceived by some aquaculturalists to be only necessary for market access requirement certification issues.

Graphical representation of results from Aquaculture stakeholder survey

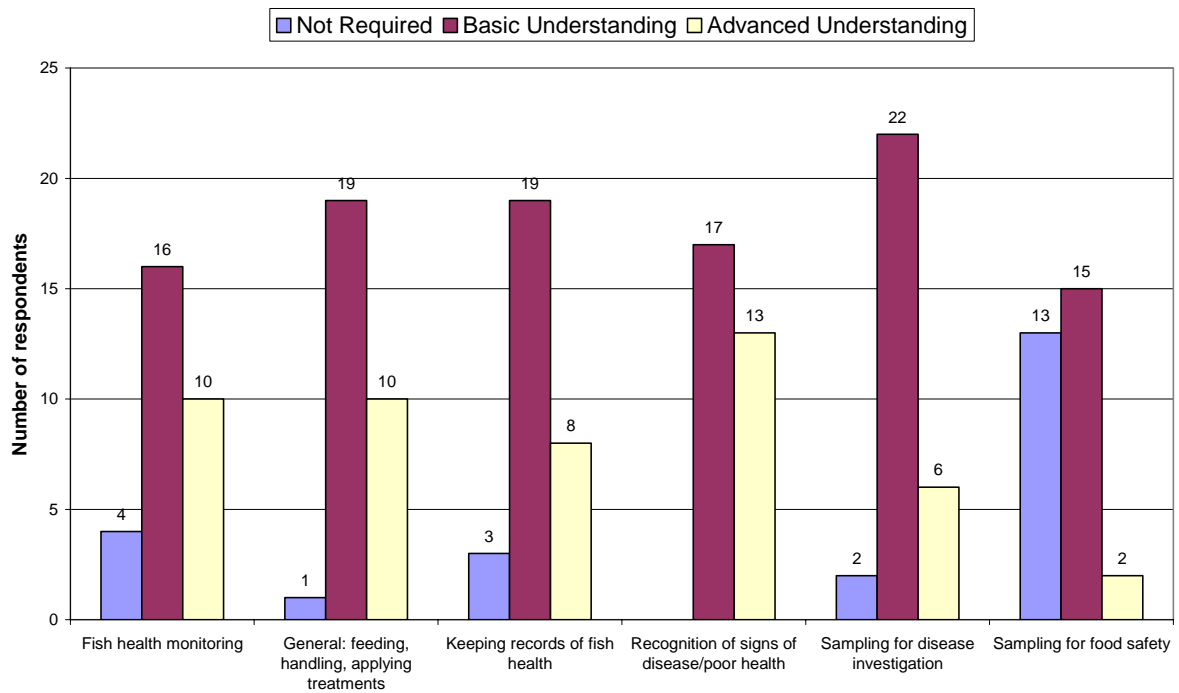


Figure 1. Aquaculture stakeholders expectations of the level of aquatic animal health knowledge their *farm hand staff* require to perform optimally in the respective activities.

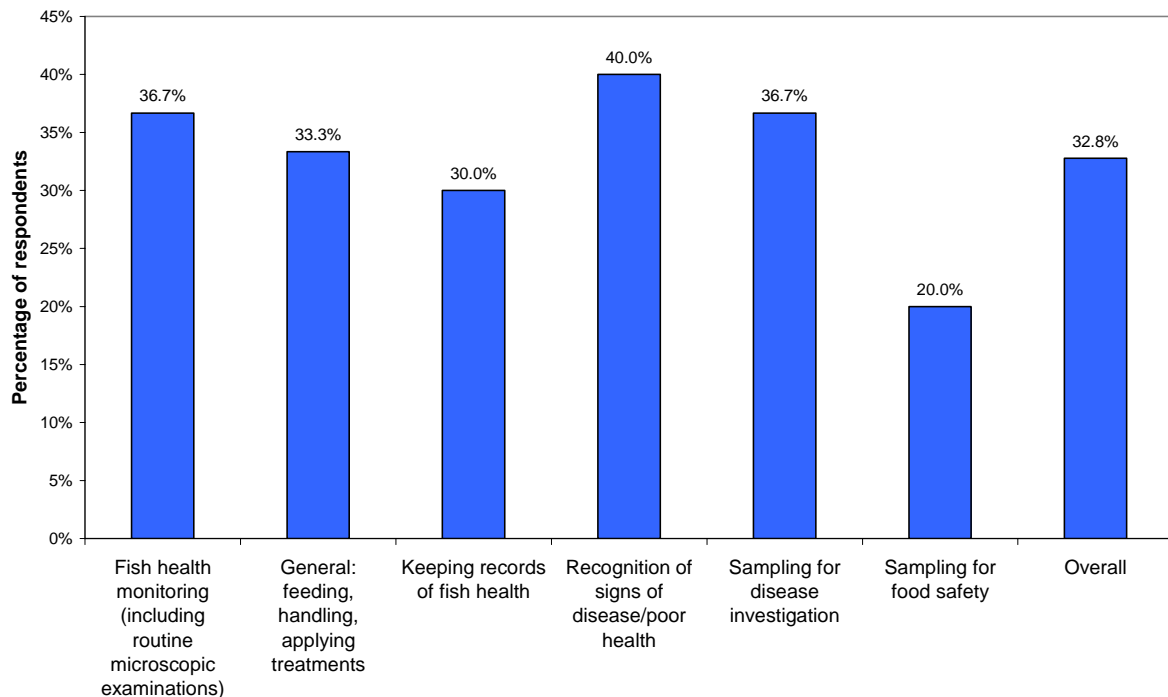


Figure 2. Proportion of aquaculture respondents believing that more training is required for their *farm hand staff* in the respective activity area.

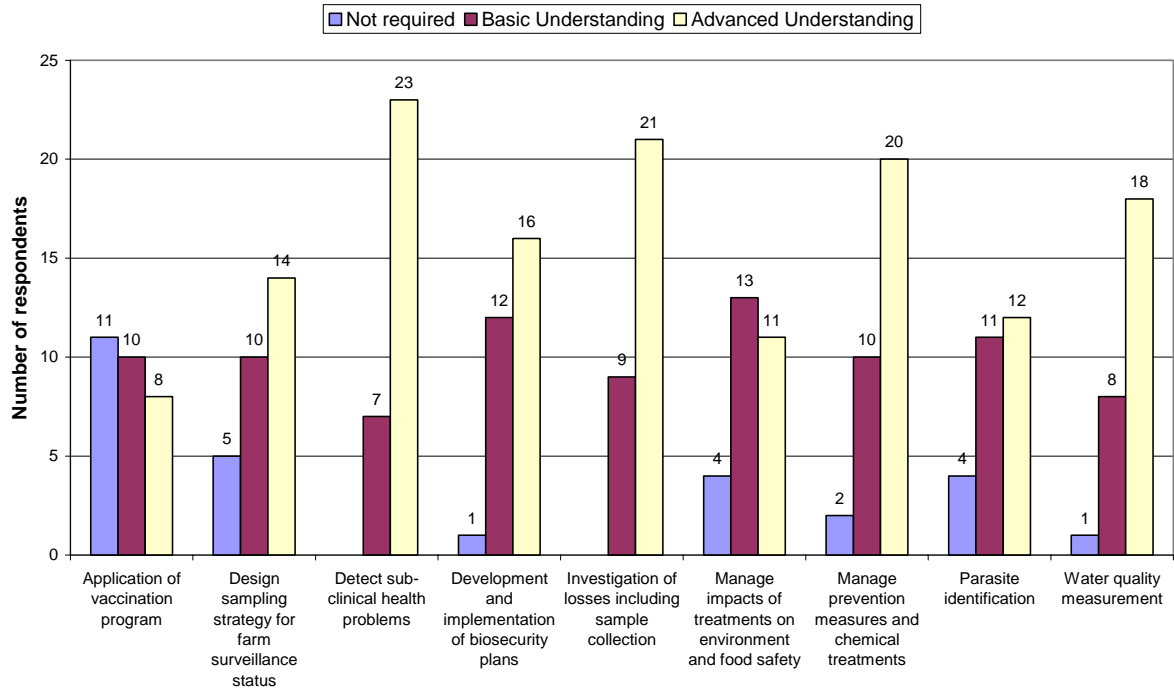


Figure 3. Aquaculture stakeholder expectations of the level of aquatic animal health knowledge they (*farm managers*) require to perform optimally in the respective activities.

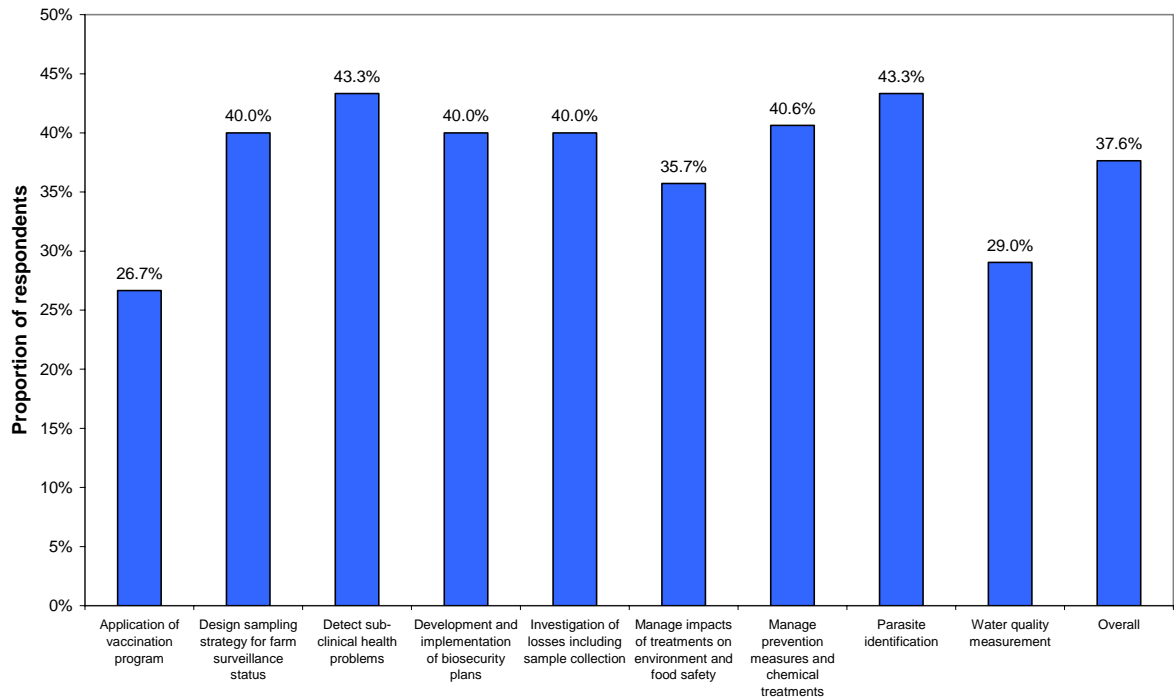


Figure 4. Proportion of respondents believing that more training is required for *farm managers* in the respective activity area.

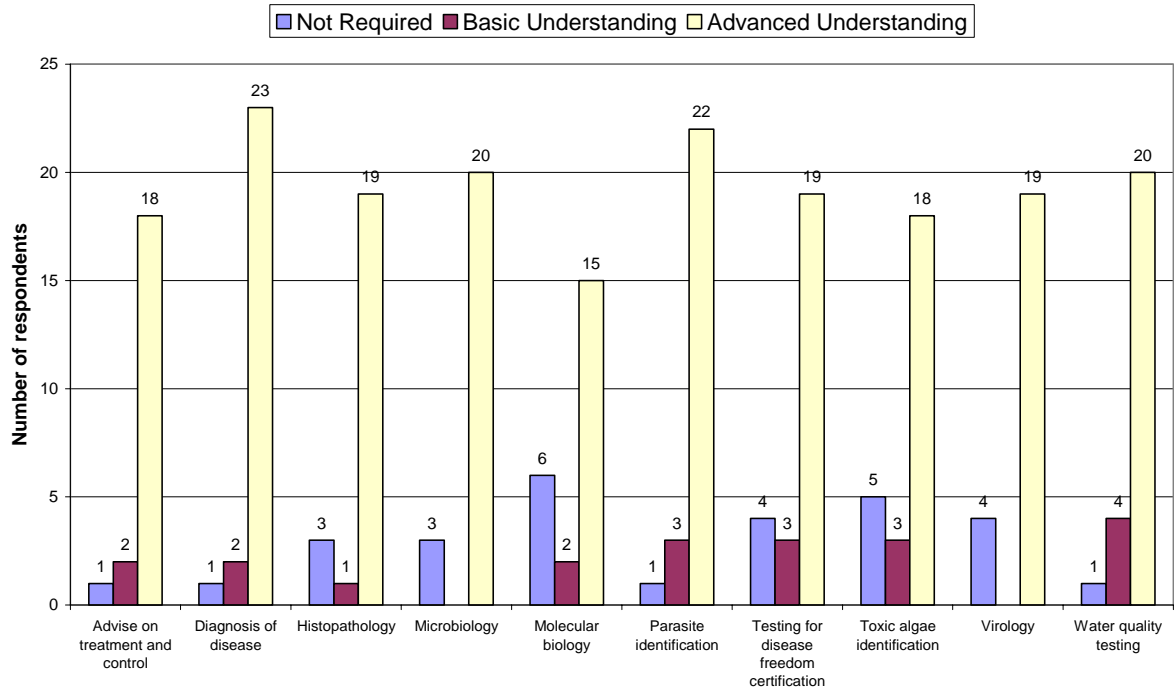


Figure 5. Aquaculture stakeholder expectations of the level of aquatic animal health knowledge required by *diagnostic laboratory employees* to perform optimally in the respective activities.

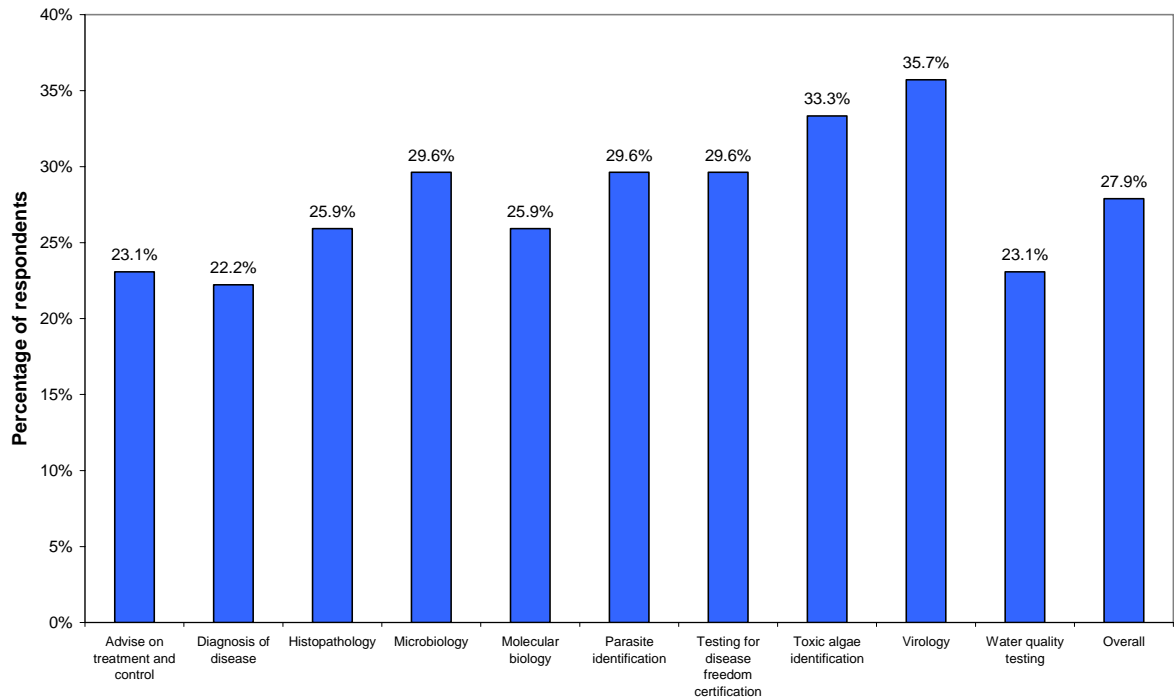


Figure 6. Proportion of aquaculture respondents believing that more training is required for *laboratory employees* in the respective activity area.

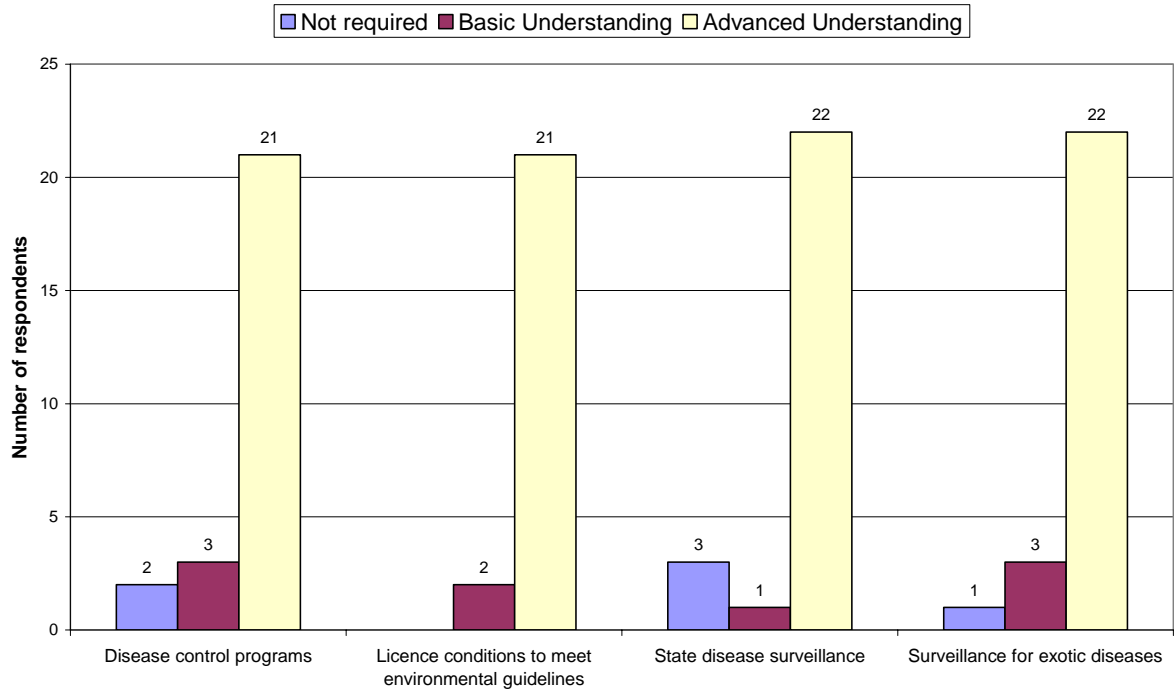


Figure 7. Aquaculture stakeholder expectations of the level of aquatic animal health knowledge required by *Government licensing/policy authorities* to perform optimally in the respective activities.

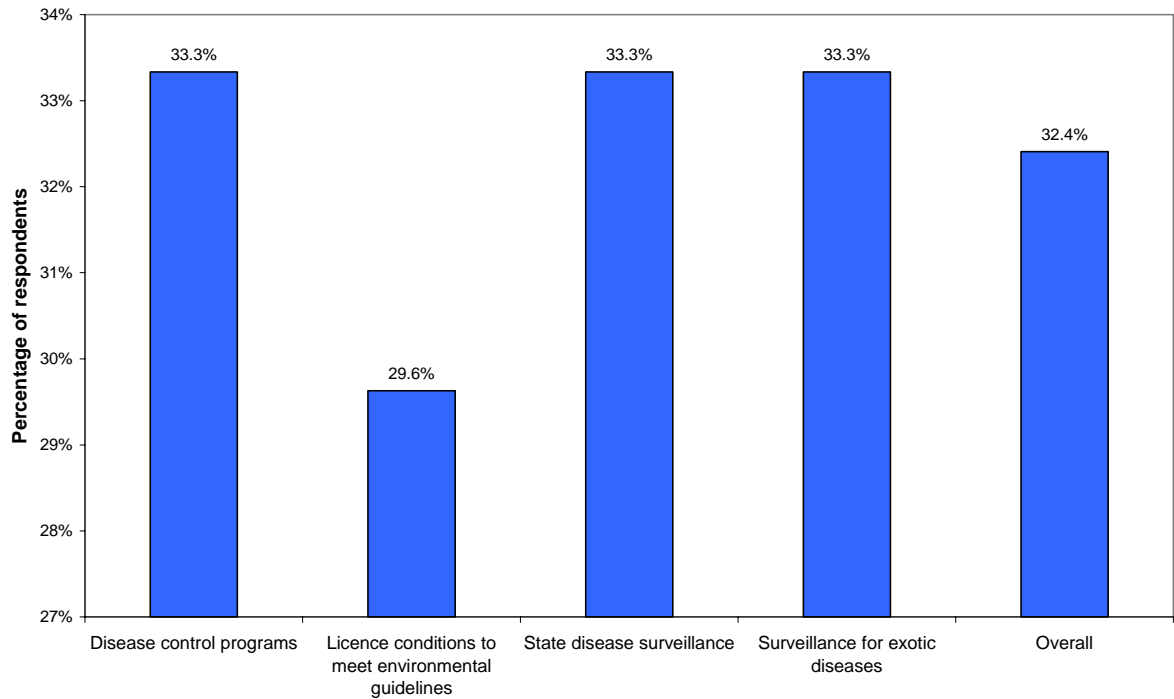


Figure 8. Proportion of aquaculture respondents believing that more training is required for *Government licensing/policy authorities* in the respective activity area.

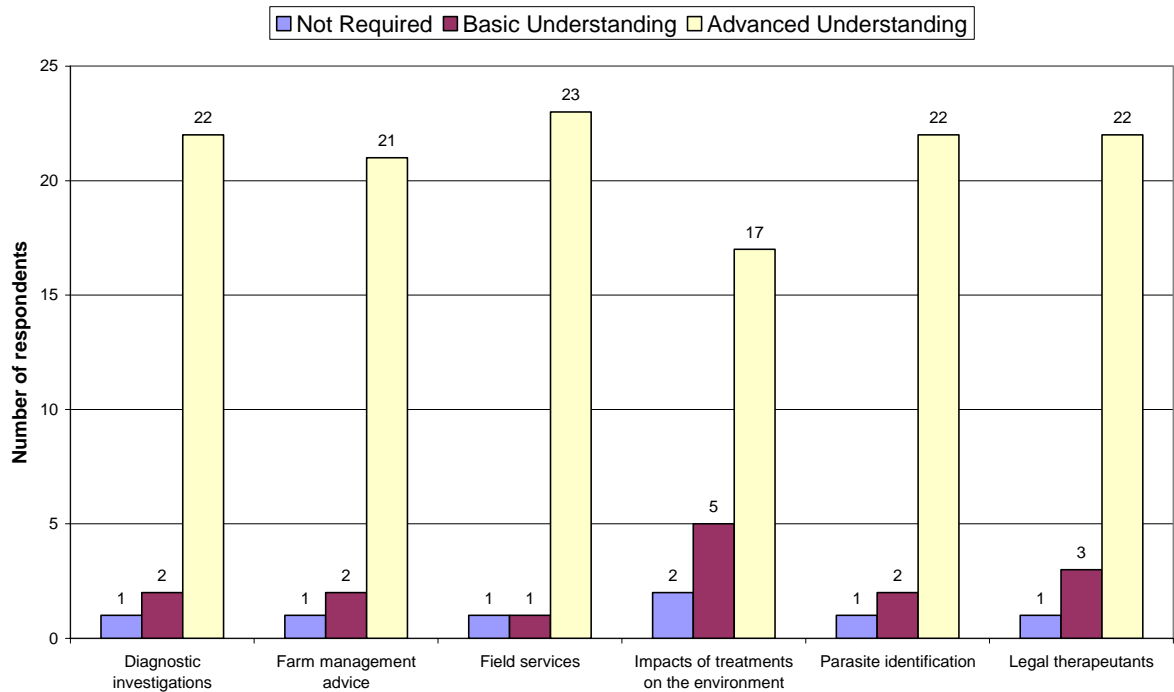


Figure 9. Aquaculture stakeholder expectations of the level of aquatic animal health knowledge required by AAH veterinarian or non-veterinary AAH professional to perform optimally in the respective activities.

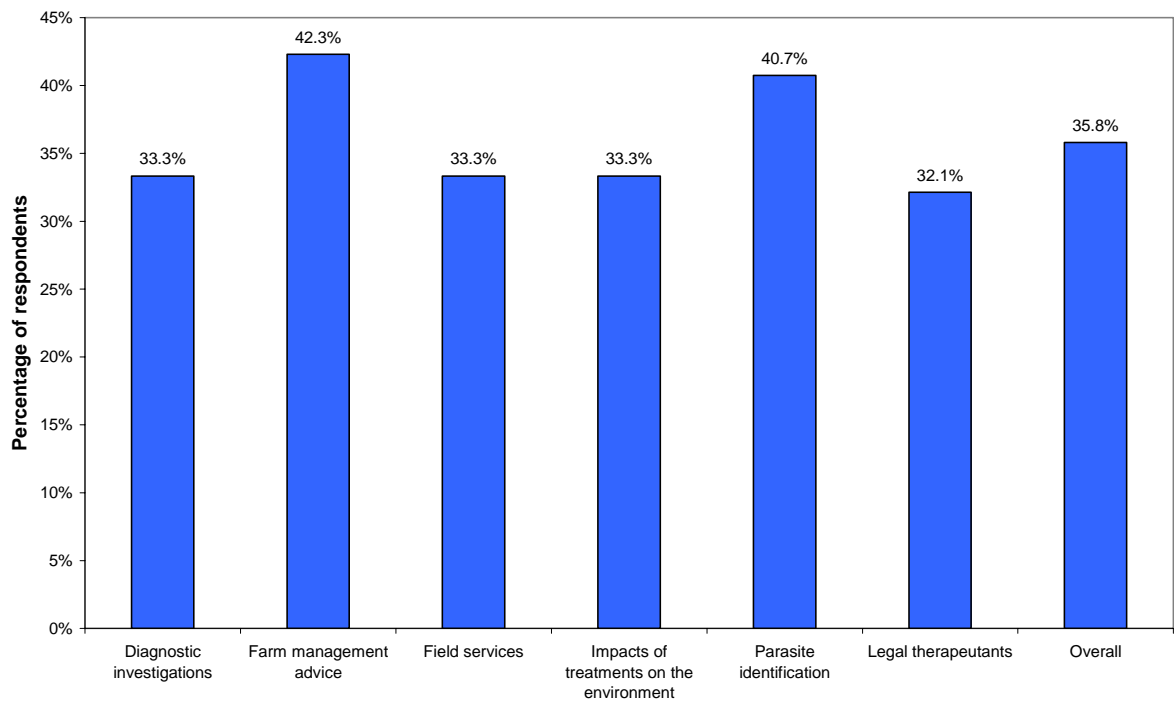


Figure 10. Proportion of aquaculture respondents believing that more training is required for AAH veterinarian or non-veterinary AAH professional in the respective activity area.

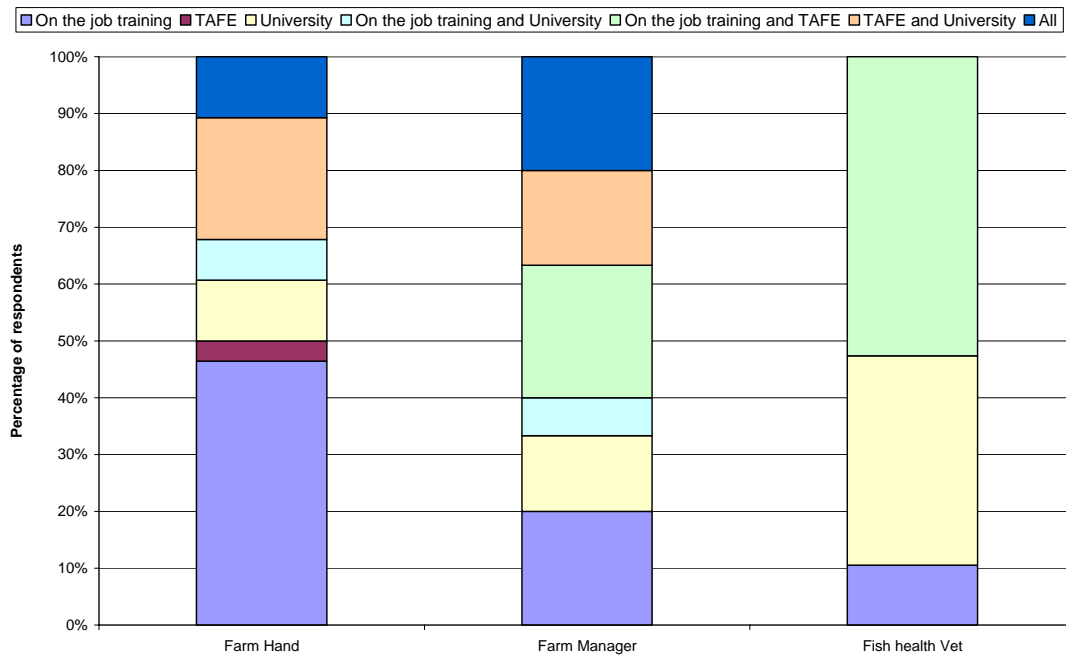


Figure 11. Source of education for farm hand staff, farm manager and fish health veterinarian.

- | |
|--|
| 1 Irrelevant |
| 2 Relevant but of insufficient depth to be of value |
| 3 Relevant but required modification to be of practical value on the farm |
| 4 Relevant, quickly applicable to work on farm to maintain current AAH standards |
| 5 Highly Relevant and increased the AAH standards on the farm |

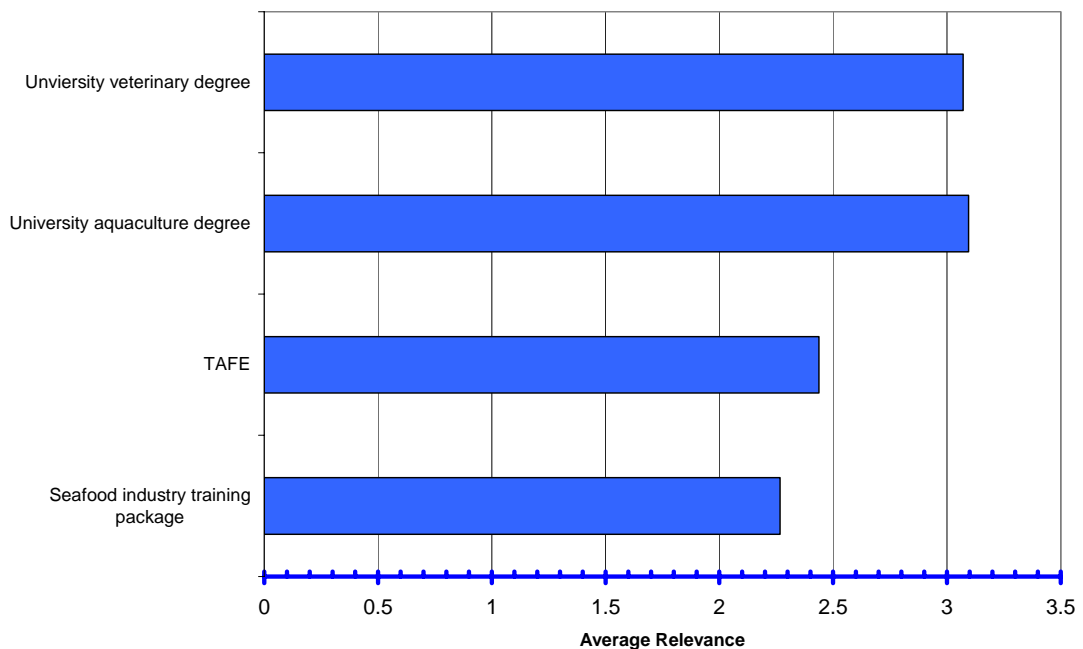


Figure 12. Relevance of off-farm AAH education and training for practical application on the farm as measured from 1 to 5 scale.

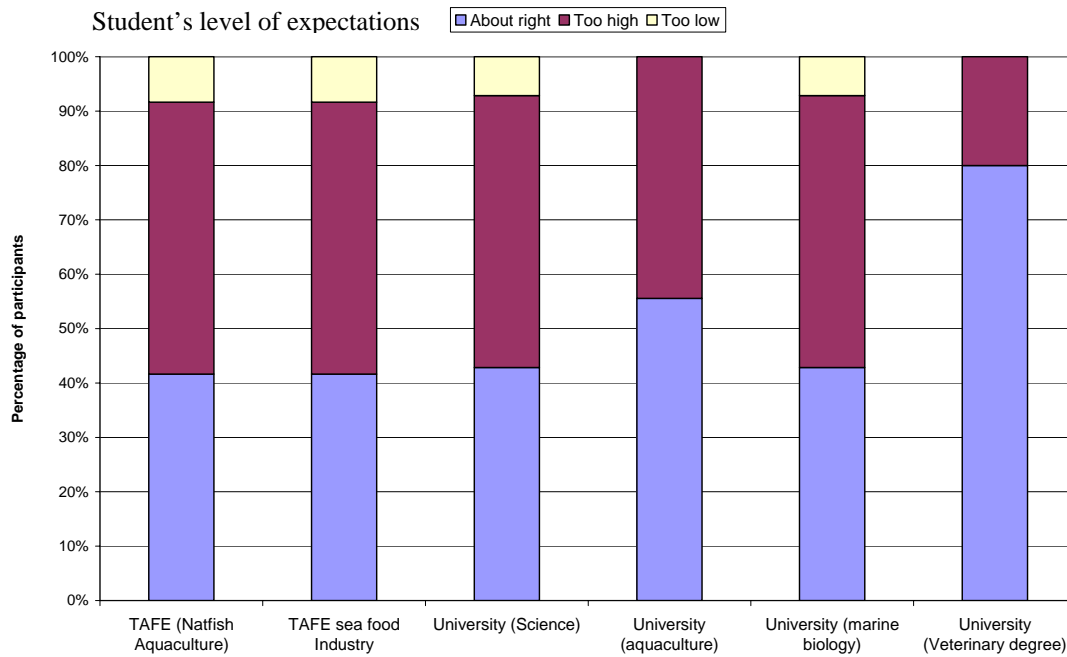


Figure 13. Aquaculture manager's perception of the level of expectations brought by recent graduates to a new job position.

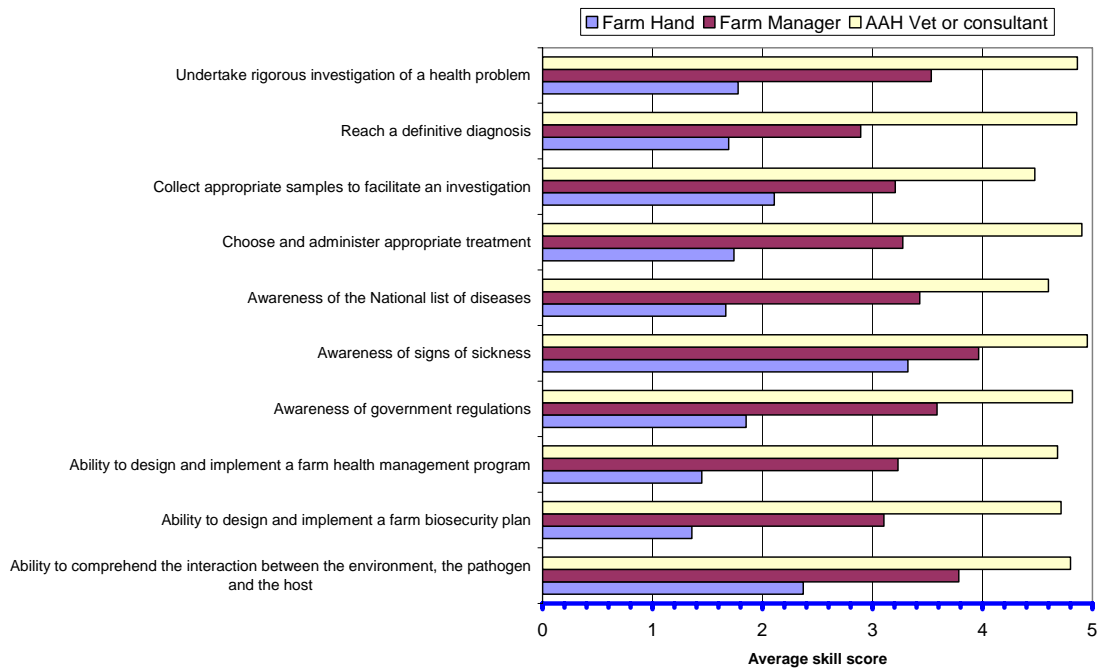


Figure 14. Scoring the level and frequency of skills required by farm hands, managers and AAH vets or consultants on a 1-5 scale.
 1- not required at all; 2- Basic skill -used rarely (once a year); 3- Basic skill used regularly; 4-Advanced skill used occasionally; Score 5-Advanced skill used regularly

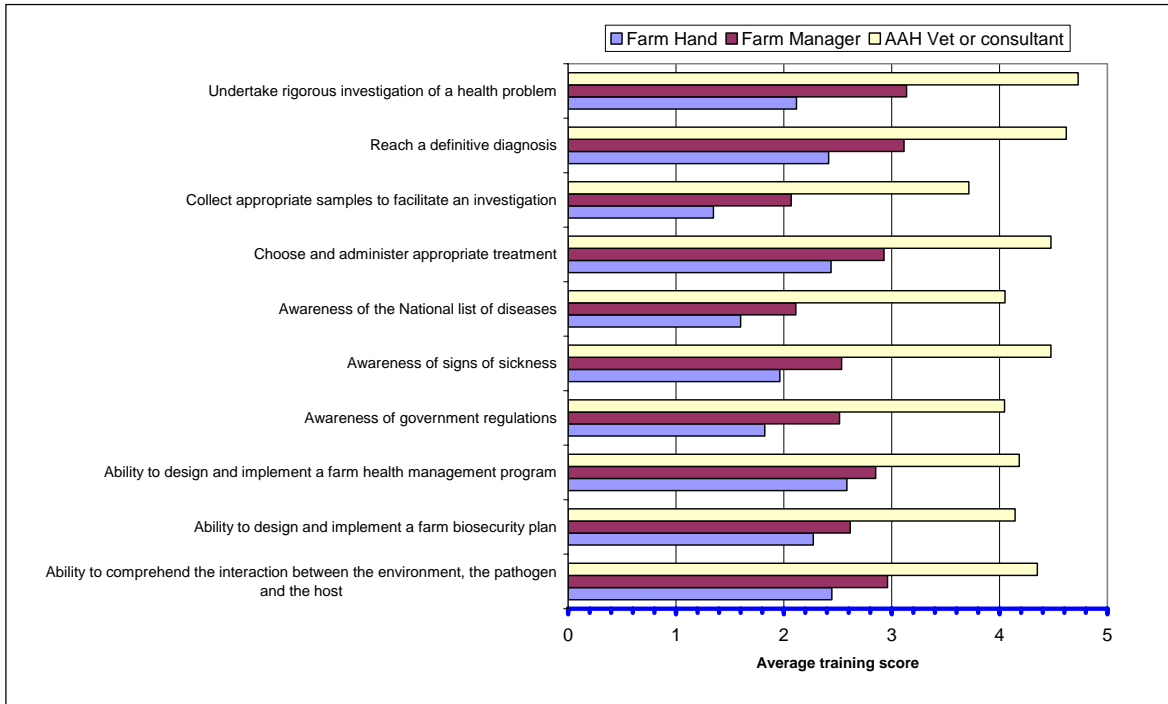


Figure 15. Scoring amount of training required for proficiency in the key AAH skill areas on 1-5 scale. 1 - Two day course; 2 - One week course; 3 - One semester course; Score 4 - One year diploma; Score 5 - Five year degree.

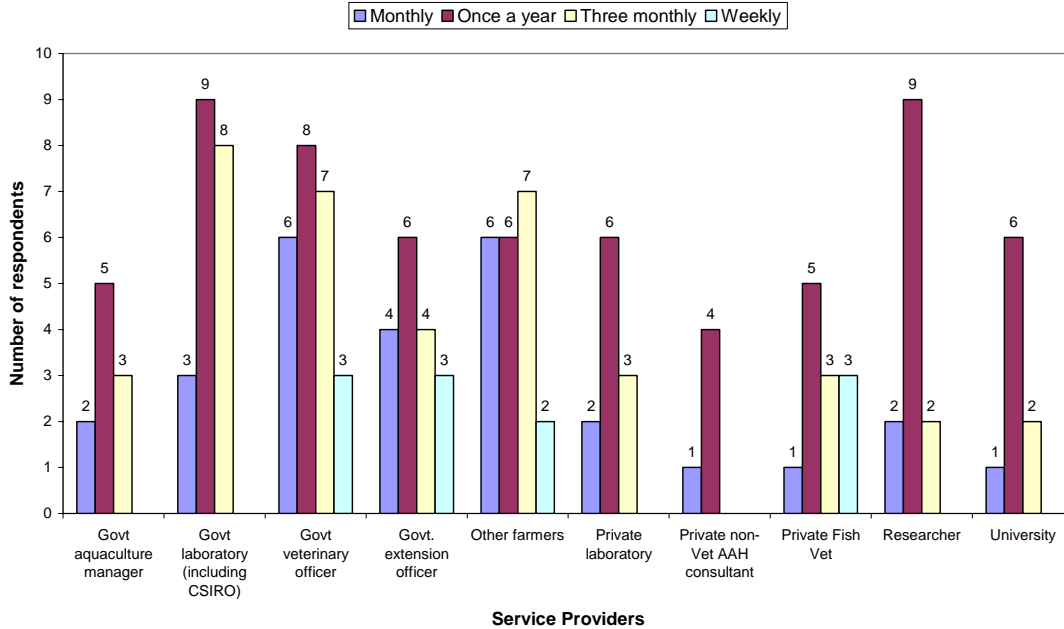


Figure 16. Ranking of service providers by the frequency of their use by aquaculture stakeholders.

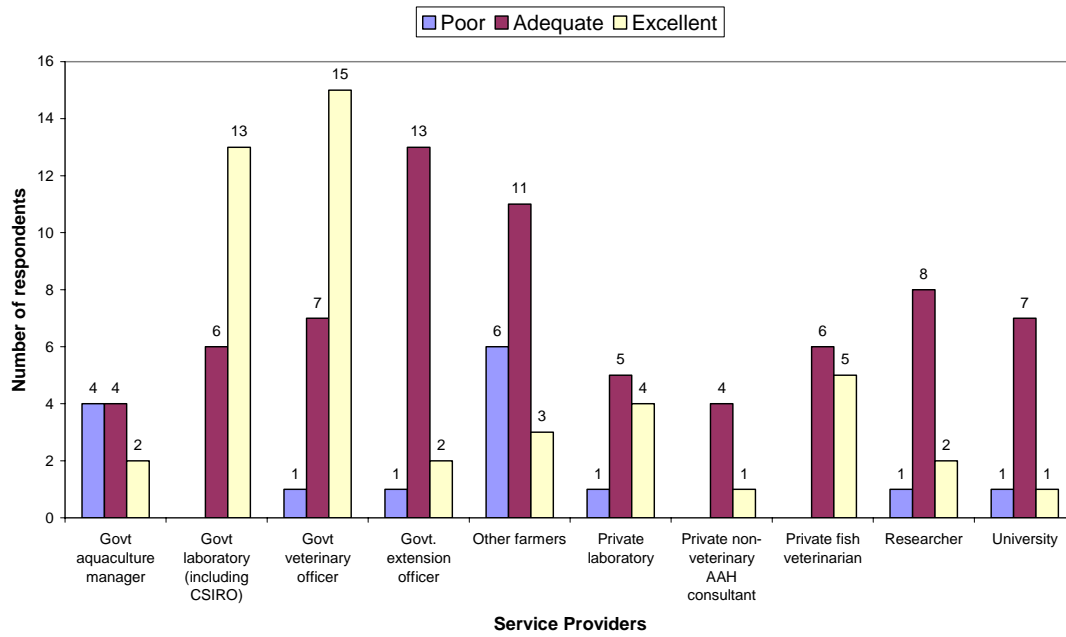


Figure 17. Diagnostic technical adequacy of service providers.

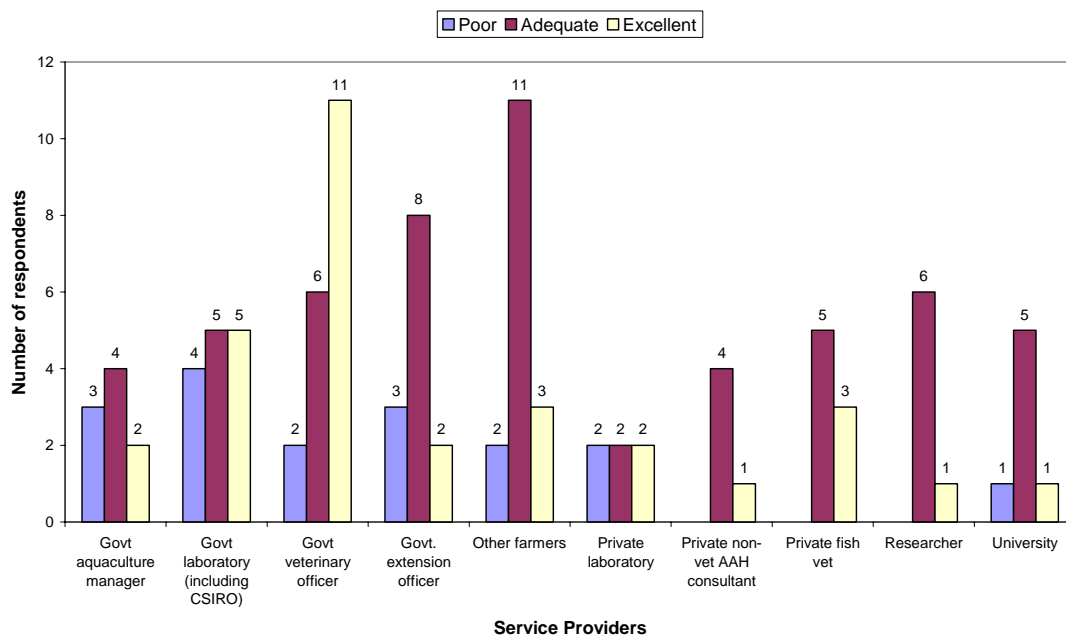


Figure 18. Treatment technical adequacy of service providers.

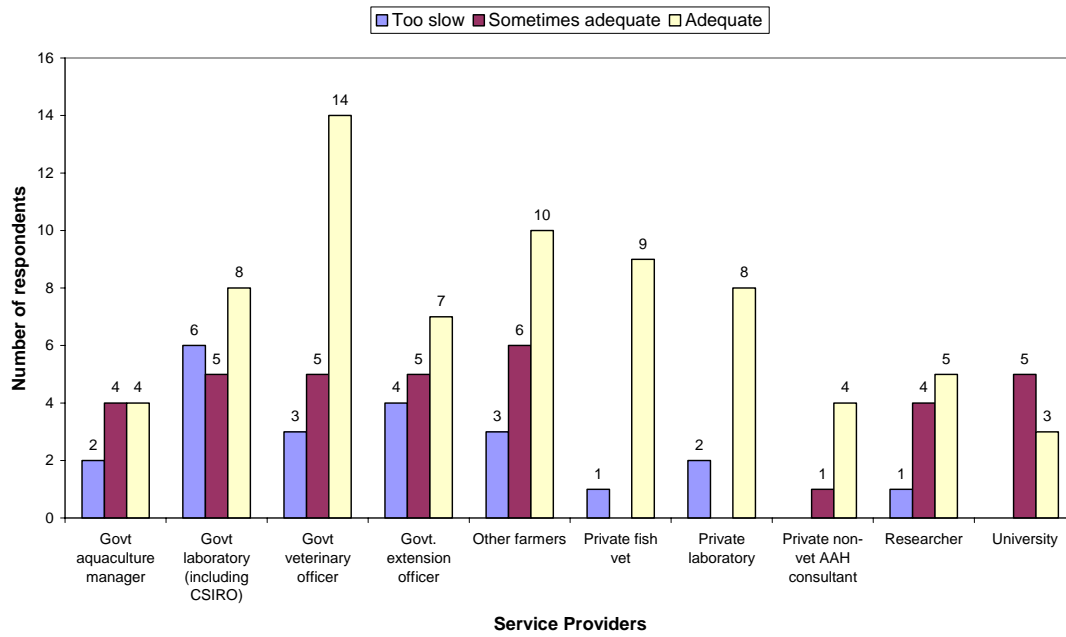


Figure 19. Timeliness of the service provided.

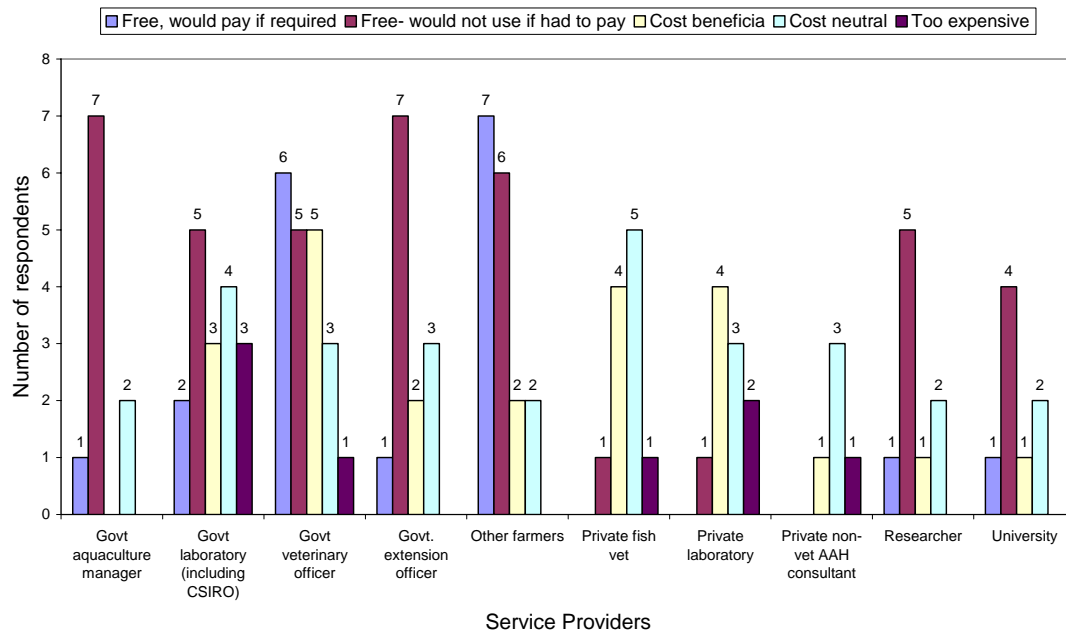


Figure 20. Cost-effectiveness of the service provided.

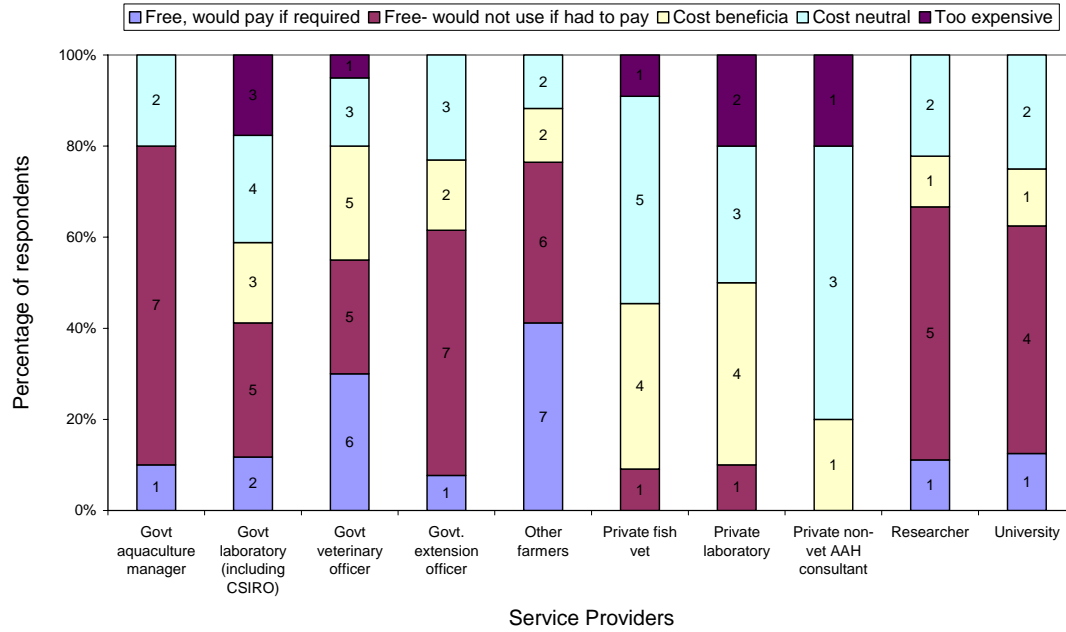


Figure 21. Cost-effectiveness of the service provided.

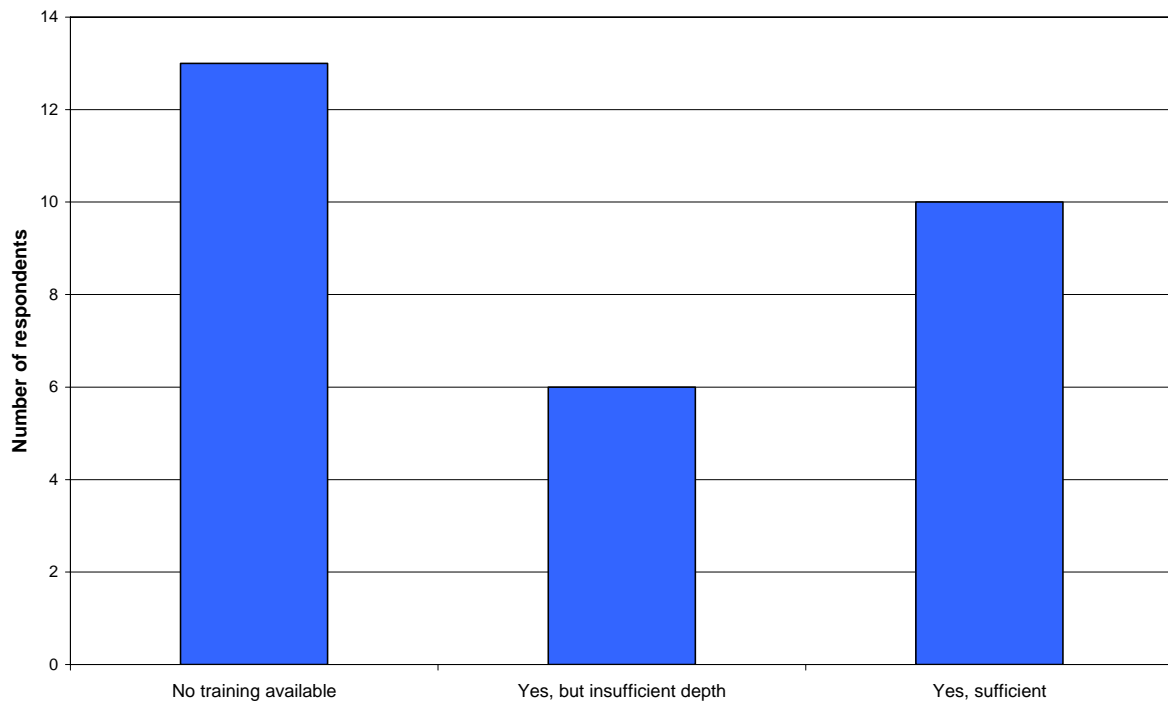


Figure 22. Perceptions of availability of training and its adequacy.

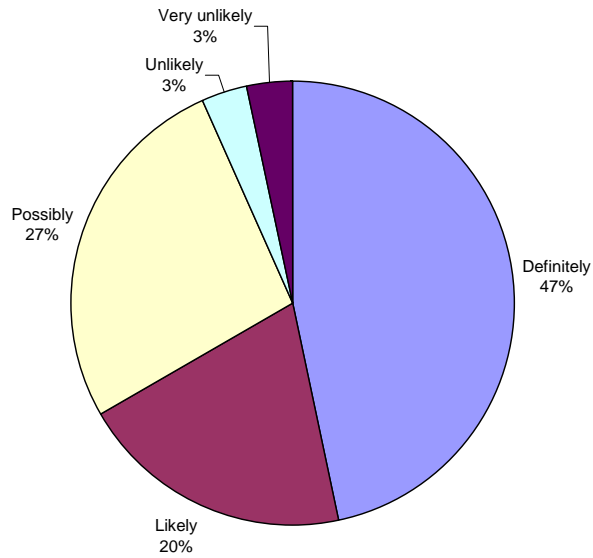


Figure 23. Proportion of participants believing that their business would benefit from improved AAH input.

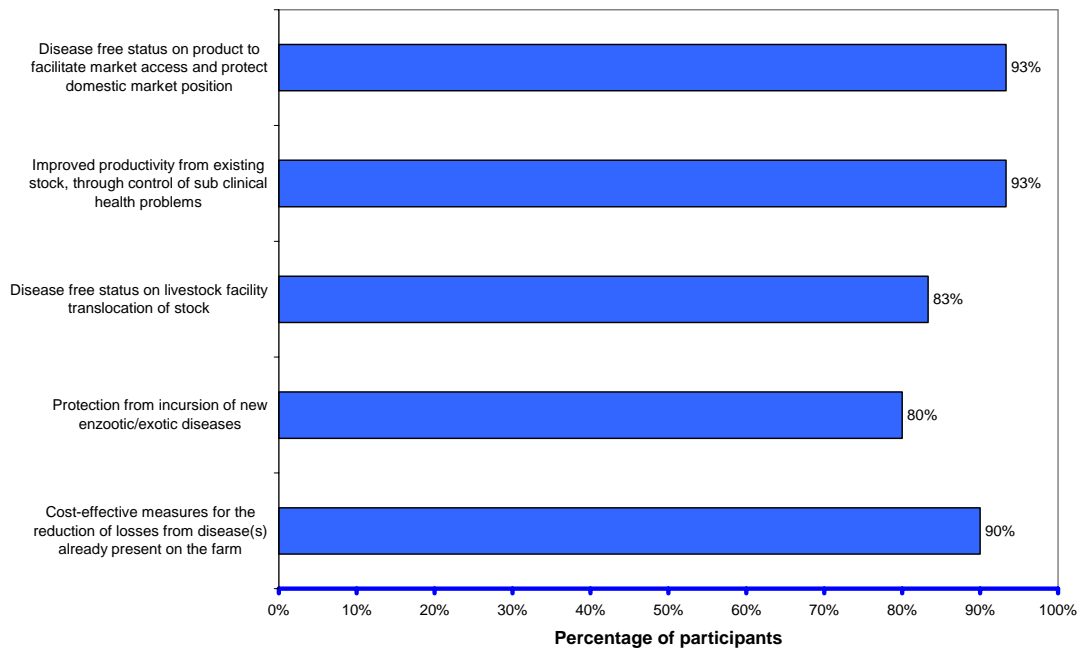


Figure 24. AAH outcomes being sought.

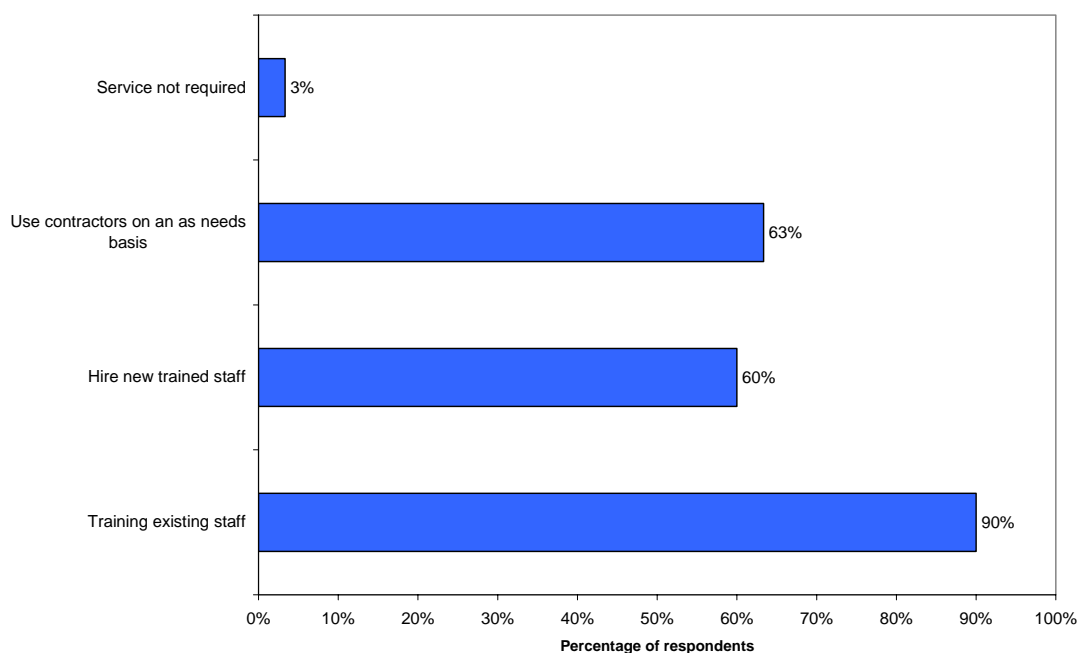


Figure 25. Preference for incorporation of more AAH services into the operations, if required.

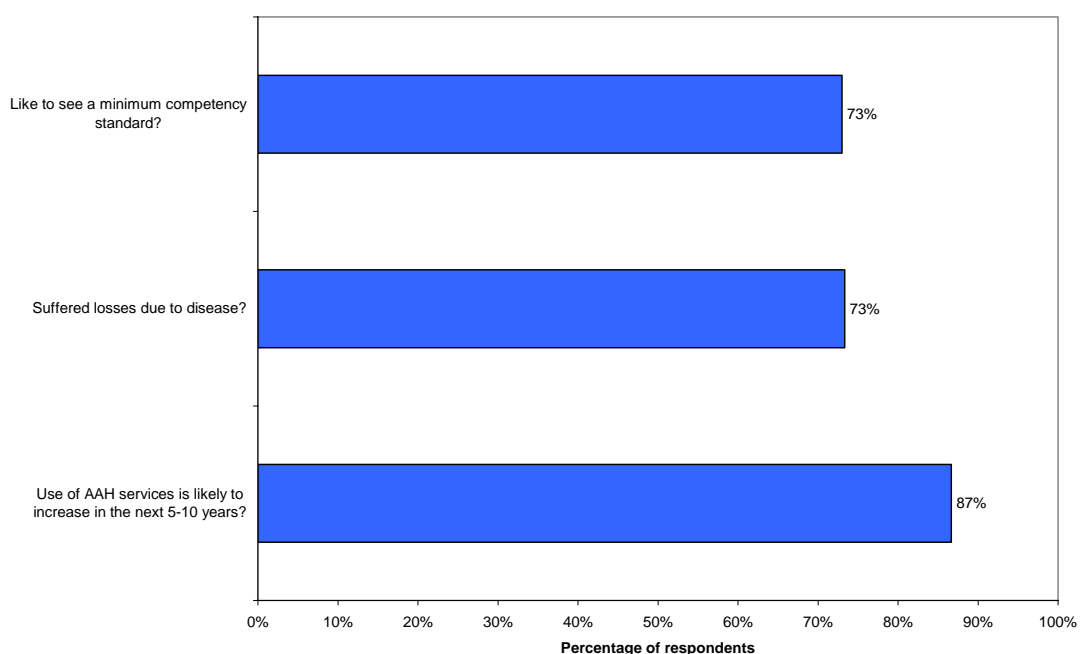


Figure 26. Experiences of past and insights for future.

Government Fisheries and Aquaculture Managers

Government managers recorded activity of varying frequency across a broad range of AAH service areas (see Figure 27). This group saw little gap between their current skill set and required skill set (see Figure 28), which is an interesting perception given the strong view of the aquaculture industry stakeholders of the need for more training in this group. Even with this perception that current skills were adequate, around 60% of respondents supported, and would attend, further training across a broad range of AAH areas (see Figure 29). When

respondents were asked to nominate the length of training required to perform optimally in each skill area, the response was diverse (see Figure 30): as 30-50% of respondents felt a degree course was the minimum training prerequisite. At the other end of the spectrum some managers see training requirements as being minimal, as little as a two-day course being perceived as sufficient.

When Government and Aquaculture Managers were asked what level of background education was required to perform adequately in their position, the responses were a fairly even mix between veterinary skills, business and administration skills and other science degrees (see Figure 31).

As with the aquaculture respondents, the majority of government respondents saw a clear need for increasing AAH services in the near future across all areas of laboratory, field and policy (see Figure 32).

This stakeholder group sought AAH services from Government laboratory resources, research facilities and universities extensively (see Figure 33) and were generally happy with the adequacy and timeliness of the advice (see Figure 34, 35), though again, government services were seen as expensive by a few respondents (see Figure 36).

In contrast to the earlier response about the adequacy of current skill levels, where respondents uniformly felt they had sufficient skills, only 8% of respondents thought that their ability to manage would not improve with increased AAH input (see Figure 39). The preferred method for incorporation of greater AAH service was through training existing staff and enhancing training for government extension staff (see Figure 37).

Again, in contrast to the responses on the adequacy of current skill levels, only 8% of respondents saw current training as sufficient, with 42% unaware of any training available to assist in up-skilling in AAH disciplines (see Figure 38). 86% of respondents had dealt with a significant scale disease problem demonstrating the ubiquitous nature of disease problems in farmed and wild animal populations (see Figure 40).

Half of the respondents would like to see accreditation standard for AAH professionals, with a further 21% uncertain of its value and 29% of respondents thought it was not required (see Figure 41).

In a separate survey undertaken by National Aquatic Animal Health Technical Working Group, representatives from each State Government were requested to populate a table indicating the current and future anticipated needs in terms of full-time equivalent staff. The aggregate results are presented in Figure 42 and 43 below, demonstrate that even currently there is an unmet need for skilled staff, which is anticipated to grow into the future.

Graphical representation of Results from Government Fisheries and Aquaculture Management Survey

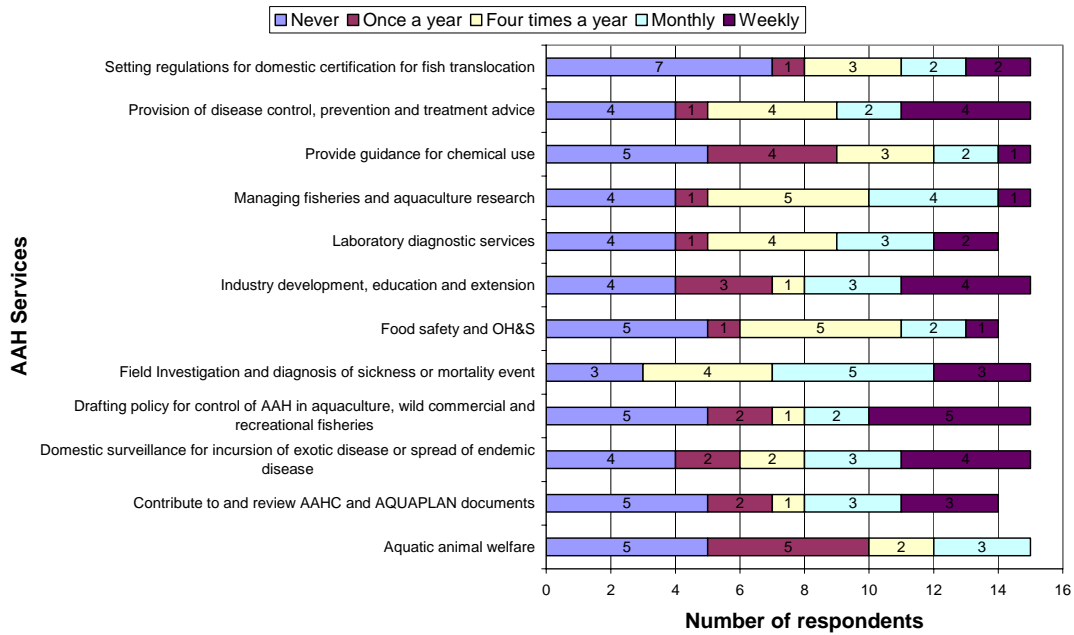


Figure 27. Frequency of service provided.

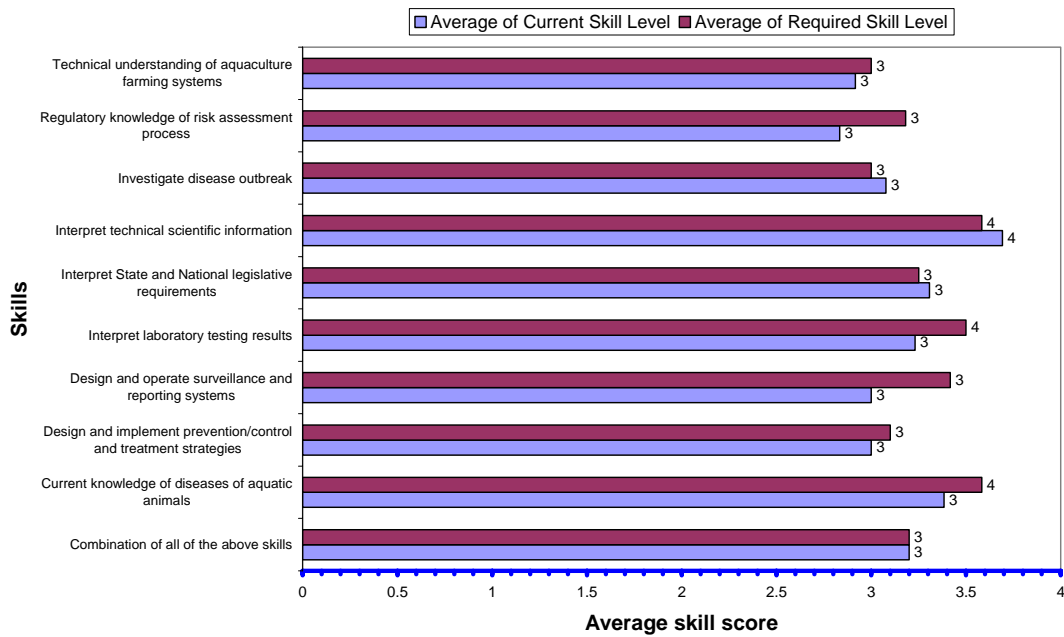


Figure 28. Current and required skills for providing requisite services.

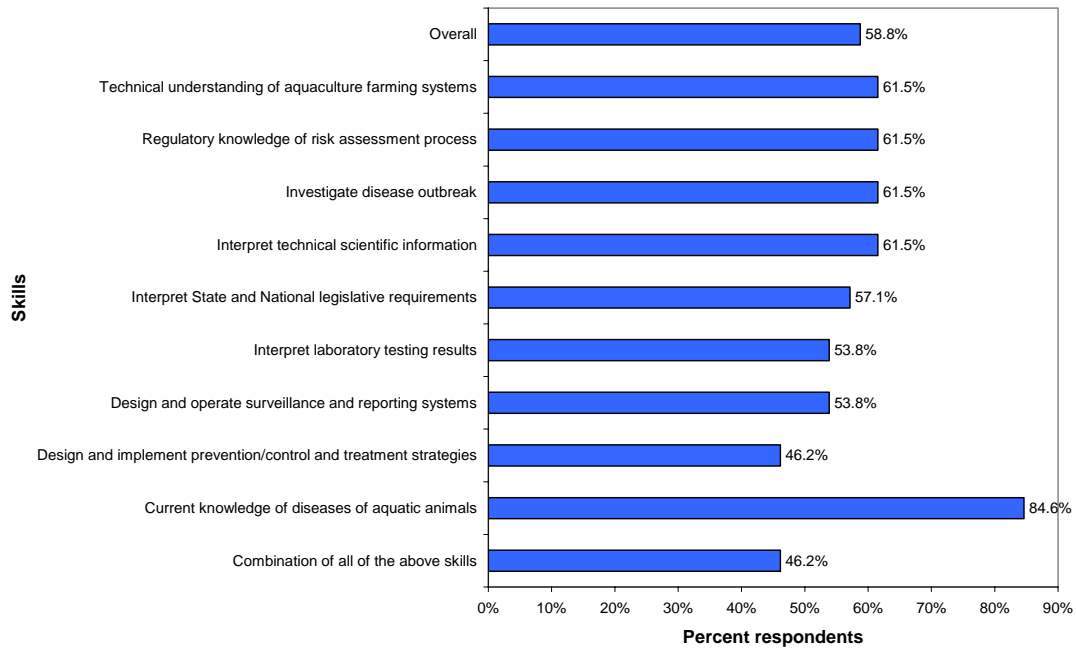


Figure 29. Percent of respondents supporting and willing to attend training in the respective skill area.

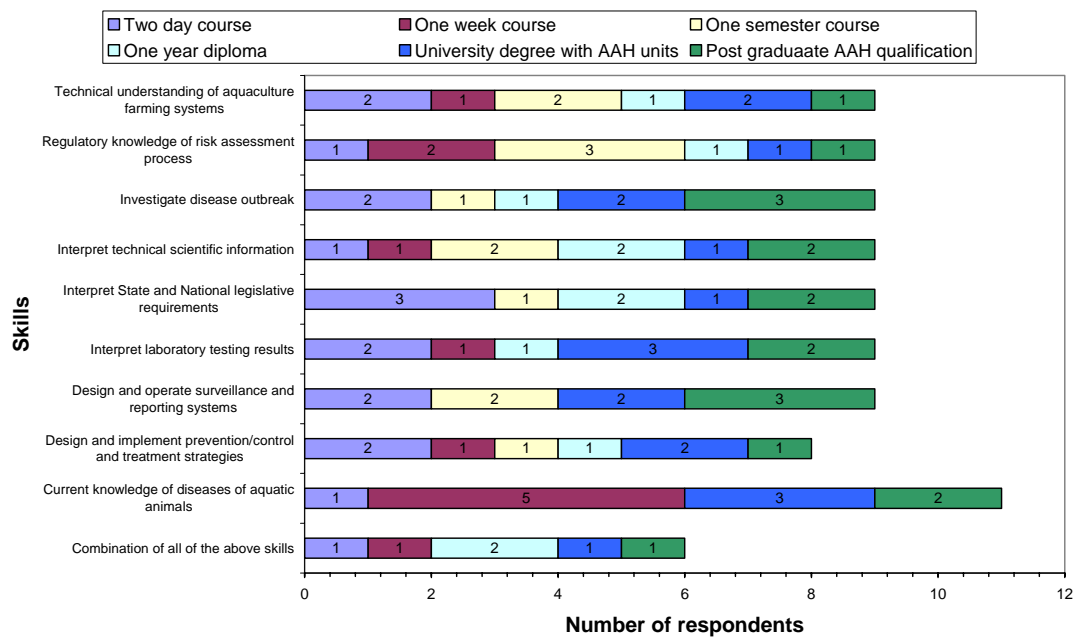


Figure 30. Length of training required to perform optimally in each skill area.

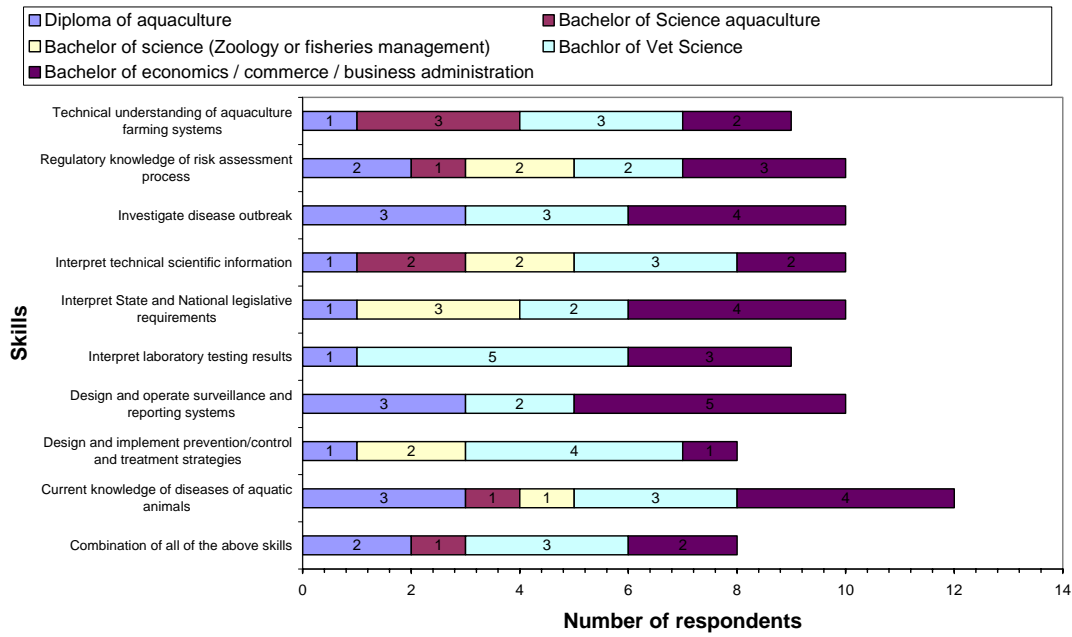


Figure 31. Background education required for various skills.

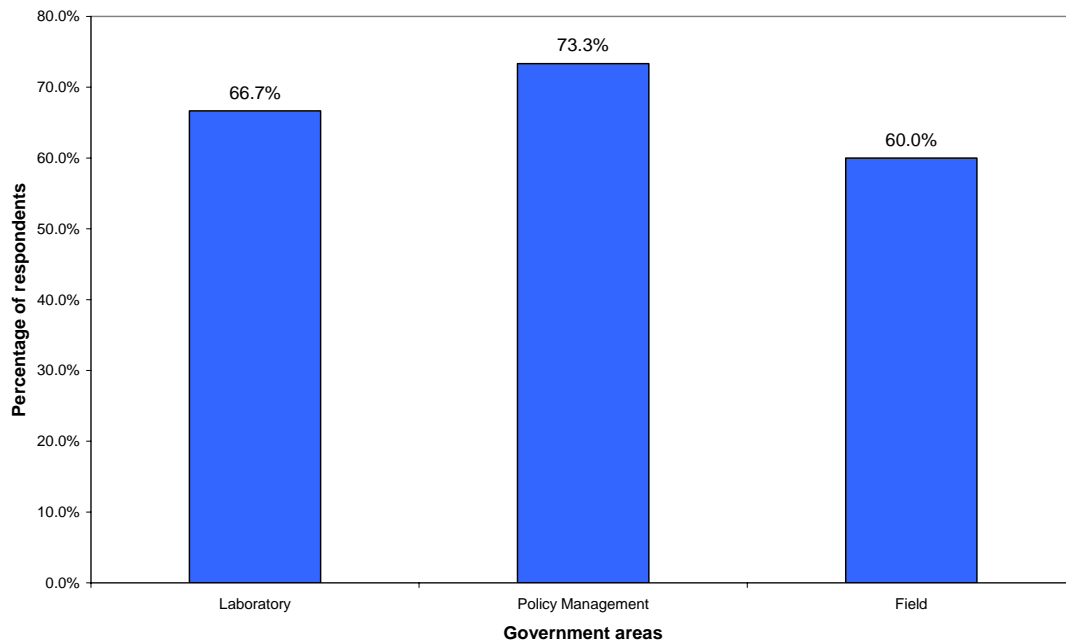


Figure 32. Proportion of respondents believing (agreeing or strongly agreeing) that the use of AAH services is likely to increase in the next 5-10 years.

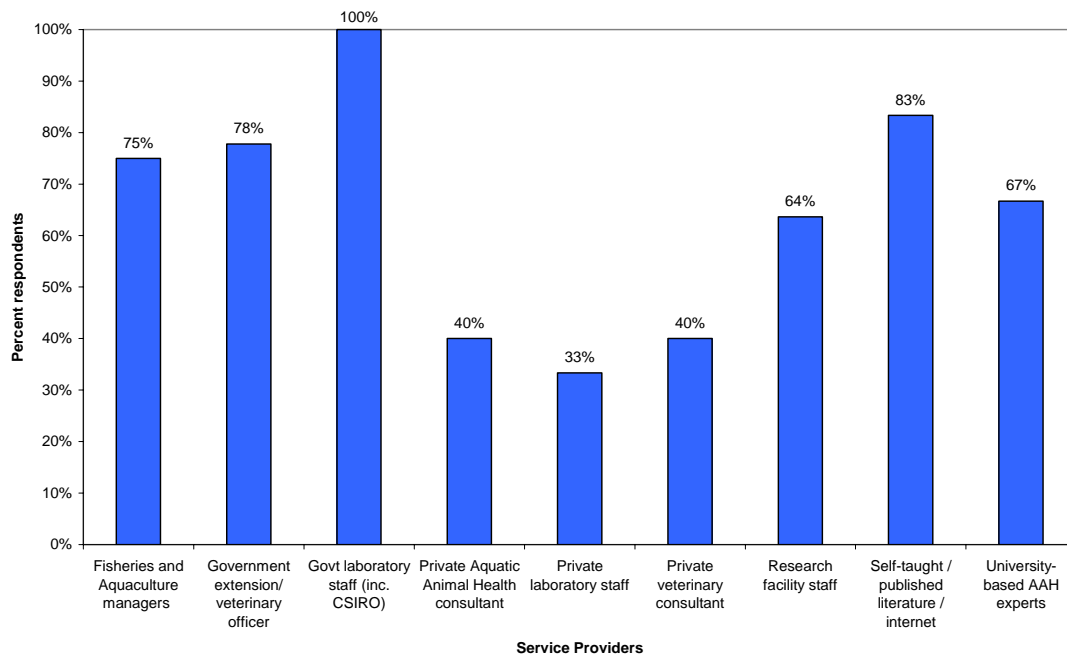


Figure 33. Percent of respondents using various services currently.

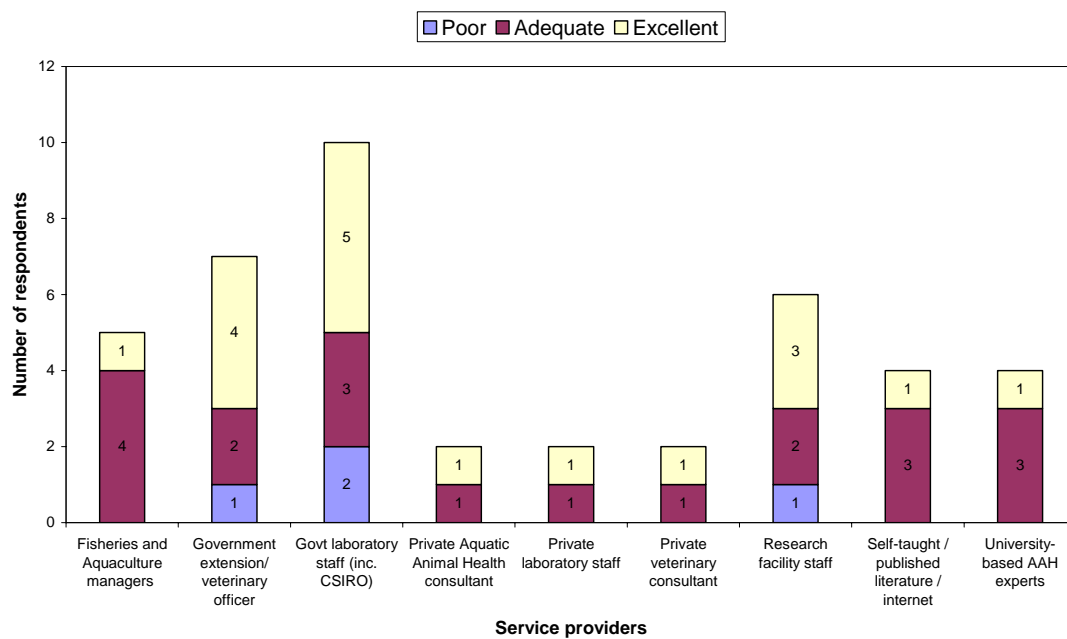


Figure 34. Technical knowledge adequacy of the service provided.

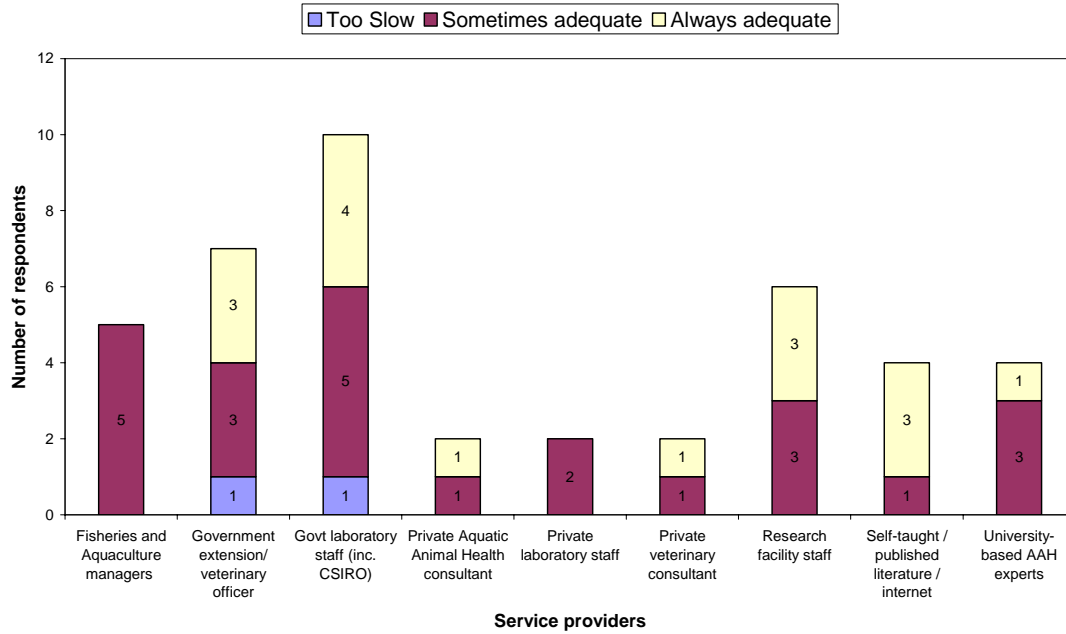


Figure 35. Timeliness of the service provided.

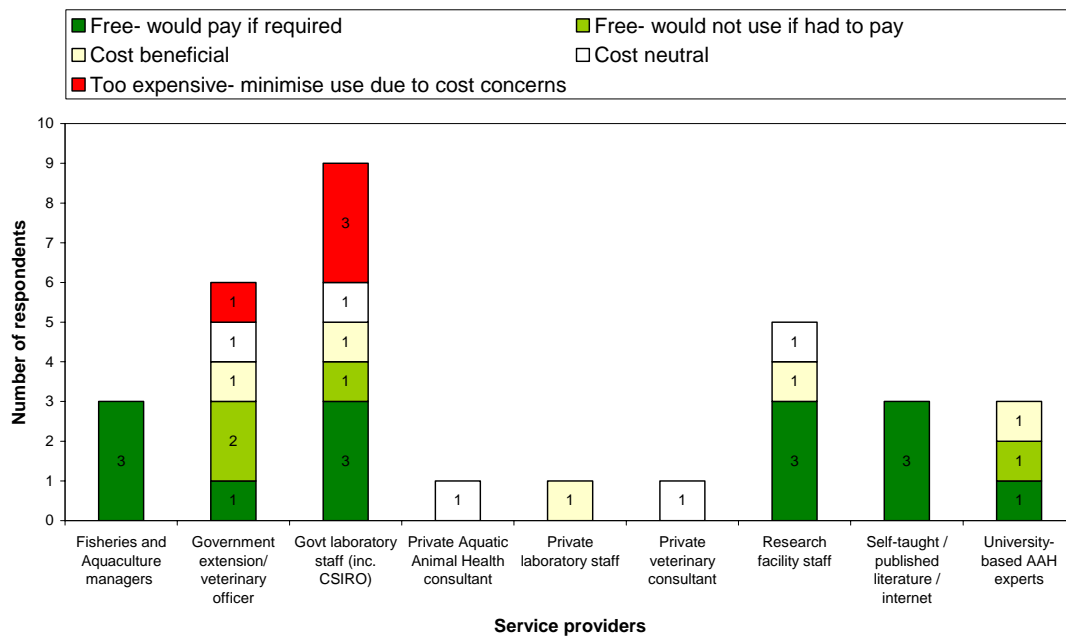


Figure 36. Cost effectiveness of the service provided.

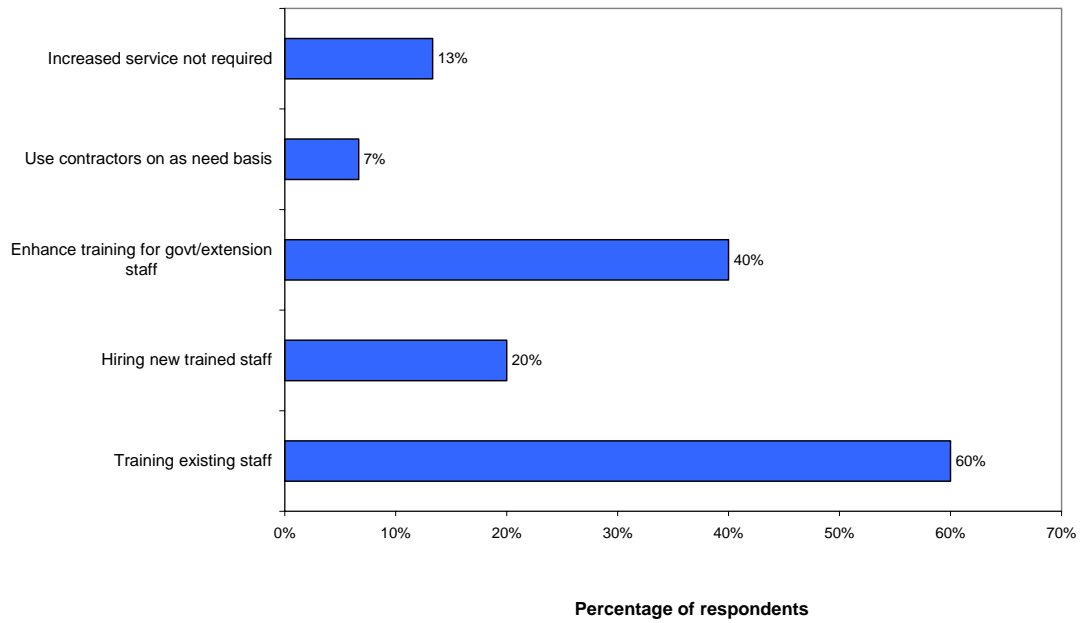


Figure 37. Preference for incorporation of more AAH services into the management, if required.

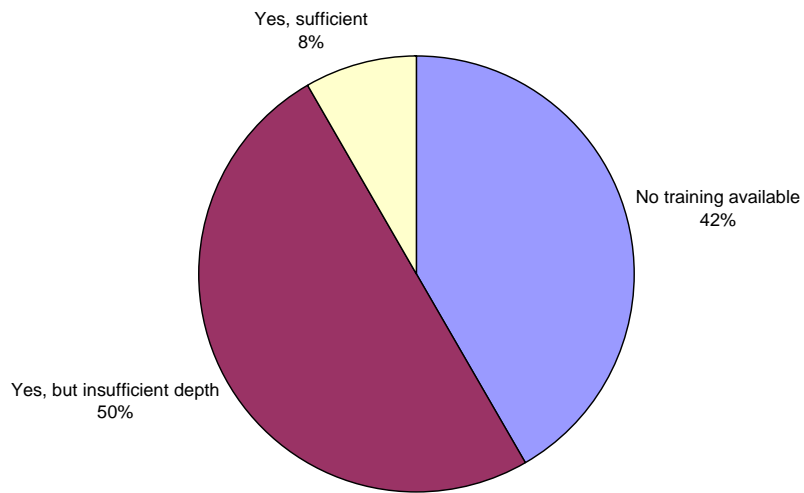


Figure 38. Perceptions of availability of training and its adequacy.

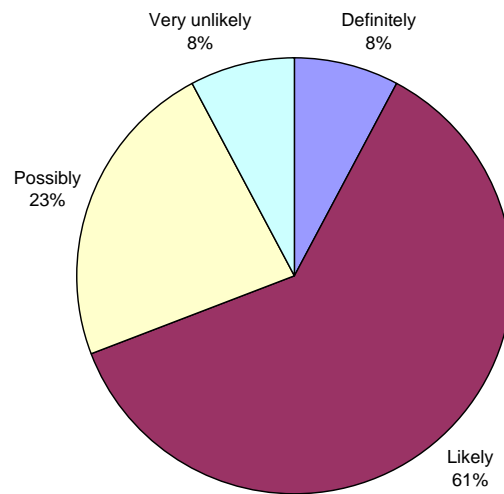


Figure 39. Proportion of participants believing that their management would benefit from improved AAH input.

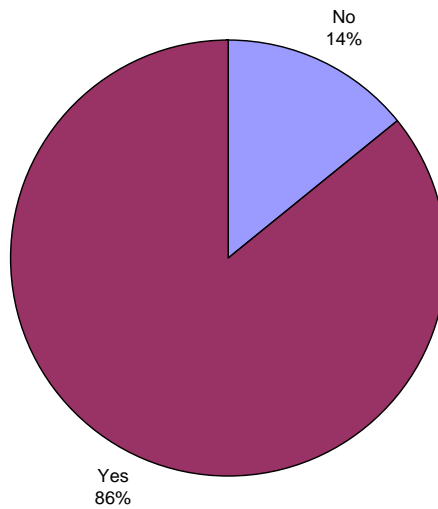


Figure 40. Proportion of participants agreeing that their management had to deal with a significant scale health/disease problem.

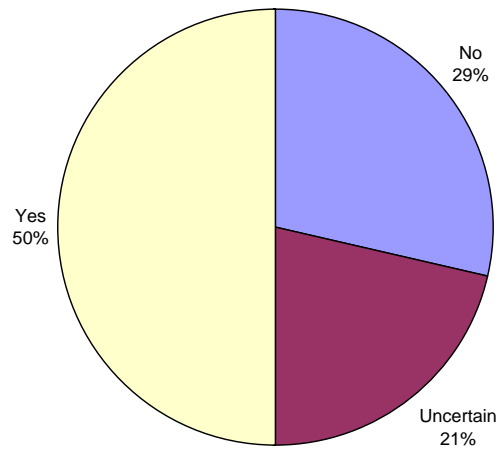


Figure 41. Proportion of participants wanting to see a minimum competency/accreditation standard to be brought into the areas of AAH service provision.

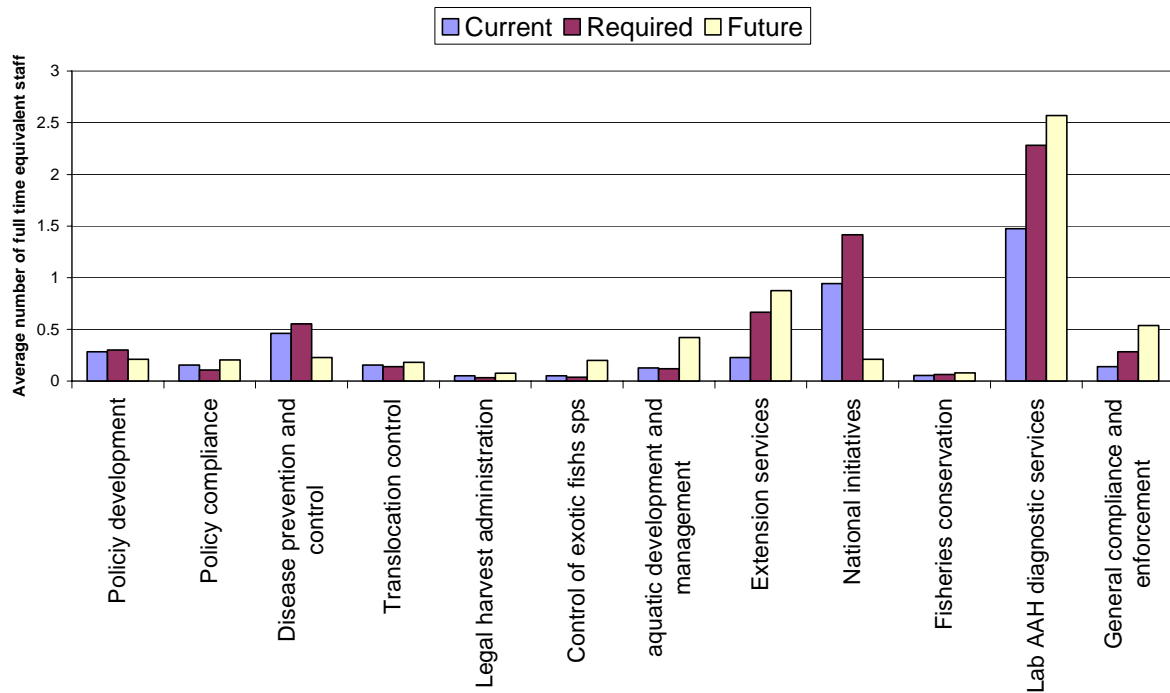


Figure 42. State Government AAH staff requirements across areas of responsibility.

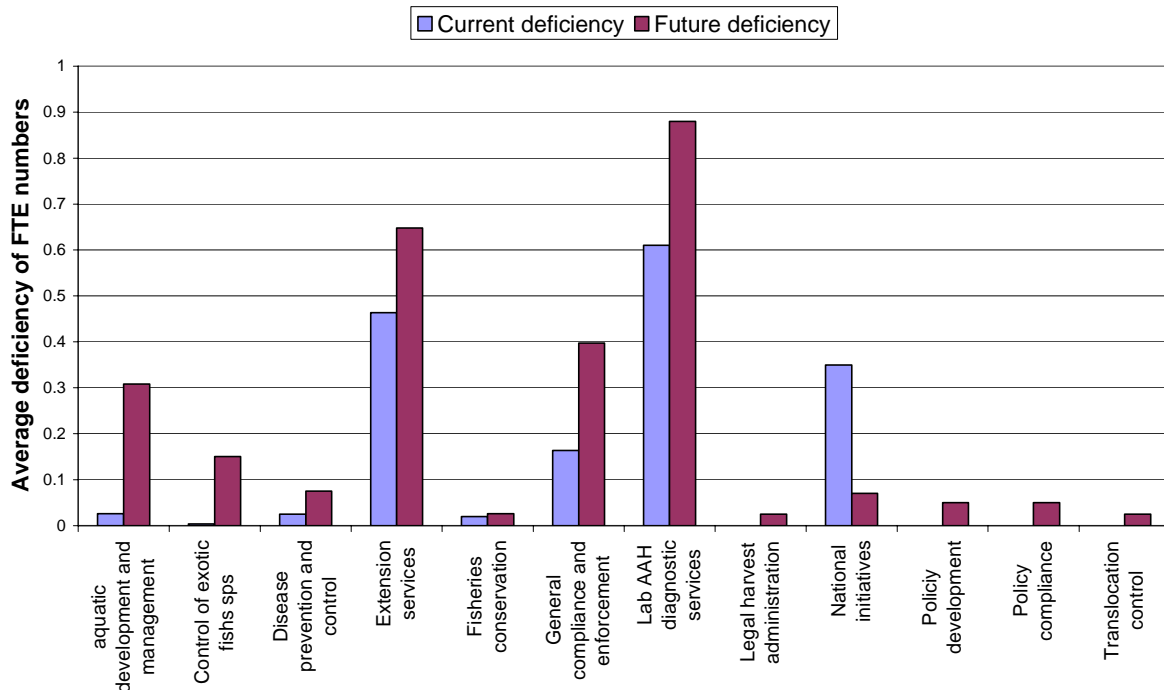


Figure 43. Aggregate State Government areas of deficiency currently and predicted staff deficiencies in 5-10 years.

Laboratory survey results

Laboratory staff possess a wide range of skills that are utilised frequently in the provision of AAH services to all of the stakeholder groups surveyed (see Figures 44, 45 and 46). Survey responses were received from a total of 31 laboratory staff from all States/Territories? The consultant also undertook informal telephone or in-person interviews with 120 laboratory staff from around Australia to collect broad views on areas of perceived need for education and training.

Across many of the skill areas respondents highlighted perceived deficiencies in their own abilities (see Figure 47). 53% believed that the technical knowledge of their discipline was not of the same standard as for terrestrial animals (see Figure 48). This flowed into the laboratory respondents' much higher perception of the level of training required for them to perform adequately, with university or post-graduate training being predominant in all the skill areas surveyed (see Figure 49). Given the earlier indications by aquaculture industry respondents that laboratory services are one of their primary sources of AAH assistance, it is clearly sub-optimal that the providers feel their capacity to deliver, is currently sub-standard.

70% of samples arriving at the laboratories come directly from farmers, with only 20% coming through referral from veterinary or non-veterinary AAH professionals (government and private) (see Figure 50). This is in striking contrast to the situation observed by the consultant for terrestrial animal samples which routinely come via a field veterinarian. 23 of 28 respondents reported that they were able to obtain field information on submissions "more often than not", however a critical finding was that half of the respondents were only "rarely" able to send results to a qualified third party for interpretation (see Figure 51).

Consistent with previous stakeholder groups, the majority of the respondents predicted that service demand would increase in the next 5-10 years (see Figure 52). The adequacy of technical knowledge, timeliness of service and cost-effectiveness mirrored other survey results (see Figure 53, 54, 55) and was generally adequate.

Only 10% of laboratory respondents felt that current training available was adequate, with 31% stating there was no training available (see Figure 57). Unsurprisingly 84% of respondents felt that laboratory services would benefit from increased AAH input (see Figure 58). The majority of laboratory stakeholders felt increased AAH input would be best achieved through training existing staff (see Figure 56).

47% of respondents would like to see competency standards, 43% were uncertain of the need for such a standard and 10% suggested there was no need at all (see Figure 59).

Magnifying the predicted increasing demand will be a declining resource of highly skilled laboratory diagnosticians. The aging profile of the current demographic of 'high level' laboratory diagnosticians was highlighted through FRDC project 2005/621, where the average age of diagnosticians was greater than 50 years (see Figure 60). Many laboratory staff highlighted this issue through interviews with the consultant, and reinforced the survey results, that not only was more training was required, but that succession planning was needed urgently to maintain laboratory capacity into the future.

Graphical representations of results of Survey Questions for Aquatic Animal Health Laboratory Stakeholders

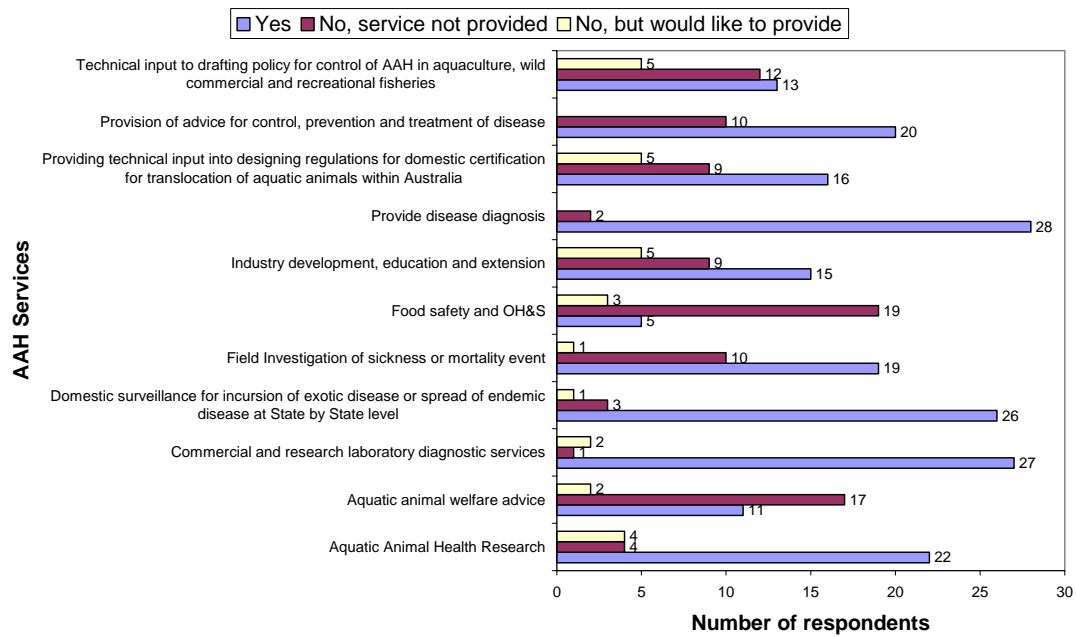


Figure 44. Provision of AAH services by lab to aquaculture and fisheries industries.

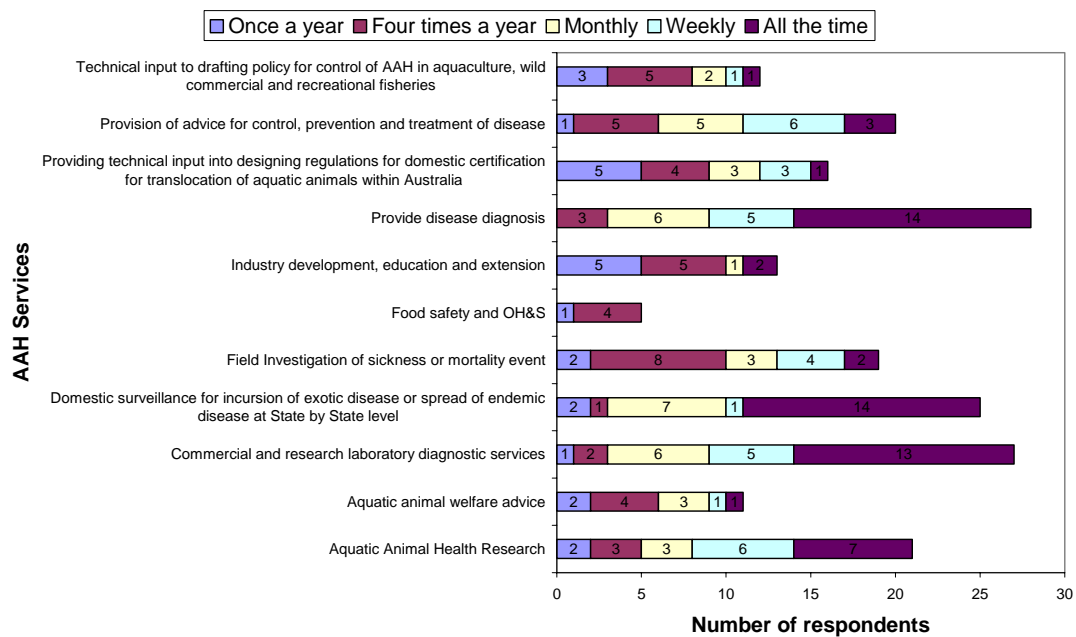


Figure 45. Frequency of AAH services provided to aquaculture and fisheries industries.

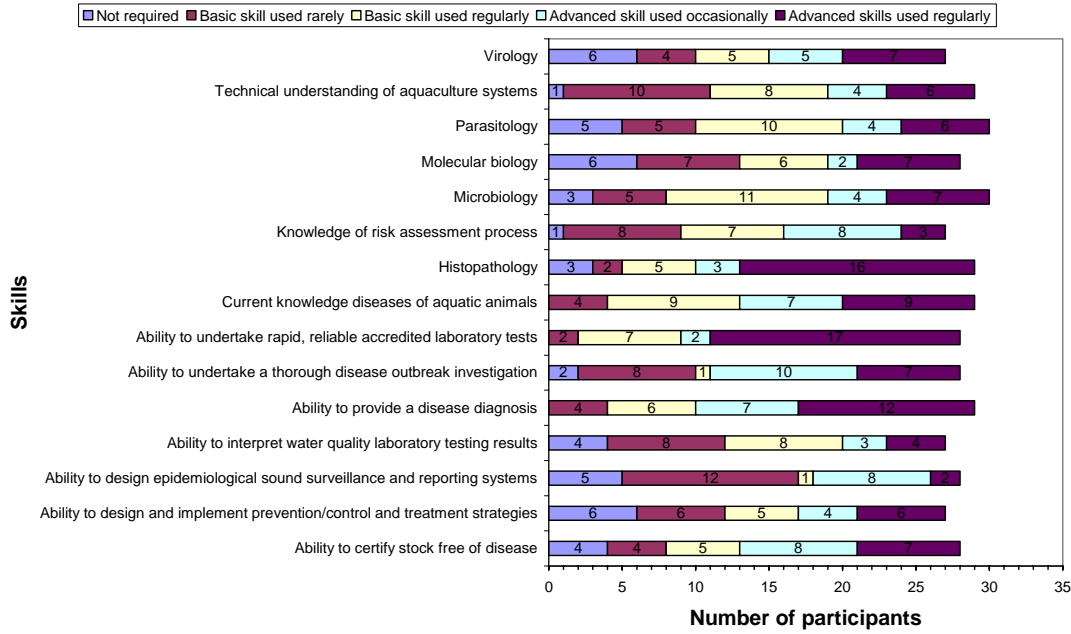


Figure 46. Current skills levels and their frequency of use.

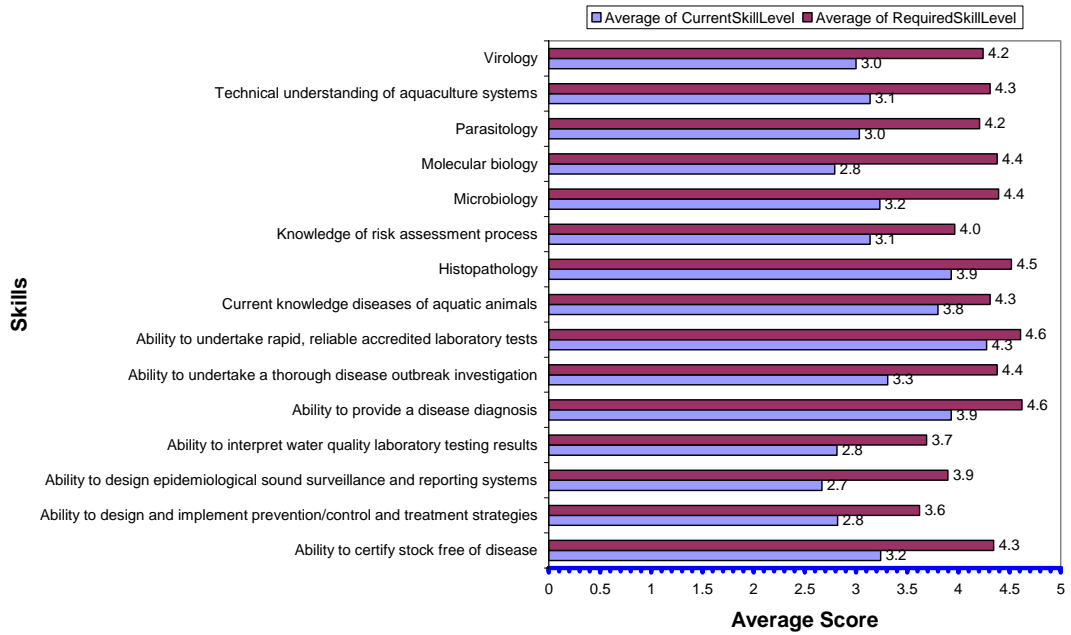


Figure 47. Scoring the level and frequency of current and required skills on a 1-5 scale. 1- not required at all; 2- Basic skill -used rarely (once a year); 3- Basic skill used regularly; 4-Advanced skill used occasionally; Score 5- Advanced skill used regularly.

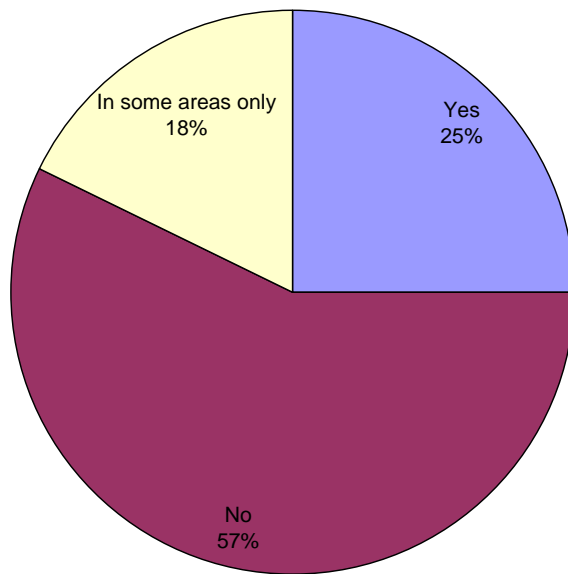


Figure 48. Proportion of respondents believing that the technical knowledge of their discipline is of the same standard as for terrestrial animal submissions.

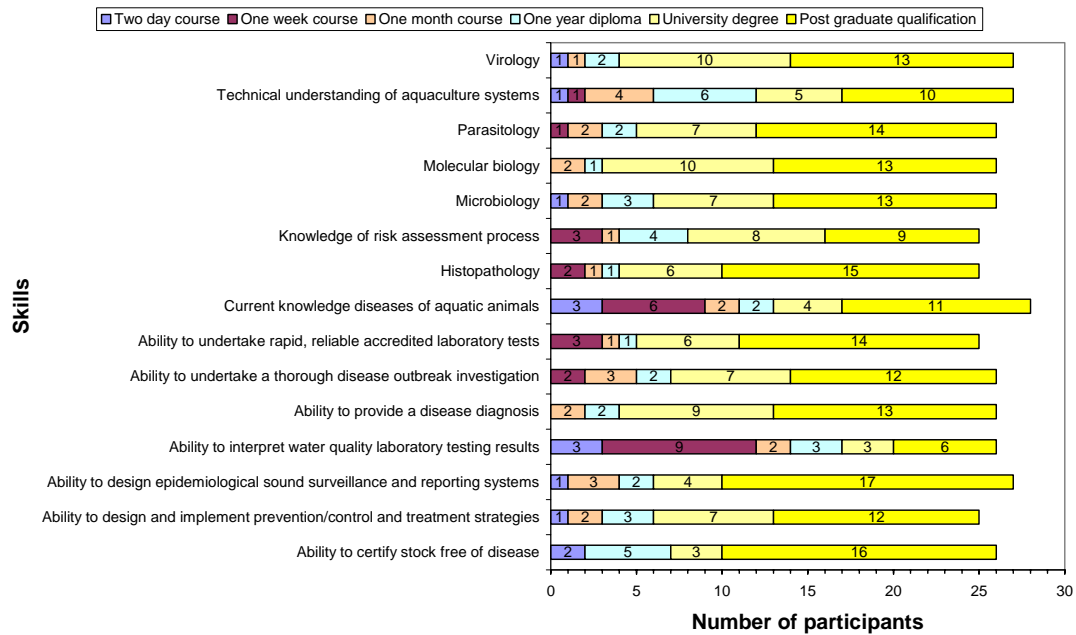


Figure 49. Amount of training required to achieve the required skill level.

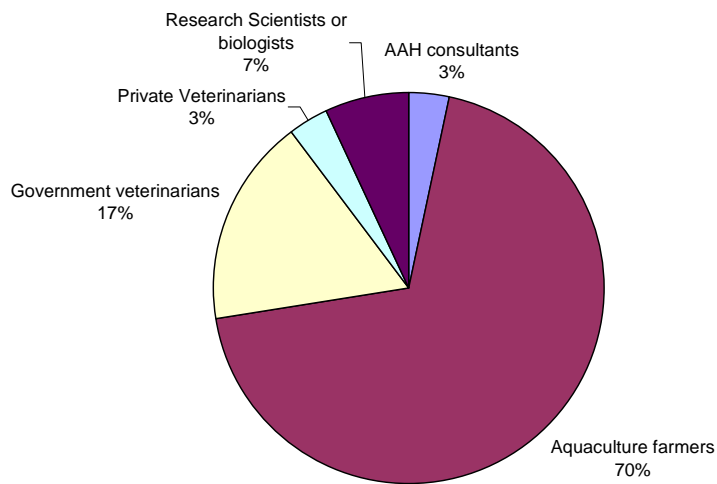


Figure 50. Most common submitters of aquatic animal diagnostic samples according to participants.

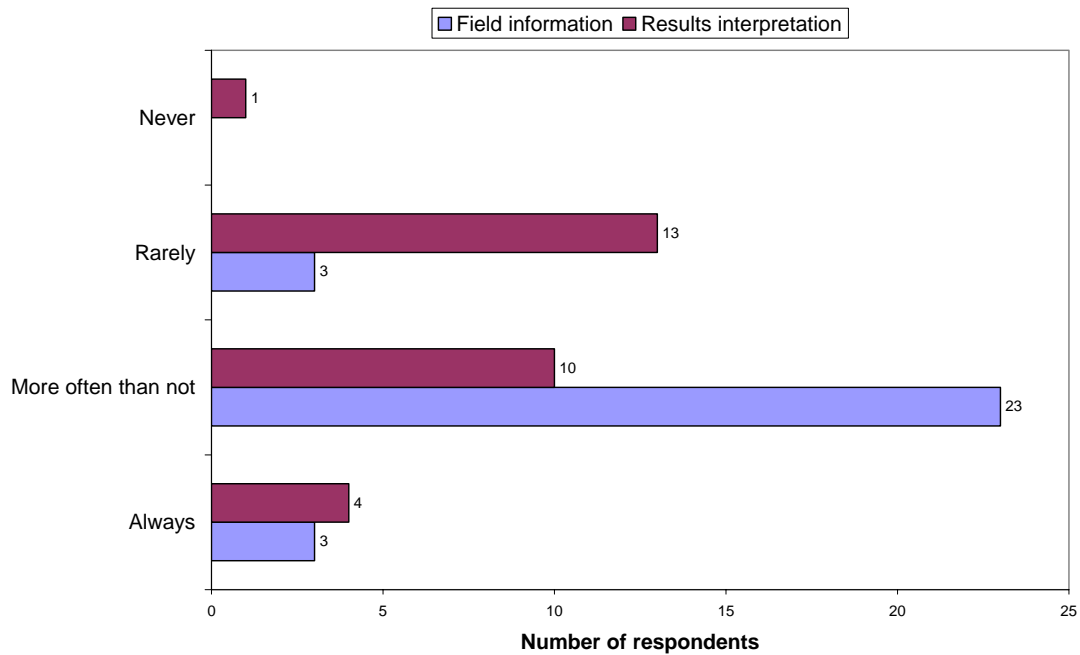


Figure 51. Proportion of respondents believing that the lab is able to obtain field information on aquatic animal submissions and lab is able to send results to a qualified third party for interpretations.

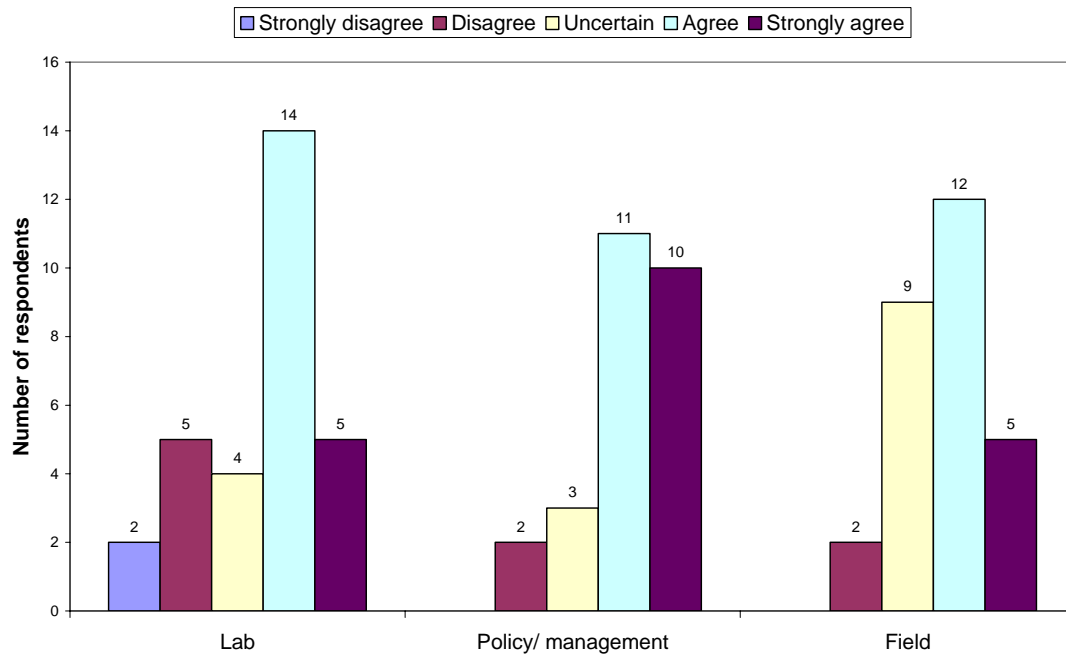


Figure 52. Views of respondents on whether the use of AAH services is likely to increase in the next 5-10 years.

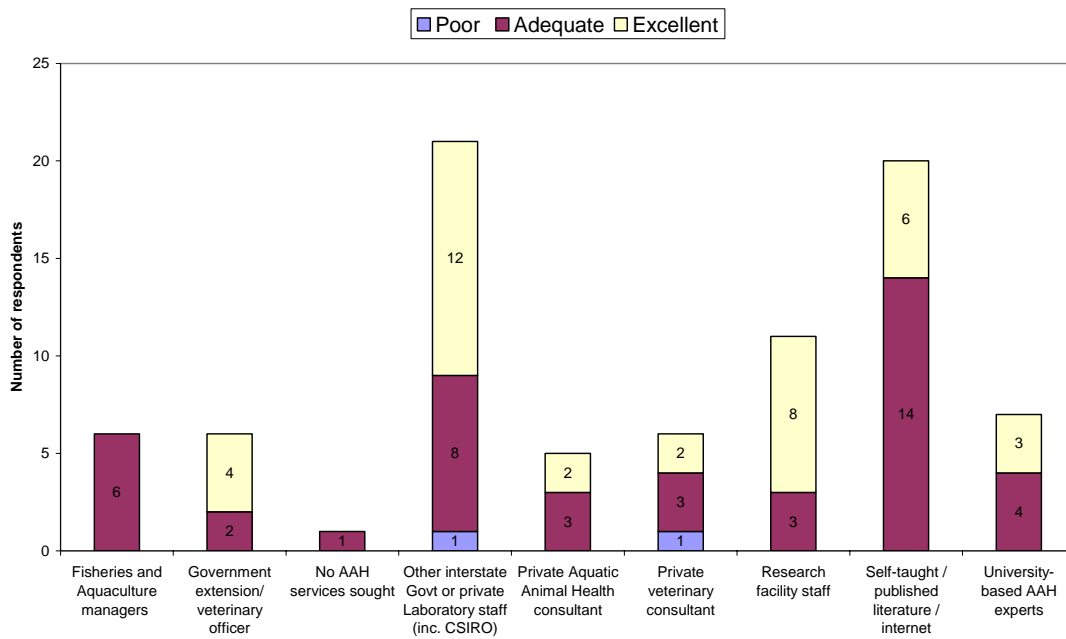


Figure 53. Technical knowledge adequacy of the service provided.

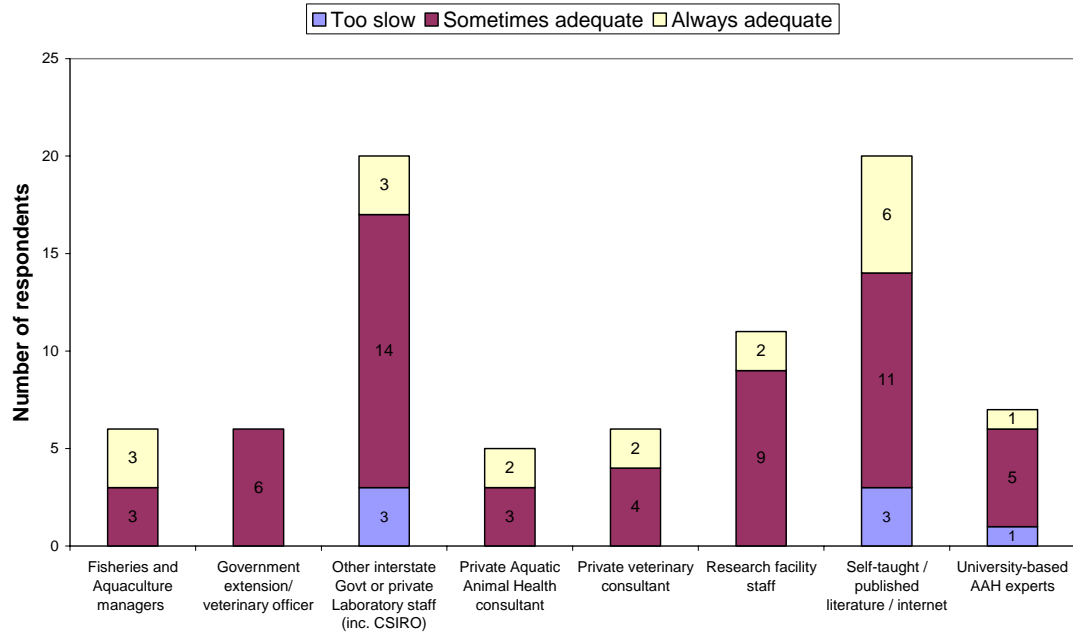


Figure 54. Timeliness of the service provided.

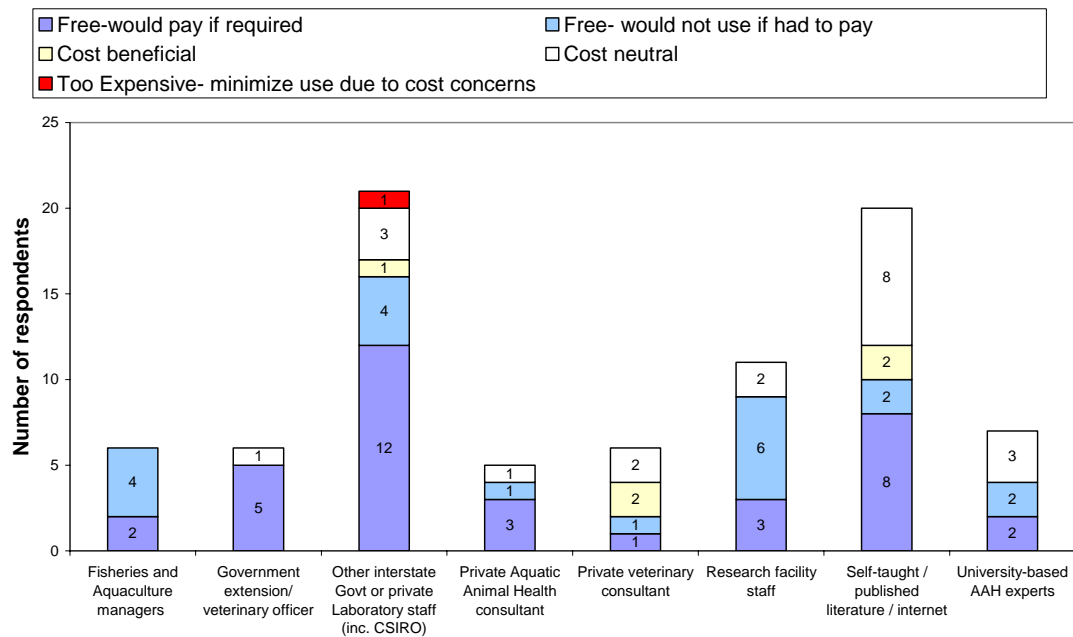


Figure 55. Cost effectiveness of the service provided.

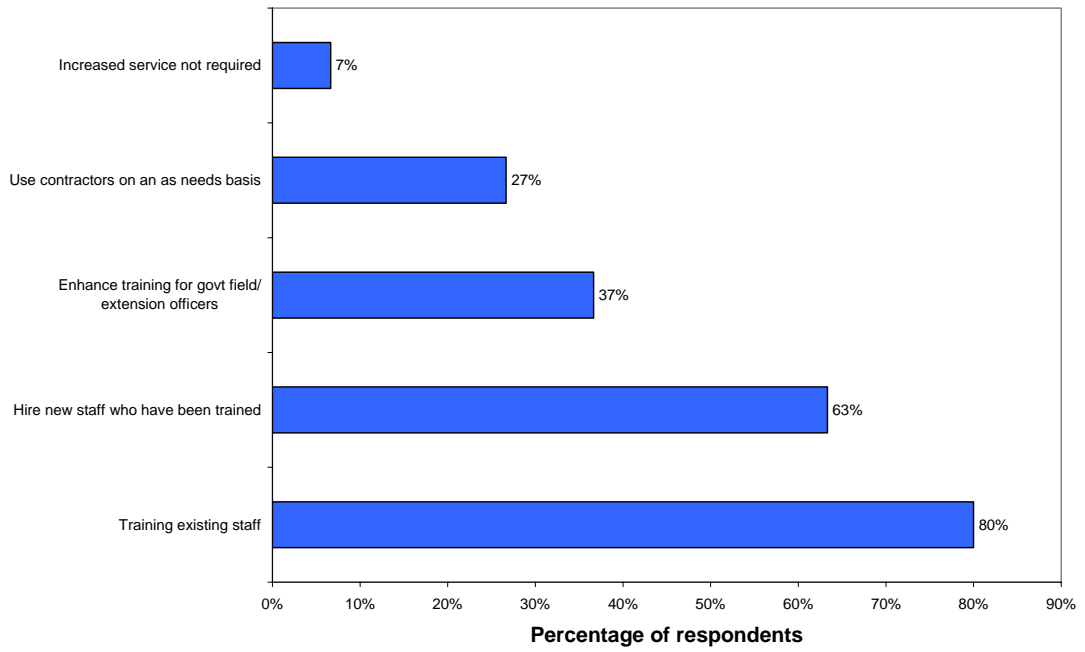


Figure 56. Preference for incorporation of more AAH services into the management, if required.

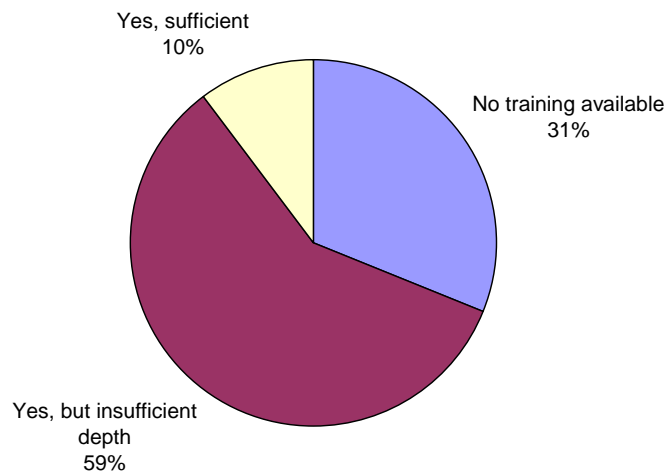


Figure 57. Perceptions of availability of training and its adequacy.

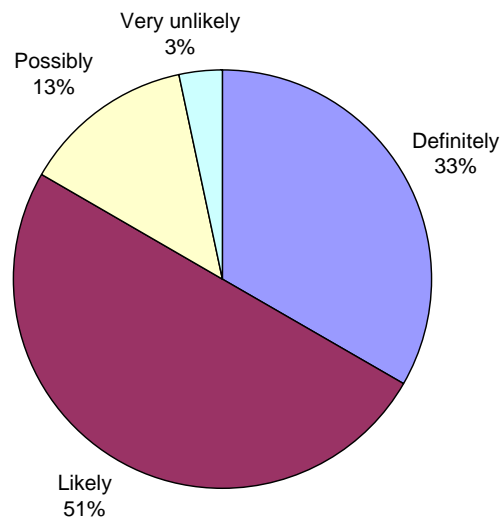


Figure 58. Proportion of participants believing that the laboratory service would benefit from improved AAH input.

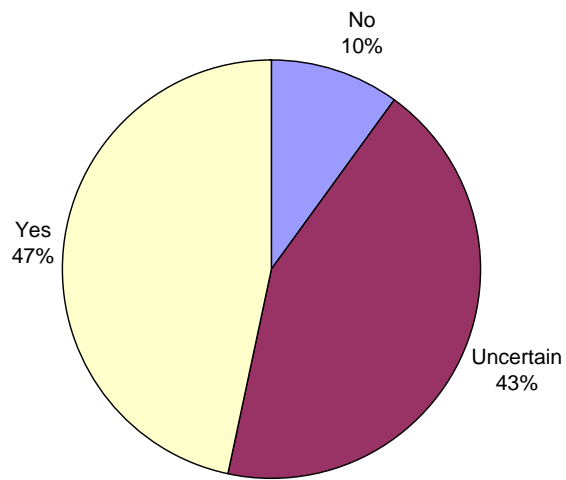


Figure 59. Proportion of participants wanting to see a minimum competency/accreditation standard to be brought into the areas of AAH service provision.

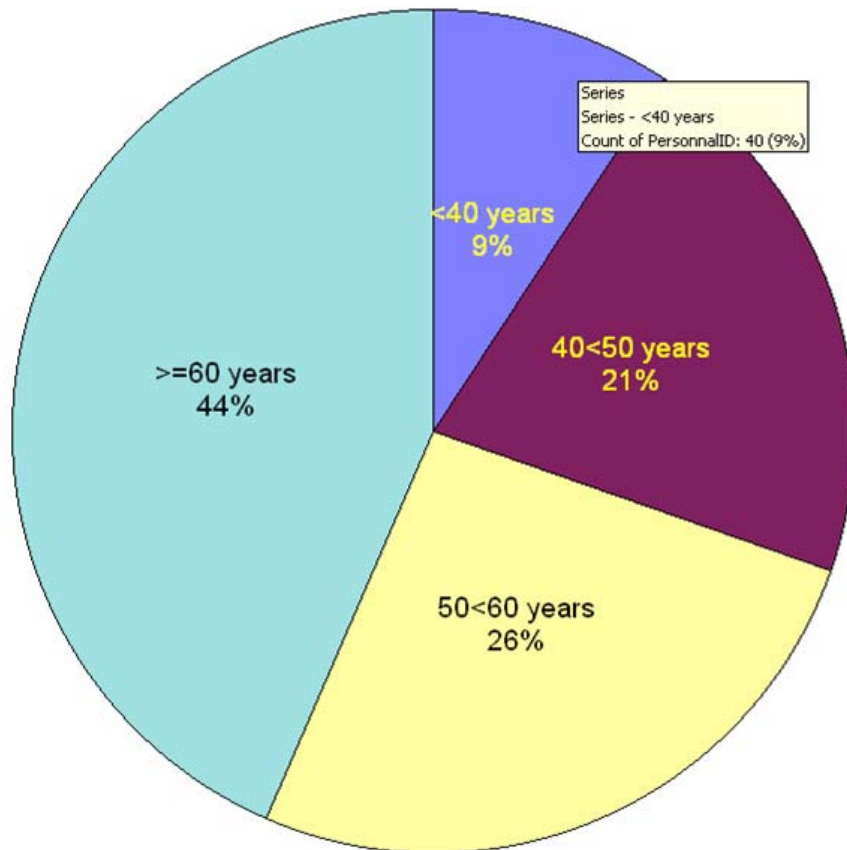


Figure 60. Age distribution of laboratory diagnosticians in Australia.

Research industry respondents

The research industry utilise a broad range of AAH services with moderate frequency (see Figures 61 and 62). These services are predominantly sourced from government service providers or research facility staff (see Figures 63, 73 and 74). The diagnostic and treatment advice was generally adequate, timely and cost effective (see Figures 75, 76, 77, 78). Researcher respondents held the expectation that skills from all service providers will be at an advanced level (see Figures 64, 65, 66, 67). As with the laboratory staff, this group rate diplomas, university and post-graduate qualifications as “required” across all sectors from which they draw services (see Figures 68, 69, 70, 71).

Again, there is agreement that use of AAH services will increase in the next 5-10 years (see Figure 72). A majority of respondent has experienced the negative impacts of a significant disease event in their research programs, highlighting the importance of AAH within this sector (see Figure 82).

Their perceptions on training are that there is none (36%) or that it is insufficient (57%) (see Figure 79). Respondents broadly agreed that research efforts would be improved with a greater incorporation of AAH skills (see Figure 81) and felt this would be best achieved through training of existing researchers (see Figure 80). 57% would like to see AAH competency standards introduced (see Figure 83).

Graphical representation of results from survey of Aquatic Animal Research stakeholders

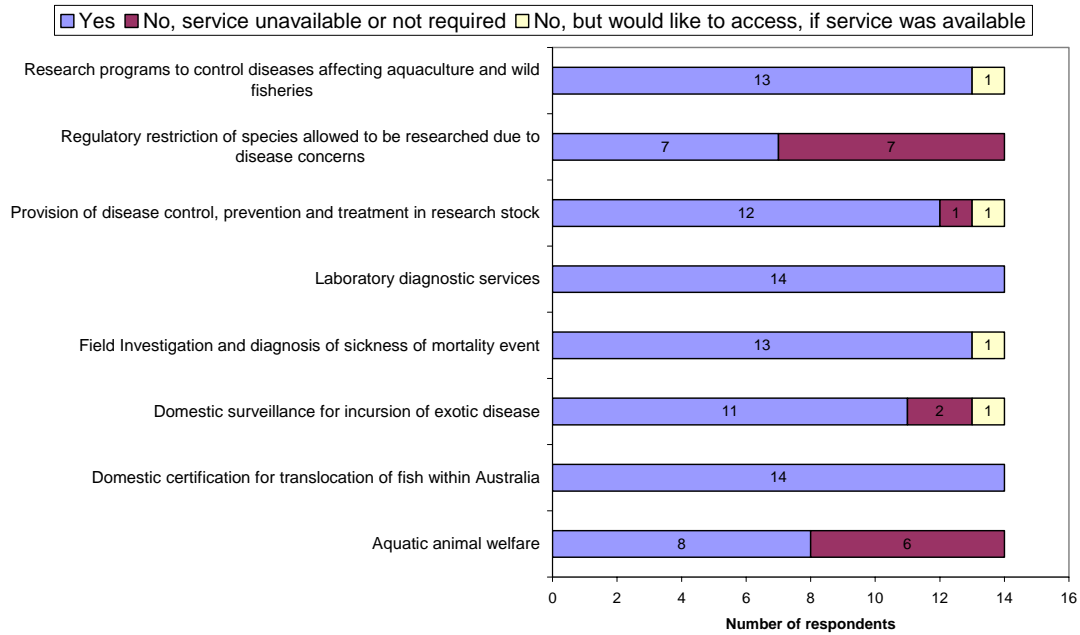


Figure 61. Utilisation of AAH services.

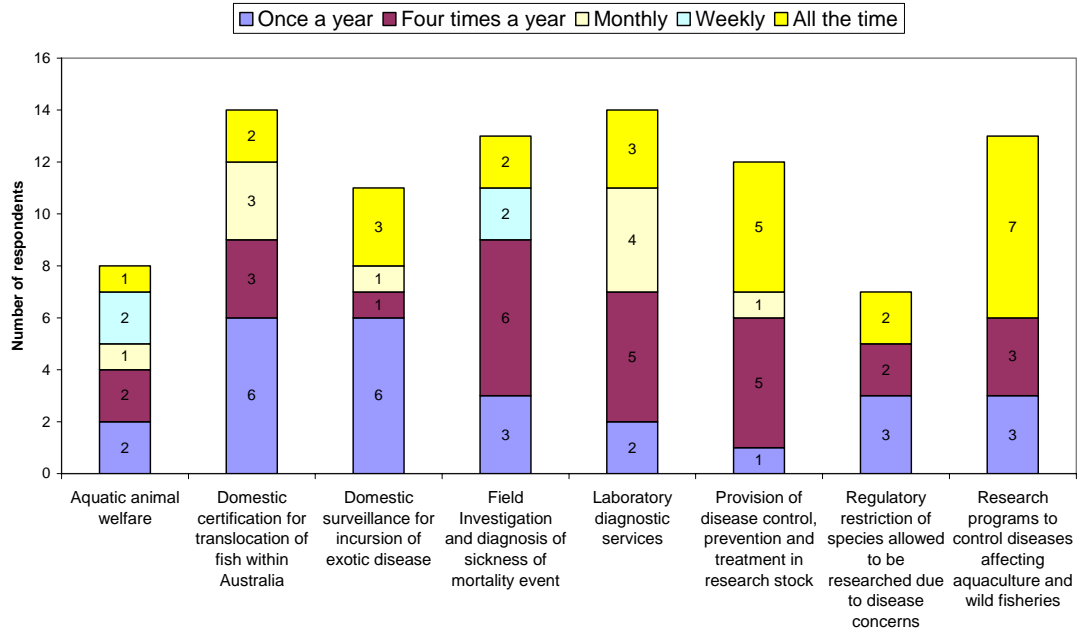


Figure 62. Frequency of AAH services utilisation.

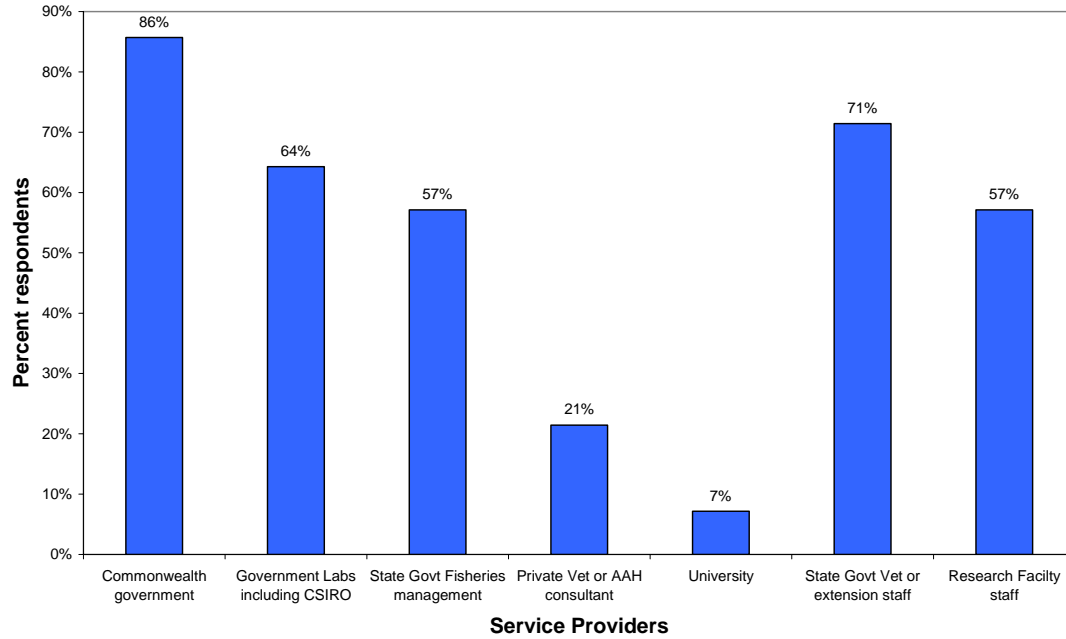


Figure 63. Proportion of research industry respondents who seek AAH services from various providers.

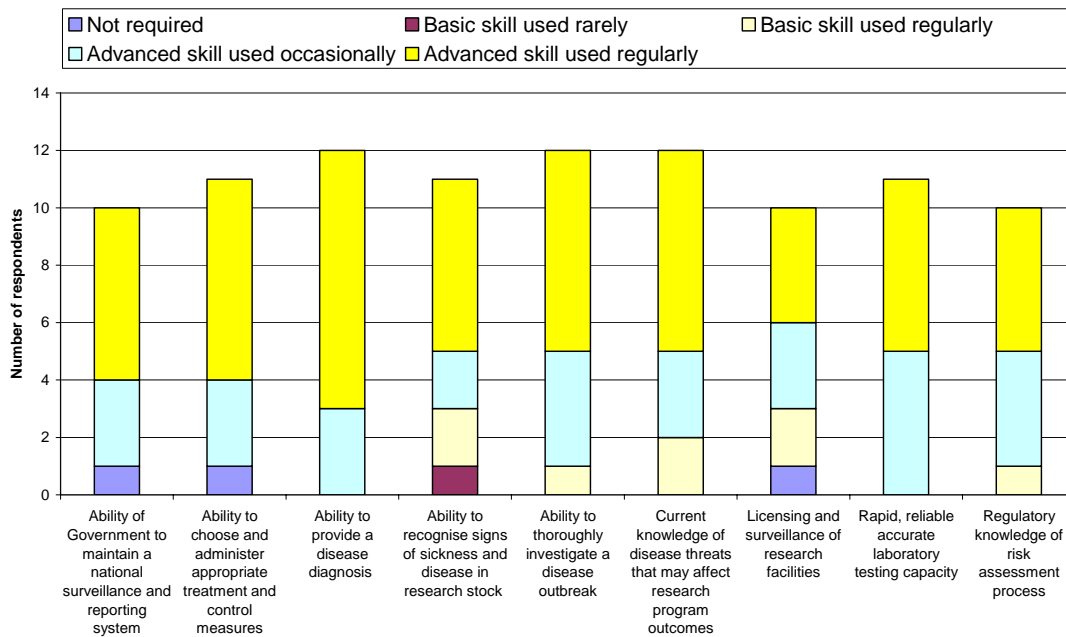


Figure 64. Skills levels expected from State Govt / private / CSIRO / University Laboratory.

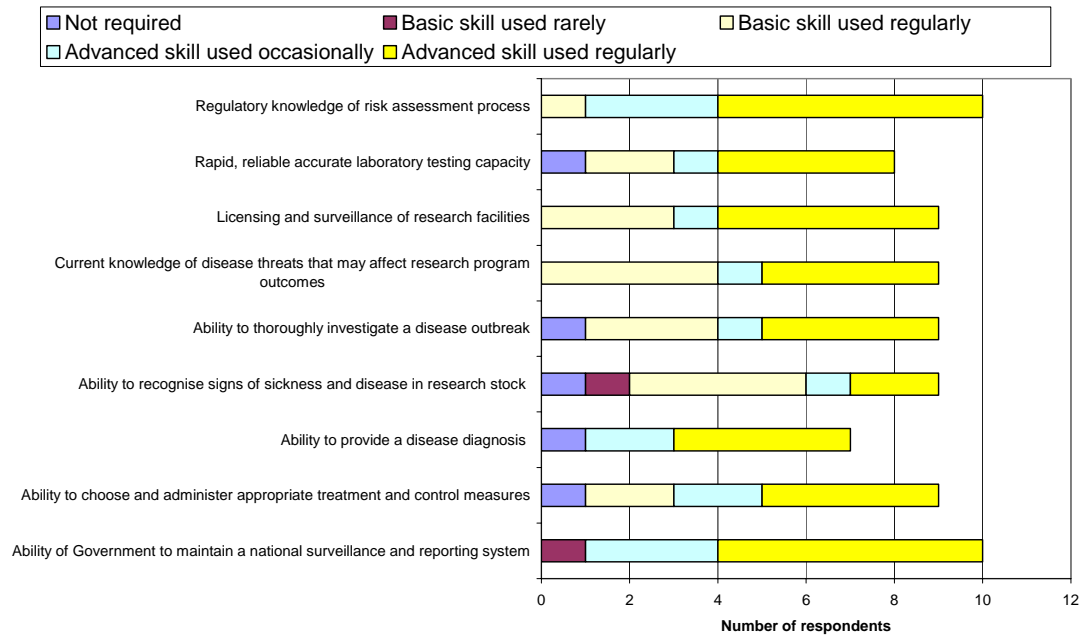


Figure 65. Skills levels expected from State/Commonwealth Govt fisheries management.

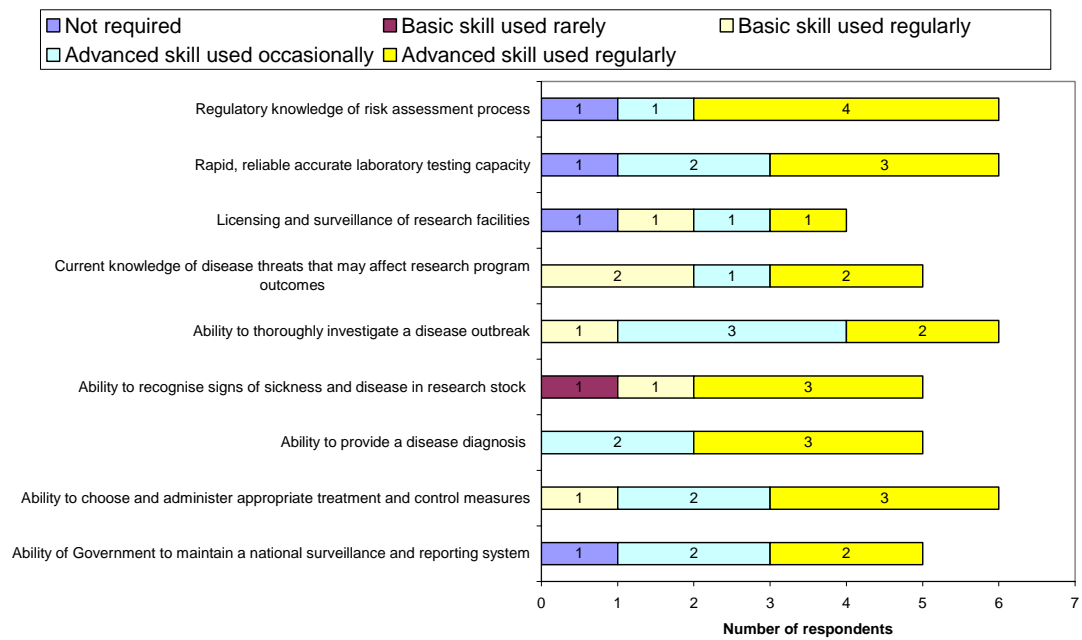


Figure 66. Skill levels expected from private veterinarian or AAH consultant.

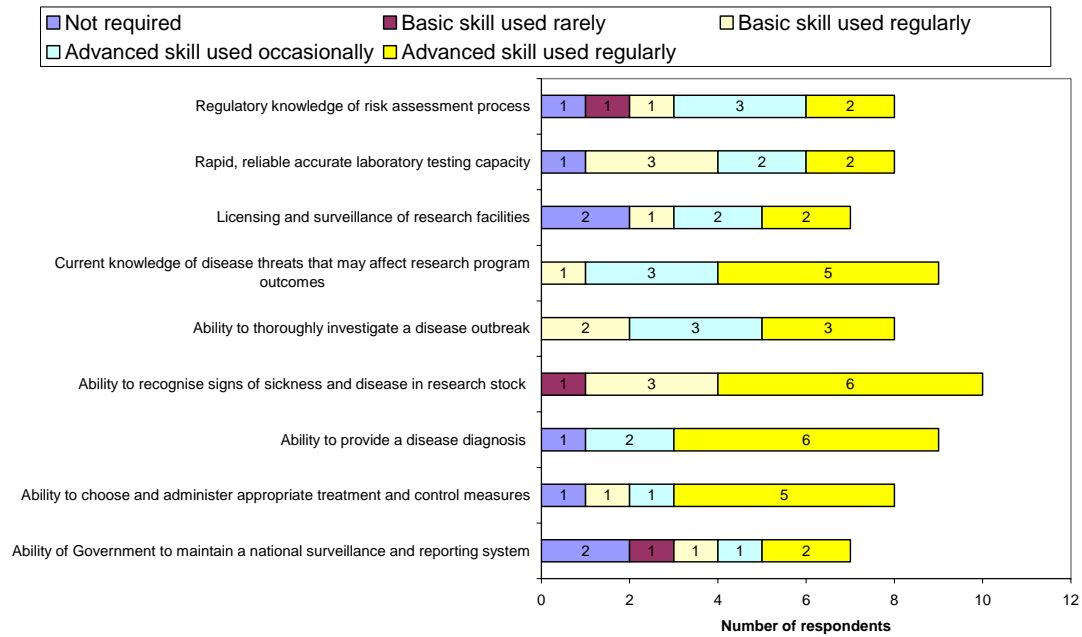


Figure 67. Skill levels expected from research staff.

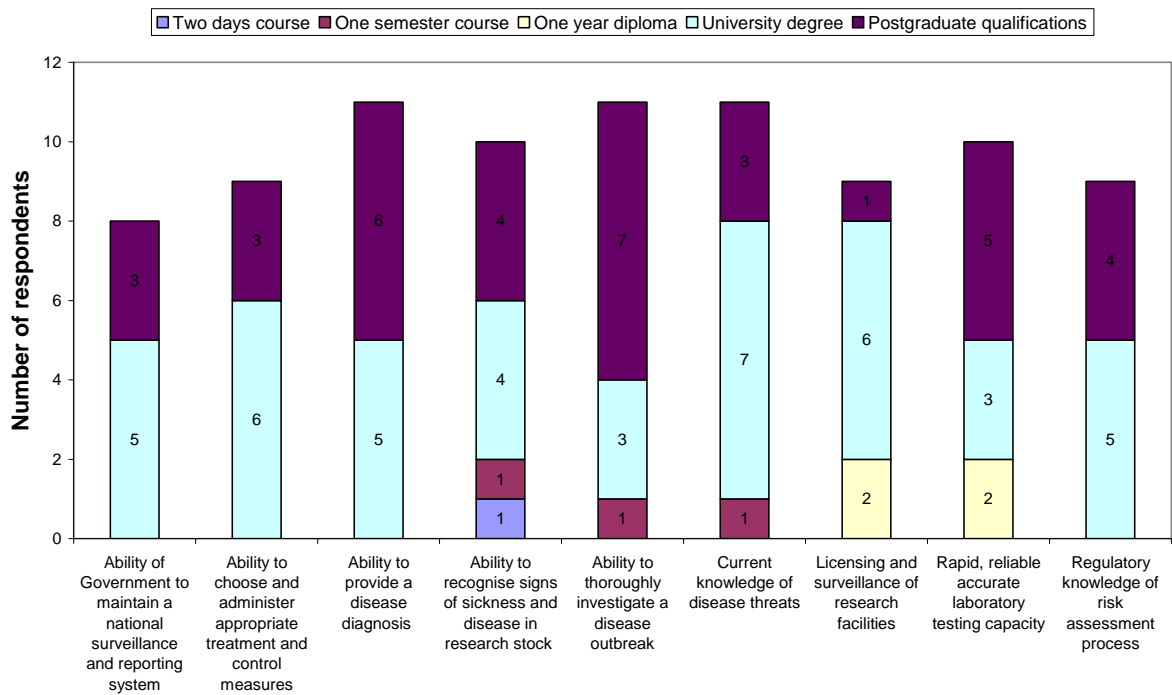


Figure 68. Amount of training for State Govt / private / CSIRO / University Laboratory required to perform optimally for the research team.

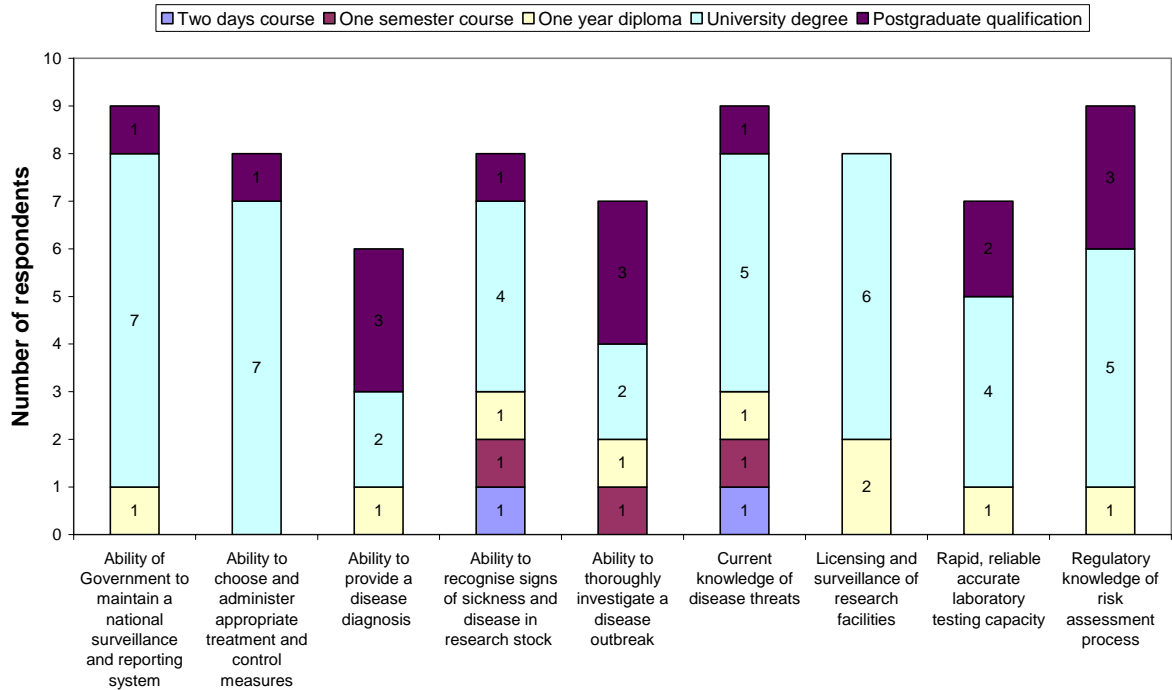


Figure 69. Amount of training for State/Commonwealth Govt fisheries management to perform optimally for the research team.

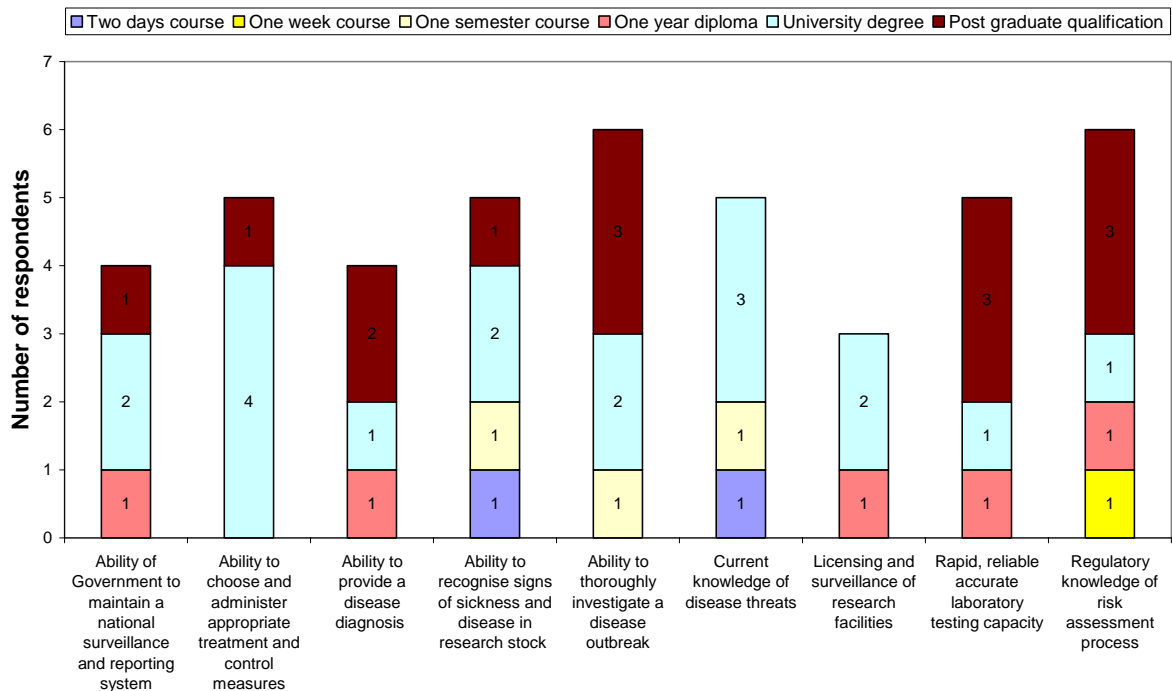


Figure 70. Amount of training for private veterinarian or AAH consultant to perform optimally for the research team.

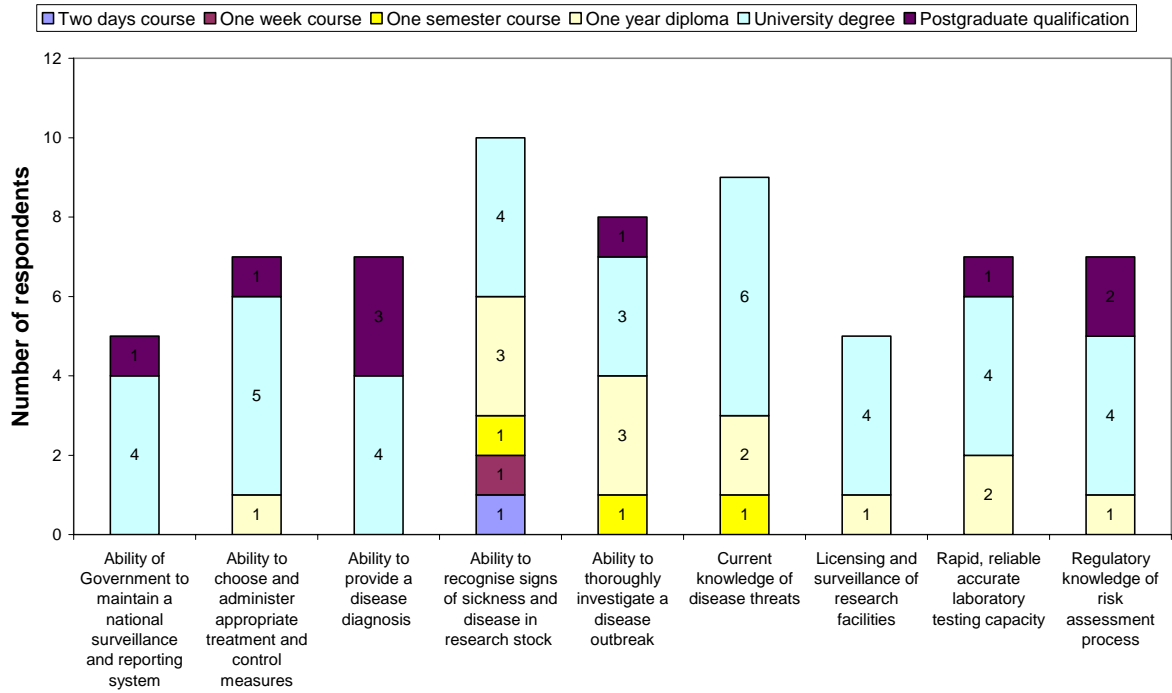


Figure 71. Amount of training for research staff to perform optimally for the research team.

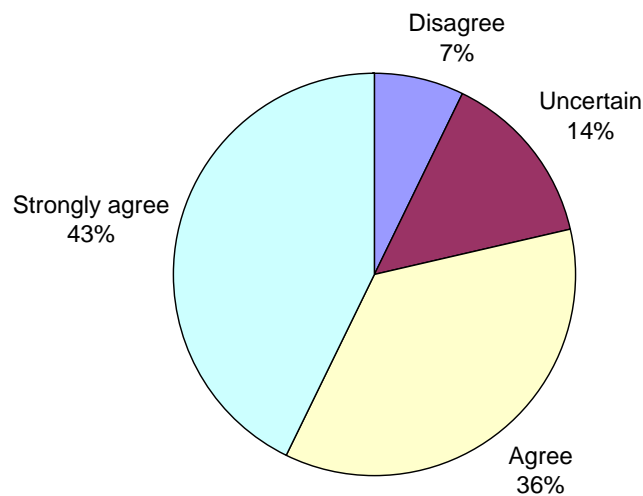


Figure 72. Views of respondents on whether the use of AAH services is likely to increase in the next 5-10 years.

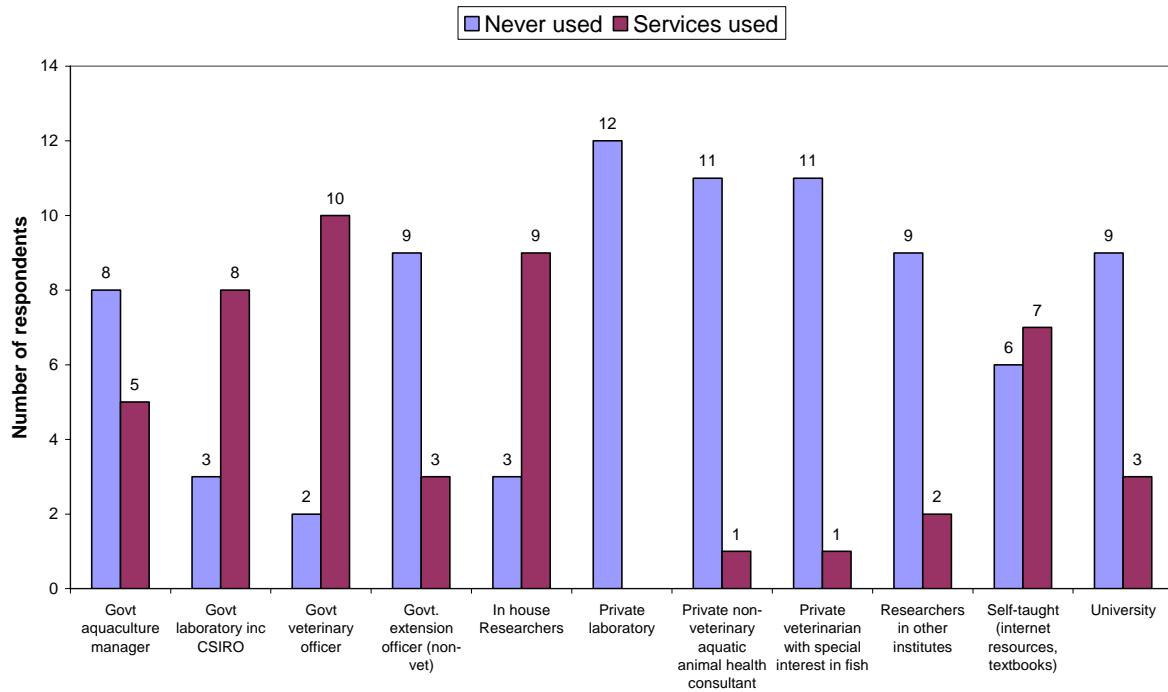


Figure 73. Use of the service providers.

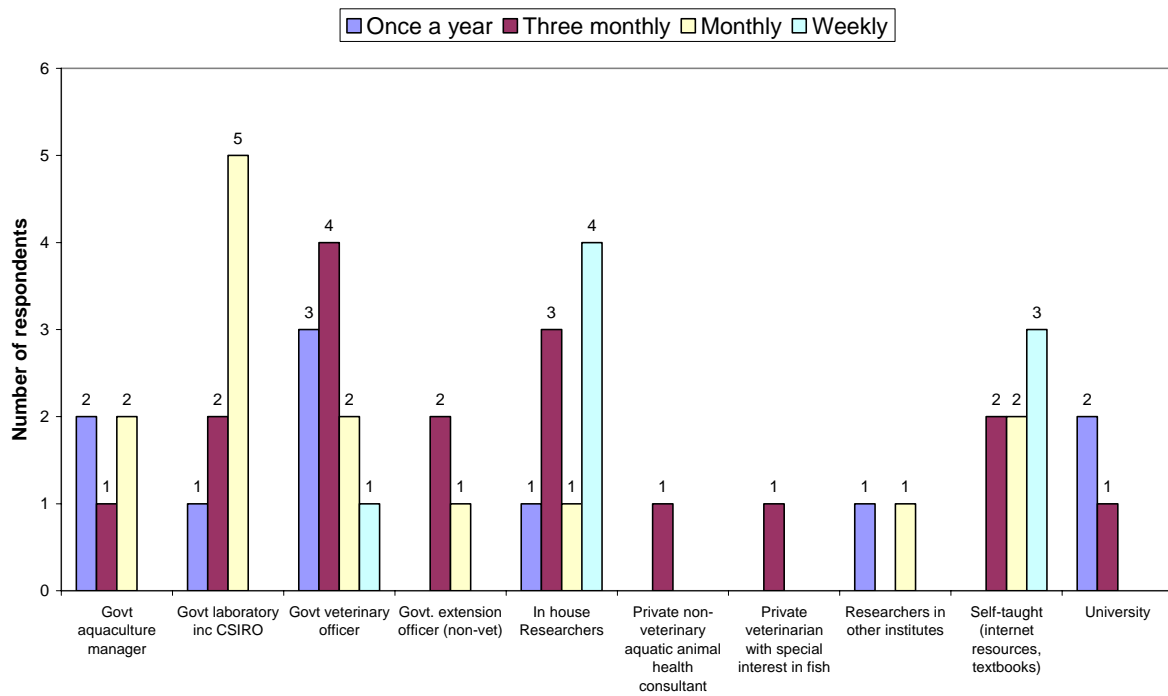


Figure 74. Frequency of service use when service providers are used.

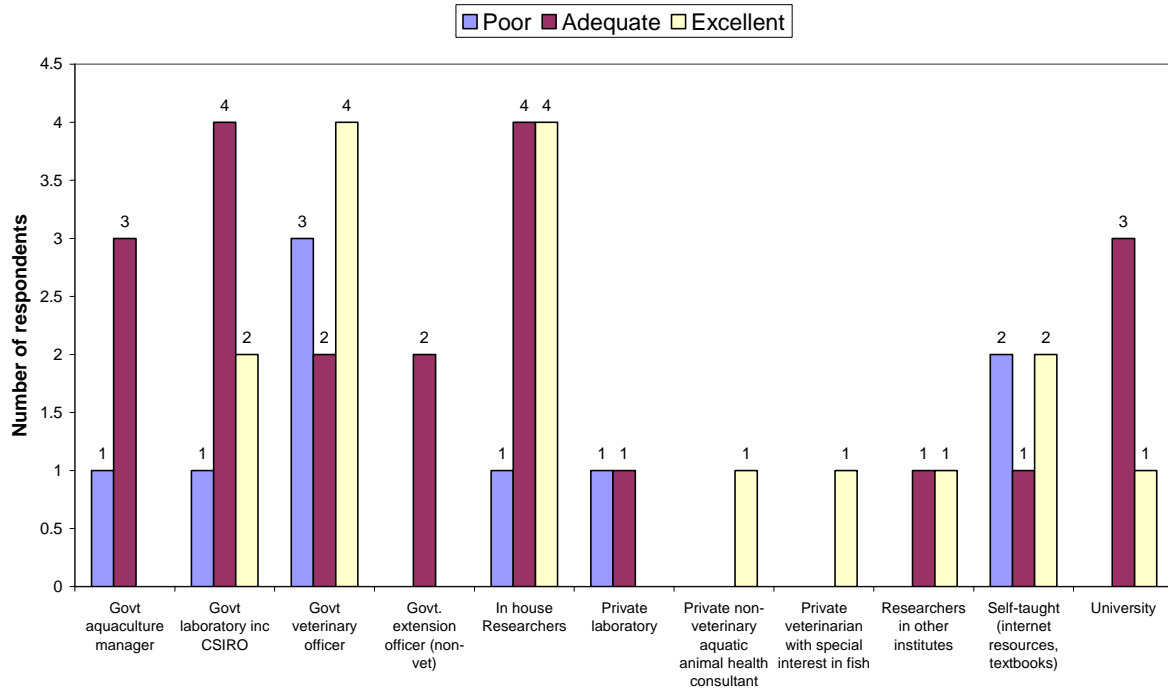


Figure 75. Technical knowledge adequacy of the service provided for diagnosis.

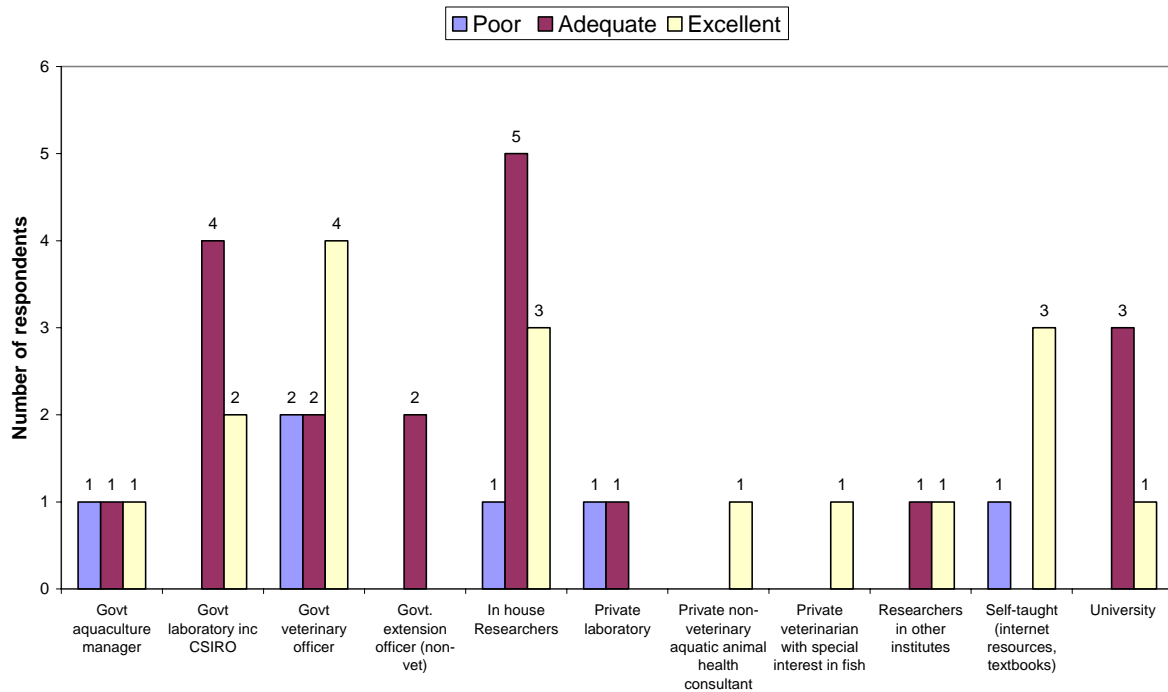


Figure 76. Technical knowledge adequacy of the service provided for treatment.

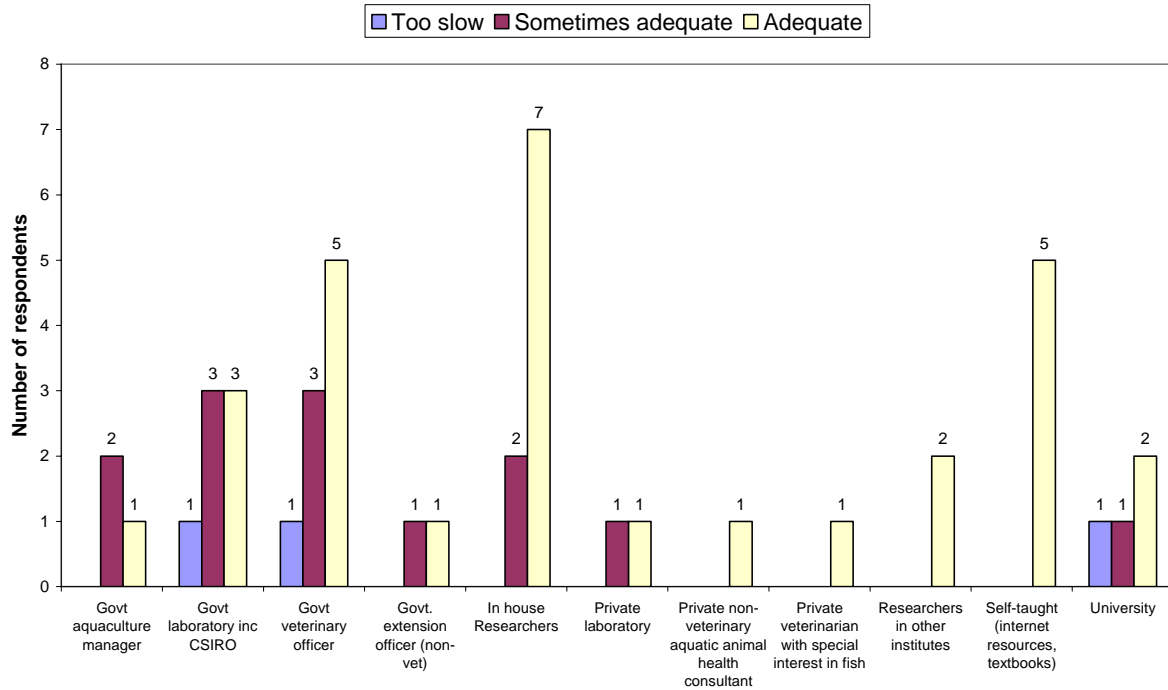


Figure 77. Timeliness of the service provided.

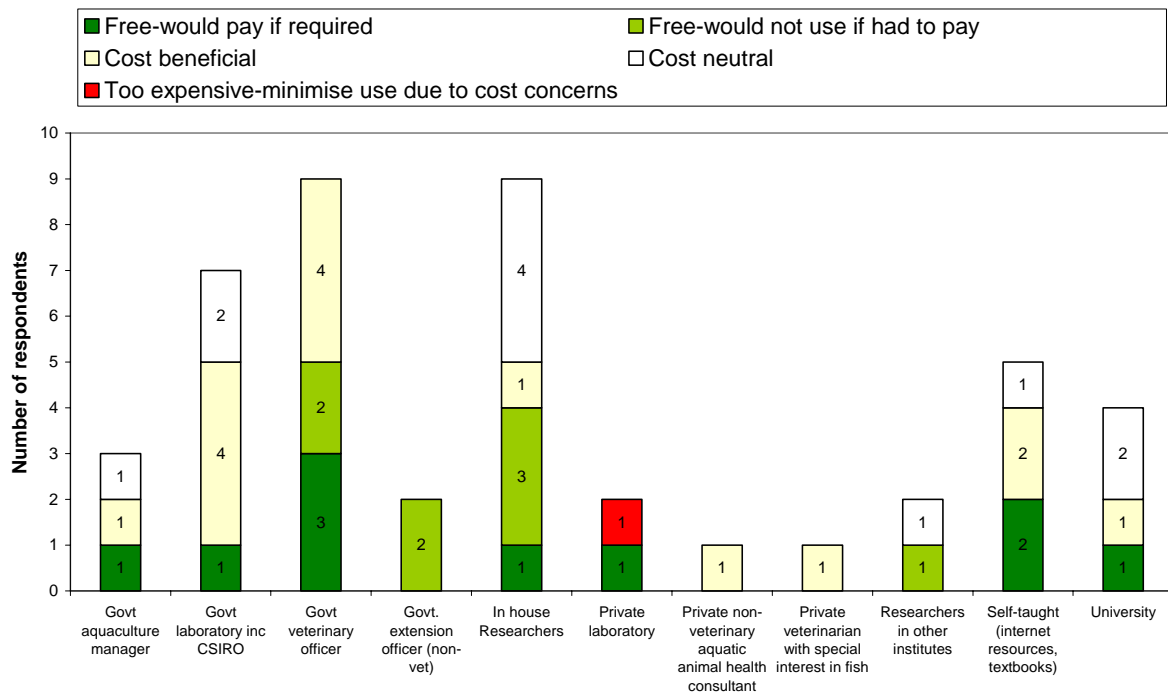


Figure 78. Cost effectiveness of the service provided.

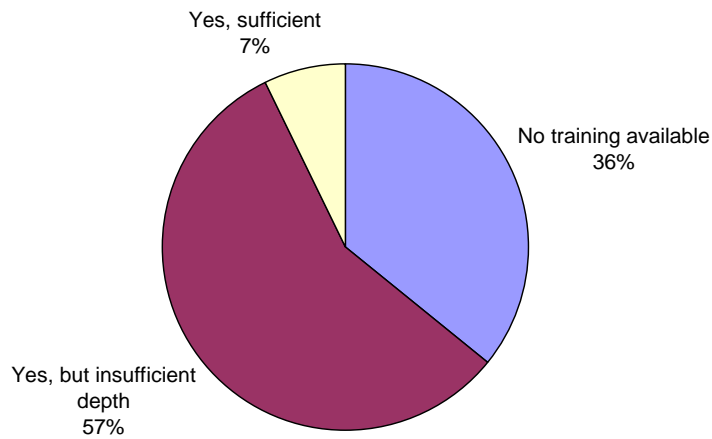


Figure 79. Perceptions of availability of training and its adequacy.

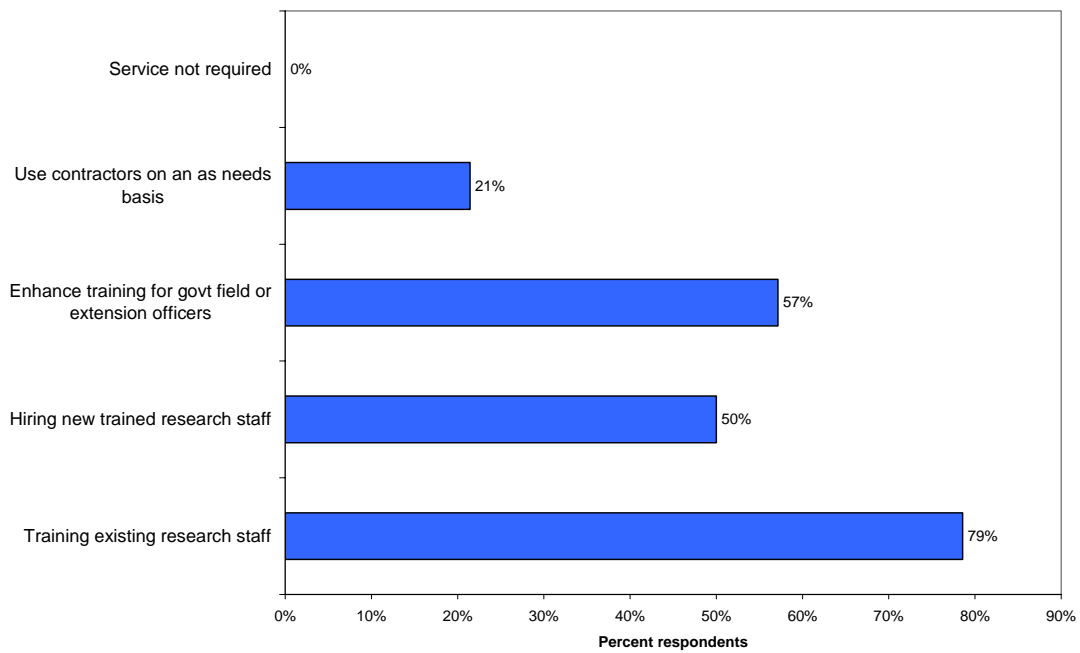


Figure 80. Preference for incorporation of more AAH services into the research team, if required.

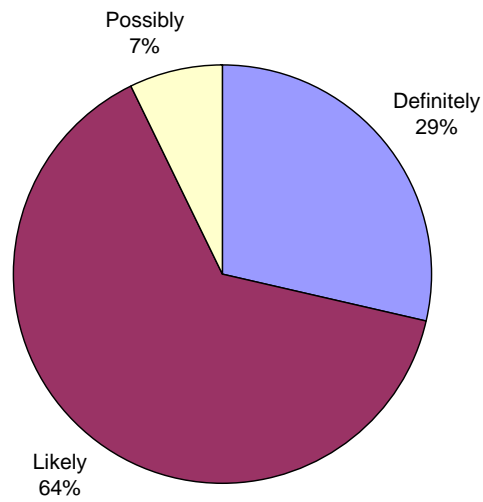


Figure 81. Proportion of participants believing that the research operations would benefit from improved AAH input.

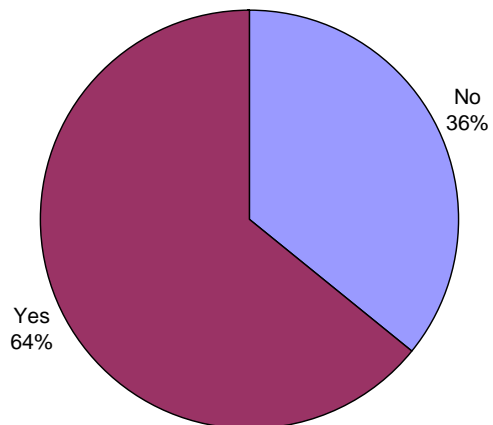


Figure 82. Proportion of participants agreeing that their research programme experienced significant losses or project interruptions due to health or disease problems.

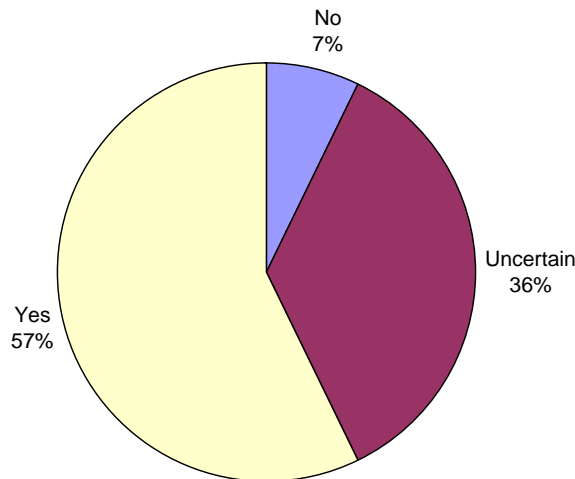


Figure 83. Proportion of participants that would like to see a minimum competency/accreditation standard to be brought into the areas of AAH service provision.

Educational institution survey

In light of the findings from the aquaculture industry survey, which highlighted a demand for training for farm hands and managers, interviews were conducted with TAFE staff and the Seafood Industry Training Package (SITP) AAH components were reviewed. Through these enquiries the consultant concluded that there was sufficient AAH training material available to the farm level, however not all farms were made aware of its existence. A similar process was undertaken with universities to determine if adequate training material existed. Six university institutions responded to the survey which assessed the breadth and depth of training provided in AAH subjects. The University of Tasmania, Bachelor of Aquaculture (BSc (Aquaculture)) degree contained significantly larger amounts of specific material on AAH subjects (see Figure 84) compared to the University of Sydney Bachelor of Veterinary Science (BVSc) degree. However, the BVSc course was considerably more thorough in providing training on general disease principles compared with the BSc (Aquaculture) degree (see Figure 85). It was apparent however that neither undergraduate course was able to provide the depth of training required for many of the essential AAH laboratory positions. As one mechanism for improving AAH training, the consultant surveyed university stakeholders on their willingness to contribute to and utilise some common AAH curricular material which would be available as a national resource to all institutions. The response was very positive (figure 86) including a willingness to utilise the skills of academics from other institutions.

Graphical representation of Educational institution survey results

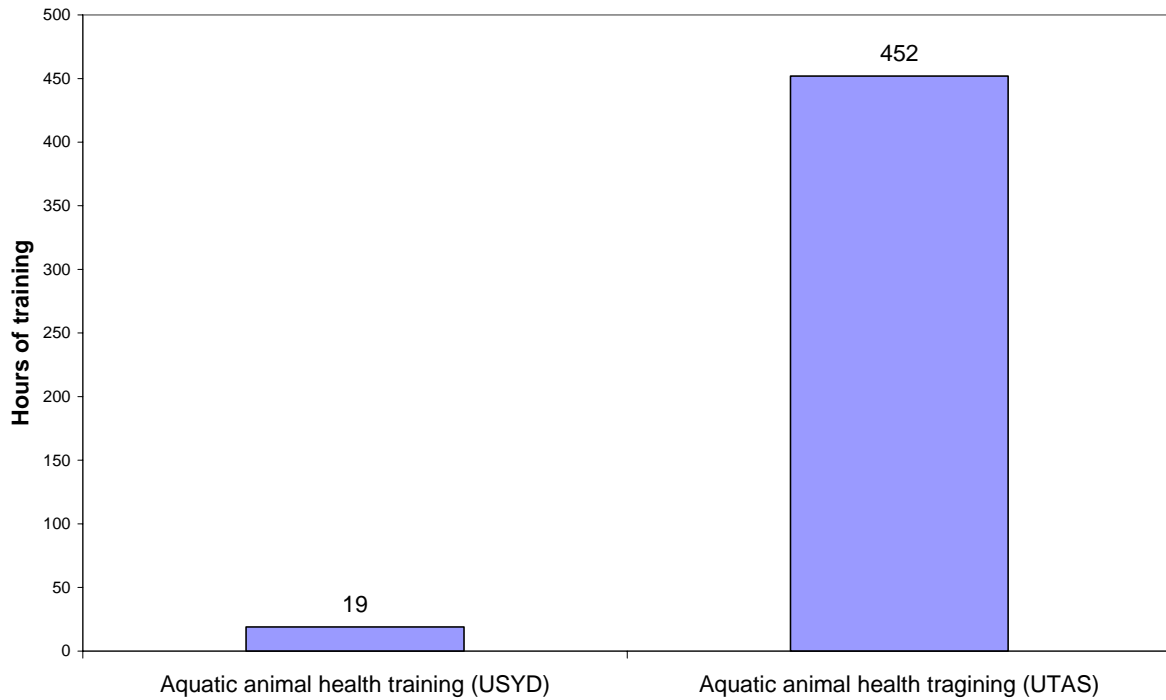


Figure 84. Comparison of amount of specific aquatic animal health training provided by BVSc and BSc (Aquaculture) degrees.

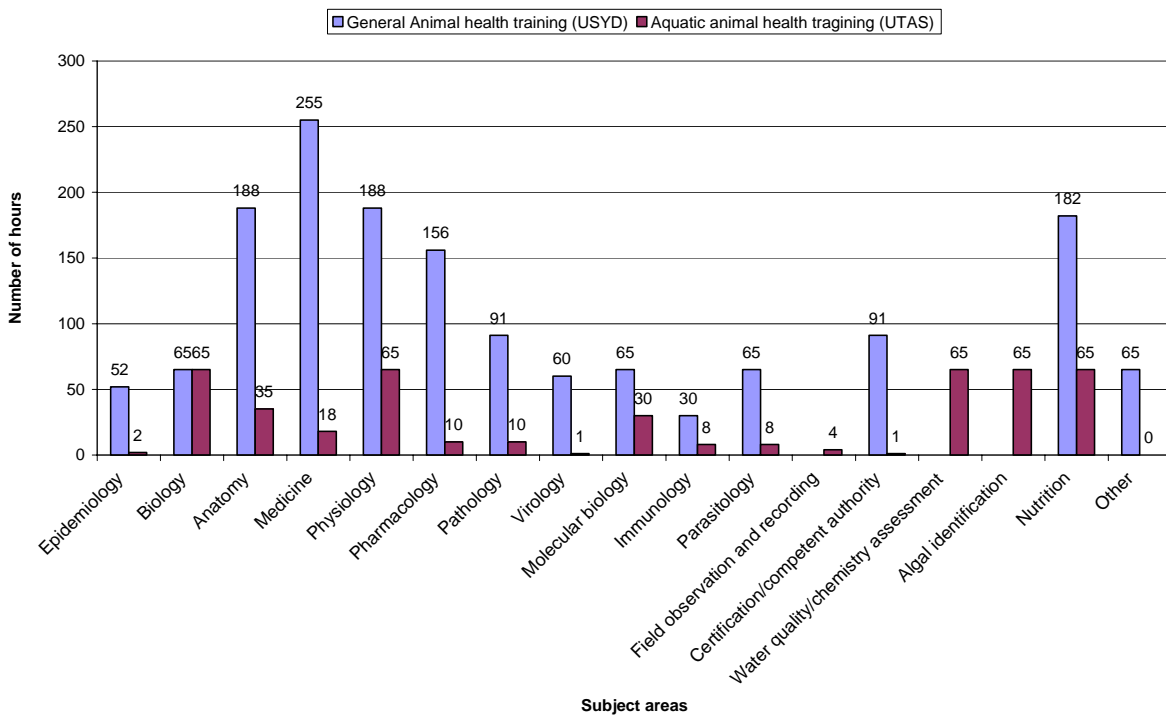


Figure 85. Comparison of the depth of general animal health training provided by BVSc and BSc (Aquaculture) degrees.

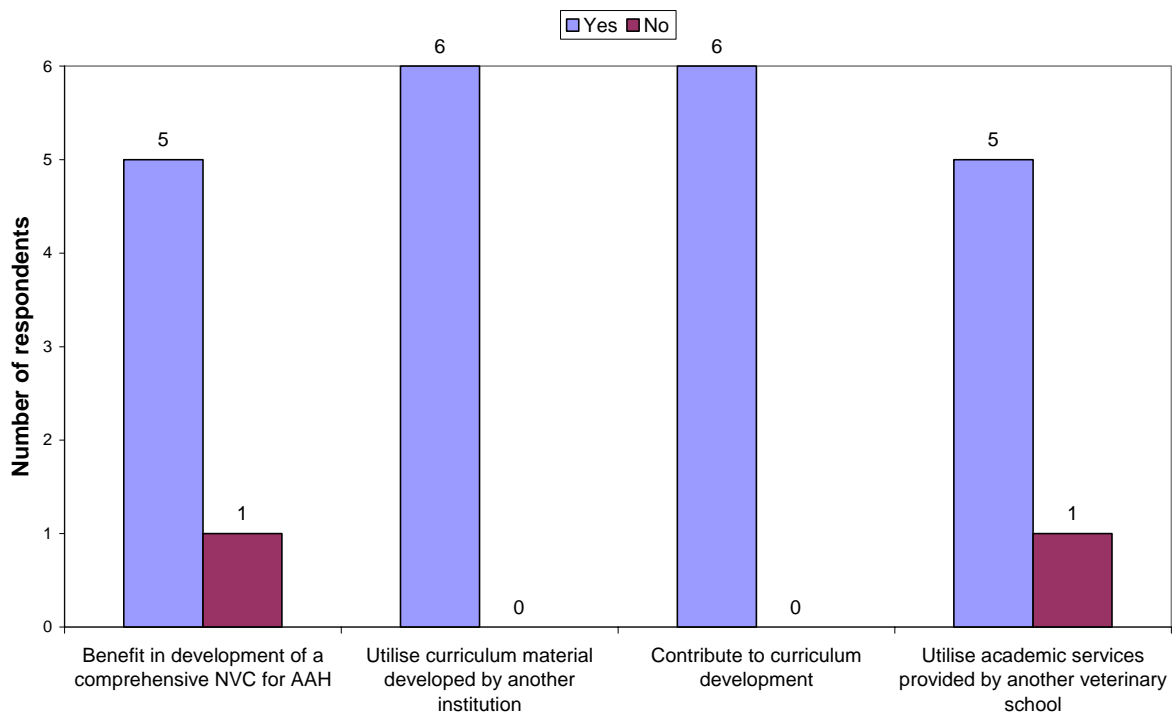


Figure 86. Responses of Veterinary and Aquaculture schools to prospect of development, contribution and use of a common curriculum.

Recreational and commercial fisheries, ornamental fish industry, aquaculture feed production industry

These stakeholder groups were contacted and several phone and in-person interviews were conducted. Their response rate to the distribution of the formal survey was poor, with insufficient returns to warrant detailed analysis. Nevertheless, their requirements and expectations broadly mirrored those of other industry groups. The recreational and commercial sectors recognised that they were heavily dependent on government services and had the expectation that advanced skills would be maintained by Government. Due to their infrequent need for direct aquatic animal health service supply most had little direct experience with AAH services to draw upon.

DISCUSSION

Historical background to current status of AAH Education

The survey results from the aquaculture sector, government management, and research stakeholders demonstrate that disease and disease management are common and significant issues for the aquaculture sector. (Figures 26, 40, 82) Through six years close involvement with various emerging aquaculture sectors the consultant is aware of numerous business failures due in part to major disease problems. This has included QX outbreaks in Sydney rock oysters, bacterial diseases in snapper and mullet in sea cages, saprolegniosis in pond reared silver perch, streptococcosis in barramundi in freshwater cage culture, ichthyophthiriosis in rainbow trout in raceways, monodon neuropathy and retinopathy in prawns and vibriosis and herpes-like virus in abalone to name but a few of the major disease related disasters that have punctuated the emergence of aquaculture in Australia. When diseases such as those mentioned affect the majority of stock on a farm the results can be terminal for the venture. Disease has thus played a significant role, through reducing

marketable volumes of product, in the underperformance of this production industry sector in Australia. To date, aquaculture industries across Australia have not met the expectations for growth anticipated by Government. This was noted in the May 2006 FRDC Fisheries R&D News magazine, where Simon Bennison of the National Aquaculture Council, recognised “the former Australian Government-industry goal of national aquaculture production being worth \$2.5 billion a year by 2010 appears to have been quietly abandoned” (Anon. 2006). All survey results indicate that appropriate co-ordinated AAH education and training are both demanded and required to improve on this performance and deliver the outcomes which are so keenly desired by aquaculture stakeholders (Figure 24). All stakeholder groups surveyed highlighted the deficiencies of the current training availability, and signalled a clear need for improvement (see Figures 22, 38, 57, 79).

Informal discussions, as part of the briefing for the educational institution survey, with Deans from the majority of Australian veterinary schools highlighted that, pre-1990, there was insignificant specific aquatic animal content provided within veterinary undergraduate degrees. There is now a very small component present specifically on aquatic animals in most of the veterinary degrees, although this is slowly increasing (see Figure 84). BSc (Aquaculture) courses have gone some way to fill this AAH educational vacuum although the lack of training depth in the principles of disease in these courses was highlighted by the survey (see Figure 85). Universities were uniformly supportive of the development of common curricular material to improve this situation, and broadly agreed that such material would be utilised (see Figure 86).

The National and State Governments’ focus on developing the aquaculture industry intensified from around 1990 until the present. The lack of direct AAH training of veterinarians unsurprisingly meant they have been virtually unengaged from delivery of AAH services (with the exception of pathology) to this developing industry. A review of Melbourne University veterinary graduates between 1995-2005 revealed that none of them had gone on to work full-time on aquatic animals. (Ivan Caple pers. comm. Dec 2005) Given the key roles veterinarians play in animal health within all other production animal industries, it is the consultant’s view, that greater engagement during this critical start-up phase of the aquaculture industry, when most diseases and optimal husbandry are poorly described or unknown, would be very beneficial. The bulk of the veterinary effort has been limited to services from State Government and CSIRO laboratories in response to disease events. In all States, veterinarians are written into State animal health legislation to diagnose disease and prescribe treatments and controls. The lack of regular field engagement of veterinarians has left the developing sectors in a “fend for yourself” environment, with few other skilled AAH professionals to turn to. There is one notable exception to this situation: The Tasmanian salmonid industry. From its inception, through significant Government support, the industry has had a coordinated approach to AAH, engaging veterinary and non-veterinary AAH professionals at all levels including: field veterinary services, laboratory services, active surveillance programs and government policy and administration. It is the view of the consultant that the continued growth of this industry has in part been due to this prominent focus on AAH services. However other smaller emerging industries around Australia have not been afforded such generous government support to implement an intensive AAH management program. For these industries many of the key field AAH roles have either been filled by biologists, or not filled at all. This situation has been further compounded by the majority of aquaculture business managers not having a background in another commercial intensive production animal industry, where the understanding of the importance of animal health is thoroughly embedded in the culture of the business.

The survey highlighted several critical areas outlined below, which the final recommendations seek to rectify and thereby meet the needs for AAH training and education identified by stakeholder groups.

1. Low level of understanding of the training depth required to instil high level skills to deliver competent AAH services

The surveys were able to identify that there was widespread misunderstanding of the skill level required to undertake certain AAH activities competently, although the salmonid and pearling industries were generally more aware. Only 49% of aquaculture stakeholder respondents recognised that farm managers need high level skills in the area of disease diagnosis, selecting and administering treatment, and creating and implementing a biosecurity farm health management program to control and prevent diseases from entering the farm and control those already present. 52% of aquaculture respondents believed that a farm manager could learn these high level skills in a course of less than one week duration. It is the consultant's view that the minimal understanding of many of the farm managers of the principles of AAH, and a concomitant lack of exposure/ access to individuals possessing this high level of understanding, has contributed to this industry misunderstanding.

2. Limited use of AAH professional services

Aquaculture respondents had higher expectations of AAH professionals (vet and non-vet) with 96% expecting high level skills across all of the skill areas; 68% of respondents expected AAH professionals to have a five-year university degree to acquire some of these skills. This suggests that aquaculturalists are aware of the high level of technical expertise required, but do not see it as their role to acquire this knowledge. However, this awareness is in contrast to the profile of low service utilisation, made of these AAH professionals by the industry (see Figure 16). The expertise of these AAH professionals is of limited value until it is deployed into the routine farm operations. It is the consultant's view that here lies the catch 22 - farms are unlikely to value such a service until they experience a positive benefit from using it. One element that has limited the use of these services has been an issue of local availability. Barramundi farms in NT, NSW Queensland; silver perch farms in NSW and Victoria, oyster farmers in Tasmania and NSW; and a kingfish farm in SA all mentioned their desire to use AAH professionals was precluded due to a lack of local experienced personnel to engage.

3. Depth and breadth of training within individual under-graduate qualifications is sub-optimal to meet industry and Government needs

It was clear that industry expectations are that AAH professionals would be highly skilled. However, upon analysing the output from educational institutions a clear need was identified to increase the depth and breadth of training in aquatic animal health, both for veterinarians and non-veterinarians if the current and future demands are to be met. It must be stressed that a multitude of disciplines are required to provide a complete service. These disciplines are detailed in Table 1 and all necessary and training must commence with under-graduates and continue into a formal post-graduate training program as described in point 4 below.

The historical lack of engagement of the veterinary faculties in the area of AAH has been covered in a limited way under the various BSc and Aquaculture courses offered in Australia. These courses tended to be developed in isolation from veterinary faculties.

Through in-person and telephone discussions the consultant found that there was a lack of awareness of the depth of general animal health training provided within undergraduate BVSc courses by graduates of BSc courses (see Figure 85). The survey of educational institutions undergraduate curricula identified veterinary graduates are offered a deep understanding of the general principles of disease, however their specific knowledge with respect to aquatic animals would be significantly lower than that of the graduates of biology/aquaculture degrees (see Figure 84). Conversely, BSc Aquaculture graduates, although exposed to a significant quantity of specific AAH training, do not obtain an equivalent deep understanding of disease principles. (See Figures 84, 85). In recent times the veterinary faculties have begun to respond to the demand for training in aquatic animal health expanding undergraduate training. Some key deficiencies in the BVSc degree relate to specific material on invertebrates, crustaceans, and aquaculture systems and their management. The key deficiency in the BSc and Aquaculture courses is the lack of content in general disease principles, pathophysiology and epidemiology. These stated “deficiencies” only relate to the aquatic animal health components of these courses. There is clearly a need for the veterinary and BSc Aquaculture institutions to work more closely as proposed in the recommendations of this report. A process for this to take place was suggested through the development of national aquatic animal health curricular material. Five of the six institutions said there would be benefit in creating such curricular material. Further, all six indicated they would be willing to use curricular material developed by another institution. Again, all six said they would be willing to assist in the development of such material and five out of six suggested they would be willing to share the services of a veterinary academic (see Figure 86).

4. No post-graduate opportunities in Australia to provide specific high level education and training in aquatic animal health

To provide AAH services on par with those provided for terrestrial animals, very high skill levels across a range of disciplines (see Table 1) are required and this was reflected in the survey results from all sectors. It is neither practicable, nor efficient to attempt to incorporate all of the required detail into current under-graduate courses. Hence, the authors recommend the creation of post-graduate opportunities in Australia, for Australian and international students. The current and predicted demand for AAH services, although significant, is unlikely to be large enough to warrant the setting up of AAH centres at all veterinary and aquaculture schools. It is likely that universities will be able to offer better post-graduate training if the educational institution is internationally linked to regional AAH, fisheries and aquaculture agencies such as NACA, ACIAR and AFS. The training of people for the massive aquaculture industry in Asia was recognised by several education institutions as one potential mechanism to sustain the post-graduate training programs in the medium to long-term within Australian universities. It is sensible to ensure these training courses are linked to veterinary institutions, for the reasons outlined above, to foster interaction between academic institutions and the aquaculture and fisheries industries.

Laboratory respondents provided a clear indication of the current deficiency in AAH training with only 19% feeling that they were able to provide the same level of technical knowledge for aquatic animals as that which is provided for terrestrial animals (see Figure 48). In many cases the acquisition of such high level knowledge necessitates some formal or informal post-graduate training. 21 of 29 (72%) laboratory respondents recognised that post-graduate training was necessary for at least one of the key skills to be performed satisfactorily. Further, 13 of these believed that a post-graduate qualification is required

for more than half of the skills listed (see Figure 49). Only 11% of laboratory respondents felt there was sufficient training, of a sufficient standard, available to facilitate them up-skilling (see Figure 57).

5. Greater hands-on training for undergraduates and post-graduates needed

Aquaculture stakeholders made comment to the consultant of the need for AAH professionals to have more hands-on experience and an improved knowledge of routine farming practices. The authors recommend that both undergraduate and post-graduate training be linked, wherever possible, to field experience with industry. The benefit from such exposure will be two-fold, firstly, industry will gain an insight into the assistance that AAH professionals can provide in their operations and secondly, students will acquire a robust practical knowledge of the workings of industry. This applies also to trainee AAH laboratory diagnosticians who need to acquire experience through participating, with experienced staff, in active AAH cases within established AAH laboratories. For this to happen it requires the creation of trainee positions and/or the linking of AAH research projects to the AAH laboratories around Australia.

Historically, disease investigation costs have been covered by State Governments to encourage submission of samples for surveillance purposes and to assist in industry development. Some State Governments have commenced charging for these investigations now. There has been a sharp decline recorded in sample submission wherever cost recovery charges have been implemented.

It is arguable that aquaculture submissions should represent a special case for subsidisation, as unlike other major production industries, there are many new diseases emerging, due to the culture of new species under new culture conditions. Hence investigations tend to be more costly (as suggested by the survey results for Government laboratories), and may require significant follow-up to determine if the novel treatments have proved efficacious. Through recommendation 4, it is proposed that laboratory services be supported to subsidise aquatic animal disease investigations until the common diseases of the species under culture are better defined. This will promote improved hands-on opportunities for education and training for diagnosticians in addition to improving surveillance, investigation and understanding of disease agents and processes that are significant impediments to aquaculture development.

6. Current expectations of laboratories exceed their capacity to deliver due to lack AAH professionals in field

In Australia, the bulk of high level aquatic animal health knowledge has historically been acquired and maintained by individuals within State Government Laboratories and CSIRO. In most States there has been minimal involvement of practicing veterinarians or non-veterinary AAH professionals in the on-farm investigation of health problems, as evidenced by a majority of samples (68%) coming direct to the laboratory from farmers (see Figure 50). Most laboratory respondents did manage to get some field information “more often than not” to support these accessions (see Figure 51). Only a minority of States have had a full time Government field veterinary service, which, where present, was heavily utilised along with the Government laboratory (see Figure 16). Hence most farmers have tended to go direct to laboratories for help. It is the view of the consultant that this direct submission approach, overlooks an essential part of the diagnostic investigation format used in all other production animal industries. The critical areas missing are: the collection of a history; observation of clinical signs; recording of

epidemiological parameters on site, and appropriate sampling by a trained animal health professional. As a result of this anomaly in service provision, many farmers now have an expectation of laboratories (see Figure 5) that they will be able to diagnose disease based solely on sending samples in (74%) and provide treatment and control advice (74%). These expectations are beyond the scope of a routine veterinary diagnostic laboratory and are not consistent with all other animal health provision in Australia. Veterinary diagnostic laboratories should provide accurate validated test results, which are interpreted in light of the field situation, assembled history, clinical signs and epidemiological picture to provide a disease diagnosis. Only then, should the focus shift to appropriate control and management measures. Only 11% of laboratory staff felt they could always send their report to someone who was well equipped to interpret it and develop an on ground action plan in response to laboratory findings (see Figure 51). Again this is a striking contrast to the terrestrial animal production industries where the vast majority of samples are submitted through a veterinarian who is trained to interpret the results when they return from the laboratory. The veterinarian generates a treatment and prevention program at the farm, with full knowledge of the husbandry situation. Unfortunately, there appears to be insufficient adequately trained veterinarians to meet all of industry's needs in some geographic areas of Australia, as was demonstrated by farmers' comments in interviews. Where farmers could access treatment advice from government veterinarians, it was generally viewed very favourable, with the highest average rating of all service providers (see Figure 18). Implementation of the recommendations to improve undergraduate training will move towards correcting this area of deficiency.

7. Loss of traditional training avenues

Through FRDC project 2006/621 interviews, it was determined that almost all of the aging population (70% >50 years of age) of highly skilled AAH laboratory diagnosticians that Australia currently possesses have acquired their skills through Government sponsored opportunities, such as the establishment of the former Australian Fish Health Reference Laboratory, Benalla, Victoria. Very few of the current high-level aquatic animal health professionals have acquired their knowledge through formal training programs - it was a process of learning on the job. Time was provided within government positions to acquire the knowledge required and resources were available to encourage disease investigation through subsidisation of laboratory samples for testing. This funding greatly enhanced the low rate of submissions to the laboratory. During informal discussions with the consultant almost all diagnosticians noted the need for a significant case load to generate and maintain high levels of competency. It must be noted that all Government laboratories recognise that few, if any, of these opportunities are currently available and this is common throughout the laboratory system (see the Frawley Review into Rural Veterinary Services, 2003). This trend reinforces the need to establish new formal training pathways and give consideration to offering more traineeships within established AAH laboratories.

8. Increasing demand for AAH services over the next 5-10 years

The lack of identified training pathways is concerning in light of the view expressed by all stakeholder groups that AAH services were likely to be in a state of increasing demand over the next 5-10 years. 73% of all respondents agreed or strongly agreed that demand would increase, 20% were uncertain and only 7% disagreed (See Figures 26, 32, 52, 72).

9. Lack of culture of use of private AAH field service providers

The lack of engagement with field veterinarians and other non-vet AAH professionals

(government and private) by farmers has contributed to the formation of a culture, where farmers attempt to deal with their health problems internally (see Figure 16) or to seek help from State Government laboratories or a Government veterinary officer where they are available. Only 20% of industry respondents indicated that they use private veterinary or private non-veterinary AAH professional for their AAH needs. For more than 53% of those using private services it is an infrequent occurrence at only once a year compared to more than 65% utilising Government services, largely through State Government laboratories and CSIRO-AAHL and 16% using advice from other farmers. This is perhaps suggestive of a need for greater marketing of the services available and their value to industry.

Improving the culture of aquaculture industries to engage AAH professionals may be facilitated through the educational enhancements proposed for research, veterinary school and diagnostic laboratory linkages in the recommendations.

10. State Government resource trend away from industry development and towards regulation and compliance threatens AAH development

A change in focus, away from industry development activities was recognised by the consultant through informal discussions with State Government AAH management staff. During the development of other intensive livestock industries the State Governments have provided considerable diagnostic support to define major disease problems. Currently, according to the National Aquaculture Council, there are over 60 species in aquaculture in Australia, most are native animals with a largely unknown parasitic fauna and unique production problems for which information is not available. This creates a high and novel workload for laboratories. As intensive production animal industries mature, the frequency of novel disease investigations declines over time. This is largely due to a bank of understanding being generated to manage around problems that have been clearly identified and characterised. Many of the aquaculture sectors are at least 10-15 years away from this point in time. The frequency of major new disease findings still remains remarkable high. A decline in government focus in this area assumes that the private sector will be able to undertake this work where it is required. However, all Government aquatic animal laboratories attest to the fact that because of the relatively recent emergence of the industry, many investigations of aquatic animal disease are complex, involving attempts to identify novel agents, in novel culture systems. Consequently, significantly greater amounts of time need to be apportioned to these investigations, to reach an outcome that may ultimately be useful to control the problem on the farm. These types of investigations do not readily fit into the high throughput environment of private laboratories. Hence the State Government laboratories tend to be left with these largely cost-unrecoverable investigations. This needs to be recognised by State Governments when resourcing laboratories.

Recommendation 5 would go some way to addressing this problem provided that State Governments committed to this industry AAH development activity. These subsidised investigations would become part of the wider training of laboratory diagnosticians and fulfil the recognised need for their up-skilling.

11. State Governments under-resourcing for its own requirements

The Government stakeholder survey results clearly noted that Commonwealth and State Governments had an ongoing requirement for high level professional AAH staff and that industry relied heavily on Government laboratories for its high level AAH advice. The

Commonwealth consults with these same professionals through the NAAH-TWG committee, although this is not the only source of AAH service utilised by the Commonwealth. A separate survey of State and Commonwealth Governments was undertaken through NAAH-TWG to determine current and future staff requirements. Through this survey a staffing shortage was identified in provision of diagnostic laboratory services, extension services and working on national initiatives within State Governments (not Commonwealth) (see Figures 42, 43).

Concerns were expressed by some that there was a real risk, in the near term, of inexperienced staff replacing those with high level AAH skills, due to a shortage of highly qualified experienced applicants. It is imperative to the quality of outcomes that highly qualified individuals continue to be available to perform these key functions for Government and industry. Currently 68% of industry refers to Government for AAH advice, typically through laboratories, as their first option for assistance. Commonwealth and State Governments need to understand the key role they play in providing employment and training opportunities to maintain the critical mass of AAH expertise in Australia. This necessitates resourcing the recommendations of this report to ensure suitably skilled staff continues to be created.

State Government employment and internship opportunities need to be available for suitably qualified people, to ensure biosecurity and AAH policy keeps pace with international best practice, whilst fostering aquaculture growth and protecting fisheries resources. Time within government positions needs to be allocated for self-education to foster continued learning in this rapidly evolving field. This mechanism is also critical to ensure efficient succession of intellectual property takes place, as many aging highly skilled fish pathologists are approaching retirement.

12. Improving the future AAH outcomes for industries

The successful examples of health management in Australia's terrestrial primary production industries and the Tasmanian salmonid industry should be followed, to seek greater engagement of AAH professionals in the aquaculture and fisheries industries. The salmonid industry has provided a useful model for how this can be effectively achieved through government-industry partnerships. A cornerstone of this success has been training and supporting of highly skilled veterinarians, with access to a broad range of ancillary specialists (outlined in Table 1) of varying university qualifications.

13. The role of the Australian College of Veterinary Scientists in continuing education of veterinarians

The Australian College of Veterinary Scientists has an Aquatic Animal Health Chapter, for which full membership is through examination. The College has broad roles across the veterinary profession to maintain standards and offer continuing education opportunities for veterinarians. Membership of the chapter continues to grow with examinations held every second year. Collaborative arrangements with overseas AAH veterinary groups in the USA and UK are at an advanced stage of discussions, and are set to further expand the educational opportunities of the Chapter. It is likely that the Chapter will continue to provide the role of continuing education for veterinarians, and will ultimately develop a fellowship level examination to permit the creation of registered AAH veterinary specialists in Australia.

14. Competency standards for AAH service provision

60% of respondents supported the creation of competency standards for AAH service provision. A competency standard is provided for veterinarians who have been working the AAH field through the Australian College of Veterinary Scientists Membership examination in aquatic animal health. To be eligible to sit this examination veterinarians must have a minimum of two years engagement within the discipline and generally undertake 12 months of mentoring of study, prior to sitting the written and oral papers.

There is currently no mechanism for accreditation of non-veterinarian AAH professionals. The authors recommend as a first step, to request AAHC to identify potential providers of a merit-based accreditation program, to undertake mentoring, training, examination and continuing professional education in AAH. This could then become recognised as a competency standard across Australia. Recently within Asia there have been discussions on the setting up of such a system within the NACA region. Australia should engage in this process and ensure that required attributes and training levels are analogous to those created in Australia and where possible look to offer those training opportunities within tertiary institutions in Australia.

BENEFITS AND ADOPTION

The executive summary and recommendations will be forwarded to Aquatic Animal Health Committee once NAAH-TWG has had an opportunity to comment on them.

Should AAHC agree with the recommendations, it may forward them to PIHC and PISC and PIMC where resources to implement the recommendations may be identified. Due to the strong commonality of the problems in provision of AAH services to the provision of animal health services more generally, it is suggested that the paper also be presented to AHC.

Should the recommendations be implemented, they will, in the long-term, provide some security to the quality and continuity of AAH service supply to aquatic animal industries. The recommendations will provide training pathways to create highly skilled aquatic animal health professionals to deliver improved health outcomes for aquaculture and other aquatic animal stakeholder industries including government.

Improved aquatic animal health services will result in more profitable, reliable production in aquaculture and improved surveillance capacity for Australia to maintain its favourable disease status.

FURTHER DEVELOPMENT

Depending on the agreement within NAAH-TWG and AAHC on the recommendations, further projects to address these recommendations may be warranted. Electronic copies of the report will be disseminated to diagnostic laboratories and government AAH management groups around Australia. Participating stakeholders will be directed to the FRDC website to acquire copies of the final report.

KEY RECOMMENDATIONS

- 1. That Australian universities be encouraged to incorporate a greater component of aquatic animal health into undergraduate training courses, through the development of a national aquatic animal health curriculum and educational resource material.**
- 2. That Australian universities be encouraged to develop post-graduate training opportunities with formal international linkages, e.g. Network of Aquaculture Centres in the Asia-Pacific (NACA), Australian Centre for International Agricultural Research (ACIAR), Asian Fisheries Society (AFS), to encourage overseas students to participate and support the running of such courses. Such training opportunities should include some direct field experience with industry.**
- 3. That funding be sourced to support traineeships in fish pathology at Government and University aquatic animal health laboratories around Australia.**
- 4. That AAHC approach providers to assess potential for endorsed graduates of tertiary undergraduate degree programs to undertake a program of mentoring, training and examination and continuing professional development in AAH which could then be recognised as the competency standard across Australia.**
- 5. That State Governments be asked to subsidise the cost of investigations of novel aquatic animal disease outbreaks, to underpin development of improved understanding of key pathogens and processes whilst the aquaculture industries are developing to maturity**
- 6. That nationally funded research projects with AAH components should include links to a veterinary school, a State Government AAH diagnostic laboratory and with industry.**
- 7. That a nationally coordinated extension program be funded to ensure key stakeholders are aware of all the training opportunities that currently exist.**

COMMENT ADDED IN PROOF

Feedback from reviewers of early drafts of this document included the following suggestions for training.

- Government scholarships for PG training overseas.
- Develop multi-organisation PG program with state government laboratory staff, CSIRO, invited overseas experts and universities all contributing. Multi-centre delivery and national funding.
- Nationally fund a program where experienced diagnostic fish pathologists and recognised research scientists, at the end of their careers or in early retirement, prepare and present modules of specific advanced topics in aquatic animal diagnosis and health for remote learning and residential workshops. Pay these experts to run a mentorship program across the country in government laboratories and with post-graduate students. There is a travelling mentor program for terrestrial animal diseases and the Australian Animal Pathology Standards Program have recently (December 2005) funded Judith Handler to prepare self-teaching continuing education courses for graduate veterinary pathologists on diseases of finfish and molluscs.
- Specific requirement in aquatic animal health research projects to identify and fund specialist training for animal laboratory scientists to acquire experience working with aquatic animal pathogens.
- A nationally funded laboratory exchange or sabbatical program to help train existing animal laboratory scientists in the test methodology for aquatic animal pathogens.
- Facilitate and provide cash incentives for research staff employed on FRDC, ACIAR and ARC etc funds to locate and work in state aquatic animal diagnostic laboratories.
- Require aquatic animal health diagnostic pathology training to be included in nationally funded aquatic animal research projects.

CONCLUSION

Demand for AAH services already exceeds the capacity of current resources to supply. This situation is likely to deteriorate significantly within the next 10 years due to the retirement of the majority of highly skilled AAH professionals from the national diagnostic laboratory network. This deterioration will become more marked as demand for services is predicted to continue to rise significantly over the next 10 years. The under-resourcing will be further exacerbated as the understanding by industry of the importance of AAH management increases (to approach that of other intensive production animal industries) from its currently low standing. Current levels of training available in Australia are inadequate to generate AAH diagnostic professionals of the calibre required to meet expectations of Government and industry. Historical training pathways by which the current AAH professionals have been generated are largely no longer available. Urgent action to create new training pathways and improve interaction between veterinary schools and science/aquaculture schools is required. The consideration of this reports recommendations and urgent actioning should be a priority.

BIBLIOGRAPHY

Anon. 2006. Competitive edge attracts. Fisheries R&D News. May Vol 14. No. 2. FRDC. p5.

Frawley P.T. 2003. Review of Rural Veterinary Services Report for DAFF and Commonwealth Department of Education, Science and Training.. Retrieved on 15 March 2006.. viewed on http://www.affa.gov.au/corporate_docs/publications/pdf/animalplanthealth/chief_vet/vetreport.pdf

Heath T.J, Niethel G.E. 2001. Veterinary practitioners in rural Australia: a national survey. Australian Veterinary Journal 79: 3-8

INTELLECTUAL PROPERTY

No intellectual property has been generated by this project.

STAFF

Matt Landos, Navneet Dhand, Brian Jones, Richard Whittington, Marion Saddington

APPENDIX 1:
Survey Questions to Aquaculture Industry stakeholders to assess current and future Aquatic Animal Health (AAH) education and training needs.

1. What level of aquatic animal health knowledge do staff require to perform optimally in their respective activities?

Operator level	Activity	Level of Aquatic Animal Health Knowledge					More training needed (Y/N)
		Not required	Basic understanding used occasionally	Basic understanding used regularly	Advanced understanding used occasionally	Advanced understanding used regularly	
Farm hand staff	General: feeding, handling, applying treatments						
	Fish health monitoring (including routine microscopic examinations)						
	Sampling for food safety						
	Sampling for disease investigation						
	Recognition of signs of disease/poor health						
	Keeping records of fish health						
	Detect sub-clinical health problems, such as poor growth or low-grade mortality.						
	Investigation of losses including sample collection						
Farm manager	Parasite identification						
	Water quality measurement						
	Development and implementation of biosecurity plans for stock movement and disease control on farm						

	Manage prevention measures and chemical treatments to control disease outbreaks									
	Manage impacts of treatments on environment and food safety									
	Design sampling strategy for farm surveillance status									
	Application of vaccination program									
Diagnostic Laboratory	Diagnosis of disease from samples sent in.									
	Histopathology (look at sections of preserved tissues under microscope)									
	Microbiology (culture and identify bacteria)									
	Virology (growing and identifying viral infections)									
	Molecular biology (tests to detect DNA material e.g. PCR)									
	Testing for disease freedom certification for translocation									
	Parasite identification									
	Toxic algae identification									
	Water quality testing									
	Advise on treatment and disease control									
	Government licensing/ policy authority	State disease surveillance to facilitate interstate trade of seedstock and product								
Surveillance for exotic diseases and provide some industry and market protection from potential imports										

	Disease control programs e.g. zoning to restrict stock movement, eradication of exotic diseases								
	Licence conditions to meet environmental guidelines								
Fish health Vet or Aquatic animal health consultant	Field services								
	Diagnostic investigations, diagnosing disease								
	Parasite identification								
	Prescribing, dispensing and advising legal therapeutants for disease prevention and control								
	Farm management advice: husbandry, stock handling, anaesthetics, vaccines, nutrition								
	Impacts of treatments on the environment								

2. Where have your farm staff (you included) received education to acquire the AAH skills they currently possess? (Mark each box with “X” and specify which institution provided the training (e.g. UTAS, Flinders, Deakin, Spencer TAFE, Natfish etc)

	Source of Aquatic Animal Health Education and Training	
	On-the-job Training	TAFE (including Seafood Industry Training Package)
Operator level		University
Farm hand staff		
Farm manager		
Fish health vet or consultant (if used)		

3. How relevant have the off-farm AAH education & training components been for practical application on the farm? (Mark with “X”, or leave line blank if not applicable to your situation)

	Irrelevant	Relevant but of insufficient depth to be of value	Relevant but required modification to be of practical value on the farm	Relevant, quickly applicable to work on farm to maintain current AAH standards	Highly Relevant and increased the AAH standards on the farm
Seafood Industry Training Package					
TAFE					
University Aquaculture degree					
University veterinary degree					
Other training (please specify)					

4. Have student job expectations at graduation, been an accurate reflection of the “real world”, once skills are employed on a farm? (Mark boxes with “X” where you have had experience with graduate employees from the various qualifications)

Education level	Student job expectations		
	Expectation too high	Expectation about right	Expectation too low
TAFE (e.g. Natfish Aquaculture)			
TAFE (Seafood Industry Training Package)			
University (Science- Biology/Zoology)			
University (Applied Science- Aquaculture)			
University (Marine biology)			
University (Veterinary degree)			

5. a. Score the key AAH skills that would be of benefit to (i) farm hands and (ii) farm managers (iii) AAH veterinarian or consultant.
- Score 1 - not required at all
 - Score 2 - Basic skill - used occasionally
 - Score 3 - Basic skill used regularly
 - Score 4 - Advanced skill used occasionally
 - Score 5 - Advanced skill used regularly
- b. For each of the skills score how much study/training you would expect a competent individual to undertake, to perform optimally for the farm.
- Score 1 - Two day course
 - Score 2 - One week course
 - Score 3 - One semester course
 - Score 4 - One year diploma
 - Score 5 - Five year degree

Skill	Farm Hand		Farm Manager		AAH veterinarian or consultant	
	Skill level (1-5)	Amount of training (1-5)	Skill level (1-5)	Amount of training (1-5)	Skill level (1-5)	Amount of training (1-5)
Awareness of signs of sickness						
Undertake rigorous investigation of a health problem						
Collect appropriate samples to facilitate an investigation						
Reach a definitive diagnosis						
Choose and administer appropriate treatment						
Awareness of government regulations, in relation to diagnosis of disease, application of therapy and food safety consequences						
Awareness of the National list of diseases, and the requirement to report outbreaks to the Govt authorities						
Ability to design and implement a farm biosecurity plan for protection from disease threats from outside of the farm						
Ability to design and implement a farm health management program, for control and prevention of diseases that occur on the farm						
Ability to comprehend the interaction between the environment, the pathogen and the host, to manifest in disease						

- 6.
- a. Have you had the need to seek professional level AAH services from **off** the farm, if so from where and how frequently? (Rank providers from those you would contact first through to those you contact last (1-10) - mark any you never use with n/a) (Mark "X" in box that best describes the frequency with which you seek out the service provider)
 - b. How adequate was the technical knowledge you received for diagnosis? Did they work out the cause of your problem? (Place score 1,2,3 in box)
 - Score 1 - Poor
 - Score 2 - Adequate
 - Score 3 - Good
 - c. How adequate was the technical knowledge you received to implement practical control and treatment for the problem? Were they able to fix the problem? (Place score 1,2,3 in box)
 - Score 1 - Poor
 - Score 2 - Adequate
 - Score 3 - Good
 - d. How timely was the service provided? (Place score 1,2,3 in box)
 - Score 1 - Too slow
 - Score 2 - Sometimes adequate
 - Score 3 - Adequate
 - e. How cost effective is the service offered? (Place score 1,2,3,4,5 in box)
 - Score 1 - It is free- but would pay market rate if required
 - Score 2 - It is free- would not use if had to pay
 - Score 3 - Cost beneficial: service more than pays for itself
 - Score 4 - Cost neutral
 - Score 5 - Too expensive- minimise use due to cost concerns

	Rank order	Frequency of service use					Diagnostic Technical Adequacy	Treatment technical adequacy	Timeliness	Cost effectiveness
		Never	Once a year	Three monthly	Monthly	Weekly				
Off Farm AAH Service provider	1-10					Weekly	1,2,3	1,2,3	1,2,3,4,5	
Other farmers										
Govt. extension officer										
Govt. veterinary officer										
Govt. aquaculture manager										
Govt laboratory (inc. CSIRO)										
Private laboratory										
Private veterinarian with special interest in fish										
Private non-veterinary aquatic animal health consultant										
University										
Researcher										

7. Are you aware of any educational programs in Australia that are able to provide your staff with training in the required AAH areas? (Mark “X” in appropriate box and specify programs, if any)

No, training unavailable	Yes, but insufficient depth	Yes, sufficient

Specify training programs:

8. Do you feel your business would benefit from improved AAH input? (Mark “X” in appropriate box)

Very unlikely	Unlikely	Possibly	Likely	Definitely

9. What AAH outcome are you seeking? (Mark “X” in appropriate box in each row)

Desired Outcomes	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree
Cost-effective measures for the reduction of losses from disease(s) already present on the farm					
Protection from incursion of new enzootic/exotic diseases					
Disease free status on livestock facility translocation of stock					
Disease free status on product to facilitate market access and protect domestic market position					
Improved productivity from existing stock, through control of sub clinical health problems.					

10. Use of AAH services is likely to increase in the next 5-10 years. (Mark “X” in appropriate box in response to this statement)

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

11. Has your aquaculture business experienced significant losses due to health/disease problems? (Mark “X” in appropriate box)

Yes	No

12. How would you prefer to incorporate more AAH services into your operations, if required? (“X” all relevant boxes)

Training existing staff	
Hire new staff who have been trained	
Use contractors on an as needs basis	
Service not required	

13. Would you like to see a minimum competency/accreditation standard brought into the areas of AAH service provision that your industry utilises? (e.g. Professional Aquatic Animal Health advice, Laboratory services) Would you use such a standard to assist in selecting suitably qualified persons to undertake work for your industry?

Yes	No	Uncertain

Aquatic Animal Health (AAH) Survey Questions to Government Fisheries and Aquaculture Management Stakeholders to assess current and future Aquatic Animal Health (AAH) education and training needs

1. How frequently do you provide/require the following Aquatic Animal Health (AAH) services, to meet your legislative and other obligations?
 Score 1 - never
 Score 2 - once a year
 Score 3 - four times a year
 Score 4 - monthly
 Score 5 - weekly

AAH Services	Frequency (1,2,3,4,5)
Managing fisheries and aquaculture research	
Aquatic animal welfare	
Domestic surveillance for incursion of exotic disease or spread of endemic disease at State or National level	
Setting regulations for domestic certification for translocation of fish within State and Australia	
Field Investigation and diagnosis of sickness or mortality event	
Drafting policy for control of AAH in aquaculture, wild commercial and recreational fisheries	
Laboratory diagnostic services	
Provision of disease control, prevention and treatment advice	
Industry development, education and extension	
Provide guidance for chemical use	
Contribute to and review AAHC and AQUAPLAN documents	
Food safety and OH&S	
Other (please specify)	

2. a. What AAH skills do you require to provide the services in Q1 competently? Please rate your skill level currently in each area. In addition note the skill level you believe is required to perform at the same high standard, as is present in terrestrial animal health management (note entries in these two columns may be the same number.)
- Score 1 - Not required at all
 - Score 2 - Basic skill used rarely (once a year)
 - Score 3 - Basic skill used regularly
 - Score 4 - Advanced skill used occasionally
 - Score 5 - Advanced skill used regularly
- b. For each of the skills, which of the following qualifications would be most applicable as background education?
- Score 1 - Diploma of Aquaculture
 - Score 2 - Bachelor of Science (Aquaculture)
 - Score 3 - Bachelor of Science (Zoology/Fisheries Management)
 - Score 4 - Bachelor of Veterinary Science
 - Score 5 - Bachelor of Economics/Commerce/Business Administration
 - Score 6 - Other- please specify
- c. For each of the skills score how much study/training you would expect a competent individual to undertake, to perform optimally for management operations.
- Score 1 - Two day course
 - Score 2 - One week course
 - Score 3 - One semester course
 - Score 4 - One year diploma
 - Score 5 - University degree with AAH units
 - Score 6 - Post-graduate qualification in AAH related discipline

d. Would you support and attend a training course in this skill area? Answer: Yes or No

Skill	Government Management Skill and training level				
	Current Skill level (1,2,3,4,5)	Required skill level (1,2,3,4,5)	Background education (1,2,3,4,5,6)	Length of training required (1,2,3,4,5,6)	More training supported Yes/No
Current knowledge of important national and international diseases of aquatic animals					
Regulatory knowledge of risk assessment process including mitigation measures to facilitate international and domestic trade and minimise disease impacts on domestic fisheries and aquaculture					
Ability to interpret technical scientific information to apply to fisheries and aquaculture management					
Ability to design and operate surveillance and reporting systems for rapid detection of new disease outbreaks/incursions					
Ability to organise and interpret a thorough disease outbreak including field investigation, collecting accurate epidemiological information about the outbreak, collection of diagnostic samples.					
Ability to interpret laboratory testing results.					
Ability to interpret State and National legislative requirements with respect to management of aquatic animal health.					
Ability to design and implement prevention/control and treatment strategies to minimise disease impacts					
Technical understanding of aquaculture farming systems to implement appropriate biosecurity plans to minimise risk of disease translocation between aquaculture facilities and to the receiving environment.					
Combination of all of the above skills					

3. Use of AAH services is likely to increase in the next 5-10 years. (Mark “X” in appropriate box in response to this statement)

Government areas	Response to Q3)Statement				
	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree
Laboratory					
Policy/Management					
Field					

- 4.
- a. Who provides the technical AAH services and advice to your management team currently? (Mark “X” if you use the service provider)
 - b. How adequate was the technical knowledge you received?
 Score 1 - Poor
 Score 2 - Adequate
 Score 3 - Excellent
 - c. How timely was the service provided?
 Score 1 - Too slow
 Score 2 - Sometimes adequate
 Score 3 - Always adequate
 - d. How cost effective was the service offered?
 Score 1 - It is free- but would pay market rate if required
 Score 2 - It is free- would not use if had to pay
 Score 3 - Cost beneficial: service more than pays for itself
 Score 4 - Cost neutral
 Score 5 - Too expensive- minimise use due to cost concerns

Service provider	Use service	Technical knowledge (1,2,3)	Timeliness (1,2,3)	Cost effective (1,2,3,4,5)
No services sought				
No service available				
Self-taught / published literature / internet				
Research facility staff				
University-based AAH experts				
Fisheries and Aquaculture managers				
Government extension/ veterinary officer				
Govt laboratory staff (inc. CSIRO)				
Private laboratory staff				
Private veterinary consultant				
Private Aquatic Animal Health consultant				
Other (specify)				

5. How would you prefer to incorporate more AAH skills and services into your management structure? (Mark appropriate boxes with "X")

Training existing management staff	
Hiring new trained management staff	
Enhance training for govt field/ extension officers	
Use contractors on an 'as needs' basis	
Increased service not required	

6. Are you aware of any educational programs in Australia that are able to provide your staff with training in the required AAH areas?

No, training unavailable	Yes, but insufficient depth	Yes, sufficient

Examples of training:

7. Do you feel your management would benefit from improved AAH input?

Very unlikely	Unlikely	Possibly	Likely	Definitely

8. Has your management team had to deal with a significant scale health/disease problems?

Yes	No

9. What tertiary qualifications do members of your aquaculture and fisheries management team (who cover AAH issues) have?

Tertiary qualifications:.....

10. Would you like to see a minimum competency/accreditation standard brought into the areas of AAH service provision? (e.g. Veterinary advice, Laboratory services) to assist in selecting suitably qualified persons to undertake work for your management operations.

Yes	No	Uncertain

Aquatic Animal Health (AAH) Survey Questions to Aquatic Animal Diagnostic Laboratory Stakeholders to assess current and future Aquatic Animal Health (AAH) education and training needs

1.
 - a. Which Aquatic Animal Health (AAH) services do you provide through your laboratory service to aquaculture and fisheries industries? Mark most appropriate box with “X” for each service.
 - b. Frequency
 - Score 1 - once a year
 - Score 2 - four times a year
 - Score 3 - monthly
 - Score 4 - weekly
 - Score 5 - all of the time

AAH Services	Yes	No, service not provided	No, but would like to provide	Frequency (1,2,3,4,5)
Aquatic animal welfare advice				
Domestic surveillance for incursion of exotic disease or spread of endemic disease at State by State level				
Providing technical input into designing regulations for domestic certification for translocation of aquatic animals within Australia				
Field Investigation of sickness or mortality event				
Provide disease diagnosis				
Technical input to drafting policy for control of AAH in aquaculture, wild commercial and recreational fisheries				
Commercial and research laboratory diagnostic services				
Provision of advice for control, prevention and treatment of disease				
Industry development, education and extension				
Aquatic Animal Health Research				
Food safety and OH&S				
Other (please specify)				

2. a. Which AAH skills, do you require to provide the services in Q1 competently?
Please rate your skill level currently in each area. In addition, note the skill level you believe is required to perform at the same high standard, as is present in terrestrial animal health laboratory services (note entries in these two columns may be the same number.) Also note if service is unavailable.
- Score 1 - not required at all
 Score 2 - Basic skill -used rarely (once a year)
 Score 3 - Basic skill used regularly
 Score 4 - Advanced skill used occasionally
 Score 5 - Advanced skill used regularly
- b. For each of the skills used, score how much study/training you would expect a competent individual to undertake, to perform optimally for the laboratory.
- Score 1 - Two day course
 Score 2 - One week course
 Score 3 - One month course
 Score 4 - One year diploma (With AAH units)
 Score 5 - University degree (BVSc, BSc(Aquaculture)
 Score 6 - Post graduate qualification in AAH

Skill	Skill and training level		
	Current Skill level (1,2,3,4,5)	Required skill level (1,2,3,4,5)	Amount of training required to achieve required level (1,2,3,4,5,6)
Current knowledge of important national and international diseases of aquatic animals			
Knowledge of risk assessment process including mitigation measures to facilitate international and domestic trade and minimise disease impacts on domestic fisheries and aquaculture			
Ability to design epidemiological sound surveillance and reporting systems for rapid detection of new disease outbreaks/incursions to support quarterly disease reporting to the Commonwealth			
Ability to undertake a thorough disease outbreak investigation including, field investigation, collecting accurate epidemiological information about the outbreak, collection of diagnostic samples.			
Ability to interpret water quality laboratory testing results.			
Ability to undertake rapid, reliable accredited laboratory tests to identify causative disease agents, including awareness of exotic diseases.			

Histopathology				
Microbiology				
Molecular biology				
Virology				
Parasitology				
Ability to design and implement prevention/control and treatment strategies to minimise disease impacts				
Technical understanding of aquaculture systems to interpret significance of laboratory findings in light of the rearing system.				
Ability to provide a disease diagnosis, rather than just a laboratory report.				
Ability to certify stock free of disease to facilitate restocking/ sale of aquaculture product/translocation of seedstock				

3. Do you feel the technical knowledge of your discipline within the laboratory, is of the same standard for Aquatic Animals, as that which is provided for terrestrial animal submissions?

Yes	No	In some areas only (specify deficiencies)

4. Who are the most common submitters of aquatic animal diagnostic samples?

Aquaculture farmers	Private Veterinarians	Government veterinarians	AAH consultants	Research Scientists or biologists

5. Is the lab able to obtain the field information on aquatic animal submissions, required to assist in selection of diagnostic tests and interpretation of findings?

Always	More often than not	Rarely	Never

6. Is the lab able to send results to a qualified third party who can interpret laboratory results and generate management and treatment recommendations to apply in the field?

Always	More often than not	Rarely	Never

7. Use of AAH services is likely to increase in the next 5-10 years. (Mark "X" in appropriate box in response to this statement- Private labs not required to respond to Policy or Field areas)

Government areas	Response to Q3)Statement				
	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree
Laboratory					
Policy/Management					
Field					

- 8.
- a. If additional technical assistance is sought with aquatic animal cases, who provides this technical AAH advice to you? (Mark “X” if you use the service provider)
 - b. How adequate is the technical knowledge you received? (i.e. Are you able to get the advice you need to accurately interpret test results?)
 - Score 1 - Poor
 - Score 2 - Adequate
 - Score 3 - Excellent
 - c. How timely is the service provided?
 - Score 1 - Too slow
 - Score 2 - Sometimes adequate
 - Score 3 - Always adequate
 - d. How cost effective is the service offered?
 - Score 1 - It is free- but would pay market rate if required
 - Score 2 - It is free- would not use if had to pay
 - Score 3 - Cost beneficial: service more than pays for itself
 - Score 4 - Cost neutral
 - Score 5 - Too expensive- minimise use due to cost concerns

Service provider	Use service provider	Technical knowledge (1,2,3)	Timeliness (1,2)	Cost effective (1,2,3,4,5)
In house: Self-taught / published literature / internet				
Research facility staff				
University-based AAH experts				
Fisheries and Aquaculture managers				
Government extension/ veterinary officer				
Other interstate Govt or private Laboratory staff (inc. CSIRO)				
Private veterinary consultant				
Private Aquatic Animal Health consultant				
Other (specify)				

9. How would you prefer to incorporate more AAH skills and services into your business/industry? (Mark appropriate boxes with "X")

Training existing lab staff	
Hiring new trained lab staff	
Enhance training for govt field/ extension officers	
Use contractors on an as needs basis	
Increased service not required	

10. Are you aware of any educational programs in Australia that are able to provide your staff with training in the required AAH areas?

No, training unavailable	Yes, but insufficient depth	Yes, sufficient

Examples of courses:

11. Do you feel your laboratory service would benefit from improved AAH expertise?

Very unlikely	Unlikely	Possibly	Likely	Definitely

12. Would you like to see a minimum competency/accreditation standard brought in for AAH service provision? (e.g. Veterinary advice, Laboratory services) to assist in selecting suitably qualified persons to undertake work.

Yes	No	Uncertain

Aquatic Animal Health (AAH) Survey Questions to Fisheries and Aquaculture Research Industry Stakeholders to assess current and future Aquatic Animal Health (AAH) education and training needs

1.
 - a. Do you utilise, or have any aquatic animal health (AAH) services issues impact on your industry sector currently? Mark most appropriate box with “X” for each service.
 - b. Score the frequency
 - Score 1 - once a year
 - Score 2 - four times a year
 - Score 3 - monthly
 - Score 4 - weekly
 - Score 5 - all of the time

AAH Services	Yes	No, service unavailable or not required	No, but would like to access, if service was available	Frequency (1,2,3,4,5)
Regulatory restriction of species allowed to be researched due to disease concerns				
Aquatic animal welfare				
Domestic surveillance for incursion of exotic disease at State by State level				
Domestic certification for translocation of fish within Australia e.g. seedstock for restocking, broodstock for specific pathogen free (SPF) breeding programs				
Field Investigation and diagnosis of sickness of mortality event				
Research programs to control diseases affecting aquaculture and wild fisheries				
Laboratory diagnostic services				
Provision of disease control, prevention and treatment in research stock				

2. Who do you expect to provide you with the AAH services noted above? (Mark all appropriate providers with ‘X’)

Commonwealth Government	Government Laboratory inc. CSIRO	State Government Fisheries management	Private sector Veterinarians or AAH consultant	University	State Govt veterinary/ extension staff	Research facility staff

- 3.
- a. What skills do you require the service provider (only fill in boxes for service providers you identified in Q2) to have to meet your AAH needs?
 - Score 1 - not required at all
 - Score 2 - Basic skill - used rarely (once a year)
 - Score 3 - Basic skill used regularly
 - Score 4 - Advanced skill used occasionally
 - Score 5 - Advanced skill used regularly

 - b. For each of the skills score how much study/training you would expect a competent individual to undertake, to perform optimally for the research team.
 - Score 1 - Two day course
 - Score 2 - One week course
 - Score 3 - One semester course
 - Score 4 - One year diploma (Aquaculture)
 - Score 5 - University degree (BSc (Aquaculture) BVSc)
 - Score 6 - Post graduate qualification in AAH

Skill	State Govt. Lab or private Lab or CSIRO lab or University lab		State/ Common-wealth Govt. Fisheries Management		Private veterinarian or AAH consultant		Research staff	
	Skill level 1-5	Amt. of training 1-6	Skill level 1-5	Amt of training 1-6	Skill level 1-5	Amt of training 1-6	Skill level 1-5	Amt of training 1-6
Ability to recognise signs of sickness and disease in research stock								
Ability to thoroughly investigate a disease outbreak including field investigation, collecting accurate information about the outbreak, collection of diagnostic samples								
Rapid, reliable accurate laboratory testing capacity to exclude exotic diseases and identify causative agent in research animals.								
Regulatory knowledge of risk assessment process including mitigation measures to facilitate international and domestic trade								
Ability to provide a disease diagnosis								
Ability to choose and administer appropriate treatment and control measures								
Ability of Government to maintain a national surveillance and reporting system for detection of new disease outbreaks/incursions, which accurately reflect the status of aquatic animal diseases in Australia								
Current knowledge of disease threats that may affect research program outcomes								
Licensing and surveillance of research facilities to ensure they do not contaminate/infect the wild fishery from their operations								

4. Use of AAH services is likely to increase in the next 5-10 years. (Mark "X" in appropriate box in response to this statement)

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

- 5.
- a. Who provides these services to your research sector and how frequently? (Rank providers from those you would contact first through to those you contact last (1-11) - mark any you never use with n/a) (Mark "X" in box that best describes the frequency with which you seek out the service provider)
 - Score 1 - Poor
 - Score 2 - Adequate
 - Score 3 - Excellent
 - b. How adequate was the technical knowledge you received for diagnosis? Did they work out the cause of your problem? (Place score 1,2,3 in box)
 - Score 1 - Poor
 - Score 2 - Adequate
 - Score 3 - Excellent
 - c. How adequate was the technical knowledge you received to implement practical control and treatment for the problem? Were they able to fix the problem? (Place score 1,2,3 in box)
 - Score 1 - Poor
 - Score 2 - Adequate
 - Score 3 - Excellent
 - d. How timely was the service provided? (Place score 1,2,3 in box)
 - Score 1 - Too slow
 - Score 2 - Sometimes adequate
 - Score 3 - Adequate
 - e. How cost effective is the service offered? (Place score 1,2,3,4,5 in box)
 - Score 1 - It is free- but would pay market rate if required
 - Score 2 - It is free- would not use if had to pay
 - Score 3 - Cost beneficial: service more than pays for itself
 - Score 4 - Cost neutral
 - Score 5 - Too expensive- minimise use due to cost concerns

	Rank order	Frequency of service use					Diagnostic Technical Adequacy	Treatment technical adequacy	Timeliness	Cost effectiveness
		Never	Once a year	Three monthly	Monthly	Weekly				
AAH Service provider	1-11						1,2,3	1,2,3	1,2,3	1,2,3,4,5
Self-taught (internet resources, textbooks)										
Govt. extension officer (non-vet)										
Govt veterinary officer										
Govt aquaculture manager										
Govt laboratory inc CSIRO										
Private laboratory										
Private veterinarian with special interest in fish										
Private non-veterinary aquatic animal health consultant										
University										
In house Researchers										
Researchers in other institutes										

6. Are you aware of any educational programs in Australia that are able to provide your research staff with training in the required AAH areas?

No, training unavailable	Yes, but insufficient depth	Yes, sufficient

Examples of training:

7. How would you prefer to incorporate more AAH services into your research team, if required? (Mark appropriate boxes with "X")

Training existing research staff	
Hiring new trained research staff	
Enhance training for govt field/ extension officers	
Use contractors on an as needs basis	
Service not required	

8. Do you feel your research operations would benefit from improved AAH input?

Very unlikely	Unlikely	Possibly	Likely	Definitely

9. Has your research program ever experienced significant losses/project interruptions due to health/disease problems?

Yes	No

10. Would you like to see a minimum competency/accreditation standard brought into the areas of AAH service provision that your business/industry utilises? (e.g. Veterinary advice, Laboratory services) to assist in selecting suitably qualified persons to undertake AAH work for your research projects.

Yes	No	Uncertain

Aquatic Animal Health (AAH) Survey Questions to Recreational Fishing Industry Stakeholders

1.
 - a. Do you utilise, or are you currently aware of any impacts of aquatic animal health (AAH) services on your industry sector? (Mark most appropriate box with "X" for each service.)
 - b. Frequency
 - Score 1 - Never
 - Score 2 - once a year
 - Score 3 - four times a year
 - Score 4 - monthly
 - Score 5 - weekly

AAH Services	Yes	No	No, but would like to access, if service was available	Frequency (1,2,3,4,5)
Investigation of fish kills/ sick looking fish e.g. parasites; EUS skin lesions				
Protection from exotic disease incursion				
Pre-release health certification of fish for restocking programs				
Control of AAH in aquaculture enterprises that have an open interface with the wild fishery				
Fish release program				
Fish welfare				
Water quality control, e.g. acid sulfate soil run-off management, pollution, pesticides run-off				
Restriction on movement of boats, gear due to disease spread threat				
Disease related fishery impacts including closures				
Food safety, e.g. oysters are safe to consume				
Bait controls: illegal to move some baits between locations, risks associated with use of imported products (prawns, pilchards, herring) for bait				

2. Who do you expect to provide AAH services to the recreational fishing industry? (Mark all appropriate providers with “X”)

Commonwealth Government	Government Laboratory (inc. CSIRO)	State Government Fisheries management	Private sector Veterinarians	Marine biologists	Tackleshop proprietors	University

3. a. What skills do you require/expect the service provider to have to meet your AAH needs?
 Score 1 - not required at all
 Score 2 - Basic skill
 Score 3 - Moderate skill
 Score 4 - Advanced skill
 Score 5 - Advanced skill and advanced experience

	Commonwealth Govt.	Govt. Lab. Inc. CSIRO	State Govt. Fisheries Management	Private Veterinarian with interest in fish	Marine biologist (other aquatic animal health profession-al)	Tackle-shop operators	University
Skills	Skill level (1-5)	Skill level (1-5)	Skill level (1-5)	Skill level (1-5)	Skill level (1-5)	Skill level (1-5)	Skill level (1-5)
Ability to thoroughly investigate a disease outbreak including field investigation							
Ability to collect relevant epidemiological information about the outbreak							
Collect appropriate samples to facilitate an investigation							
Ability to undertake a competent laboratory investigation in an accredited lab							
Ability to interpret laboratory results							

and provide management options									
Awareness of government regulations, in relation to diagnosis of disease, food safety, and disease reporting requirements									
Up to date understanding of international diseases of importance and requirement for reporting exotic disease incursions									
Ability to design and implement a biosecurity plan for protection from disease threats from outside the State									
Ability to diagnose disease									
Ability to design and undertake protocols for detection of disease in fish for stocking programs									
Research skills to investigate negative impacts of recreational fishing such as hooking mortality, catch and release during the breeding season and the impacts of other activities on the sustainability of the recreational fishery (e.g. aquaculture effluent, urban sewage effluent)									

4. Use of AAH services is likely to increase in the next 5-10 years. (Mark "X" in appropriate box in response to this statement)

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

- 5.
- a. Who provides these services to your industry and how frequently? (Rank providers from those you would contact first, through to those you contact last (1-12)) (Mark "X" in box that best describes the frequency with which you seek out the service provider)
 - b. How adequate was the technical knowledge you received for diagnosis? Did they work out the cause of your problem? (Place score 1,2,3 in box)
 - Score 1 - Poor
 - Score 2 - Adequate
 - Score 3 - Good
 - c. How adequate was the response to implement practical control and treatment for the problem? Were they able to fix the problem? (Place score 1,2,3 in box)
 - Score 1 - Poor
 - Score 2 - Adequate
 - Score 3 - Good
 - d. How timely was the service provided? (Place score 1,2,3 in box)
 - Score 1 - Too slow
 - Score 2 - Sometimes adequate
 - Score 3 - Adequate
 - e. How cost effective was the service offered? (Place score 1,2,3,4,5 in box)
 - Score 1 - It was free- but would pay market rate if required
 - Score 2 - It was free- would not use if had to pay
 - Score 3 - Cost beneficial: service more than pays for itself
 - Score 4 - Cost neutral
 - Score 5 - Too expensive- minimise use due to cost concerns

AAH Service provider	Rank order	Frequency of service use				Diagnostic Technical Adequacy	Control response technical adequacy	Timeliness	Cost effectiveness
		Never	Once a year	Three monthly	Monthly				
Self-taught	1-12					1,2,3	1,2,3	1,2,3,4,5	
Other fishermen									
Tackle shop proprietor									
Govt. extension officer									
Govt veterinary officer									
Govt aquaculture manager									
Govt laboratory inc.									
CSIRO									
Private laboratory									
Private veterinarian with special interest in fish									
Private non-veterinary aquatic animal health consultant									
University									
Researcher									

6. What AAH outcome are you seeking?

Desired Outcomes	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree
Minimal impact of existing diseases on sustainability of wild fish stocks					
Protection from incursion of new enzootic/exotic diseases					
Identify threats from industry/ agriculture and develop and implement protection measures					
Ensure aquaculture practices do not spread diseases into wild fishery					
Ensure maximum survival of catch and release fish					
Ensure any stocking programs delivery cost effective fishery enhancement, without detrimental impacts on the ecosystems					

7. Are you aware of any educational programs in Australia that are able to provide your business with training in the required AAH areas? (Mark "X" in appropriate box and specify programs, if any)

No, training unavailable	Yes, but insufficient depth	Yes, sufficient

Specify training programs that you know of:

Specify training programs you would enrol in.....

8. How would you prefer to incorporate more AAH services into your industry? (Mark appropriate boxes with "X")

Training Tackleshop proprietors	
Enhance training for govt field officers	
Run training courses for the public e.g. fishcare volunteers	
Use contractors on an as needs basis	
More service not required	

9. Would you like to see a minimum competency/accreditation standard brought into the areas of AAH service provision that your industry utilises? (e.g. Veterinary advice, Laboratory services) to assist in selecting suitably qualified persons to undertake work for the industry.

Yes	No	Uncertain

Survey Questions to Wild Capture (Professional fishing) Industry, and Seafood Importer stakeholders

1.
 - a. Do you require any of the aquatic animal health (AAH) services below, in your industry sector currently? (Mark all appropriate boxes with “X”).
 - b. Frequency of service use?
 Score 1 - once a year
 Score 2 - four times a year
 Score 3 - monthly
 Score 4 - weekly
 Score 5 - all the time
 - c. Would you, or your employees, participate in formal training in any of these service areas if offered? (Answer Yes or No)

AAH Services	Not used/ not required	Frequency of use (1,2,3,4,5)	Not used, but would be useful if service was available	Extra training required (Yes/No)
Investigation of fish kills/ sick looking aquatic animals e.g. skin lesions-red spot, deaths in live holding tanks, skin discolouration, cottontail in prawns				
Surveillance for exotic disease incursion e.g. Whitespot virus (WSV) in prawns, Viral Haemorrhagic Septicaemia (VHS) in imported baitfish				
Development of Quality Assurance/Control protocols for live fish holding/processing plants				
Market access / protection through disease certification, import risk assessment (claim disease freedom) e.g. Require testing on imported raw bait (prawns/crab bait/pilchards) due to disease transfer risks				
Control of AAH in aquaculture enterprises that have an open interface with the wild fishery to avoid spread of disease from aquaculture to the wild fishery				
Translocation certification - moving live fish between				

areas, for restocking/ranching programs, live fish harvest and transportation.				
Aquatic Animal welfare advice				
Water quality control, e.g. acid sulfate soil run-off management, pollution, pesticides run-off, heavy metal residue				
Restriction on movement of boats or gear due to disease spread threat (e.g. for abalone in-between perkinsus infected zones in NSW)				
Disease related impacts on fishery viability e.g. associated with closures or stock reduction (pilchard kill, abalone die-off)				
Food safety, e.g. shellfish are safe to consume, ciguatera, algal toxins, scombrotoxins in tuna/mackerel, flesh quality problems from parasites like kudoa.				

- 2.
- a. What skills do you require the service provider to have to meet your AAH needs in the commercial wild capture, seafood importation industry?
 - Score 1 - not required at all
 - Score 2 - Basic skill -used rarely (once a year)
 - Score 3 - Basic skill used regularly
 - Score 4 - Advanced skill used occasionally
 - Score 5 - Advanced skill used regularly

 - b. For each of the skills, score how much study/training you would expect a competent individual to undertake, to perform optimally for the commercial fishing industry, seafood importation business.
 - Score 1 - Two day course
 - Score 2 - One week course
 - Score 3 - One semester course
 - Score 4 - One year diploma
 - Score 5 - University degree and field experience

	State Govt Fisheries Compliance Officer		State Govt Fisheries Management		Private veterinarian or consultant		Govt laboratory staff inc CSIRO		In house staff	
	Skill level 1-5	Amt of training 1-5	Skill level 1-5	Amt of training 1-5	Skill level 1-5	Amt of training 1-5	Skill level 1-5	Amt of training 1-5	Skill level 1-5	Amt of training 1-5
Field skills										
Thoroughly investigate a disease outbreak on site										
Recognise sick animals										
Ability to collect relevant epidemiological information about the outbreak										
Collect appropriate (fish/water/algae) samples to facilitate an investigation										
Laboratory skills										
Undertake a competent laboratory investigation in an accredited lab										
Rapid, reliable accurate testing capacity to exclude exotic diseases from imported product										
Ability to interpret laboratory results and provide science-based management options										
Diagnose disease outbreaks										
Policy Skills										
Understanding of national and international diseases of importance										
Understanding of risk management of disease threats (or threatening processes such as acid-sulfate run-off, and salinisation of the Murray Darling) posed by imported products, domestic aquaculture and other impacts on the domestic fishery										
Ability to design and implement a biosecurity plan for protection from disease threats from outside the State										
Ability to design and undertake protocols for detection of disease in fish for stocking programs										
Research skills to investigate potential impacts on the fishery from disease/poor aquatic animal health (e.g. due to aquaculture effluent, urban sewage effluent, recreational catch and release impacts during breeding seasons)										

3. Are you aware of any educational programs in Australia that are able to provide your staff with training in the required AAH areas?

No, training unavailable	Yes, but insufficient depth	Yes, sufficient

Specify training options:

4. Use of AAH services is likely to increase in the next 5-10 years. (Mark "X" in appropriate box in response to this statement)

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

- 5.
- Who provides these services to your industry/business currently and how frequently? (Rank providers from those you would contact first through to those you contact last (1-10) - mark any you never use with n/a) (Mark "X" in box that best describes the frequency with which you seek out the service provider)
 - How adequate was the technical knowledge you received for diagnosis? Did they work out the cause of the problem? (Place score 1,2,3 in box)
 - Score 1 - Poor
 - Score 2 - Adequate
 - Score 3 - Good
 - How adequate was the technical knowledge you received to implement practical control and treatment for the problem? Were they able to fix the problem? (Place score 1,2,3 in box)
 - Score 1 - Poor
 - Score 2 - Adequate
 - Score 3 - Good

d. How timely was the service provided? (Place score 1,2,3 in box)

Score 1 - Too slow

Score 2 - Sometimes adequate

Score 3 - Adequate

e. How cost effective is the service offered? (Place score 1,2,3,4,5 in box)

Score 1 - It is free- but would pay market rate if required

Score 2 - It is free- would not use if had to pay

Score 3 - Cost beneficial: service more than pays for itself

Score 4 - Cost neutral

Score 5 - Too expensive- minimise use due to cost concerns

	Rank order	Frequency of service use				Diagnostic Technical Adequacy	Treatment technical adequacy	Timeliness	Cost effectiveness
		Never	Once a year	Three monthly	Monthly				
Off Farm AAH Service provider	1-10					1,2,3	1,2,3	1,2,3	1,2,3,4,5
Self taught (internet, textbooks)									
Other professional fishermen									
Govt. compliance officer									
Govt veterinary officer									
Govt aquaculture manager									
Govt laboratory inc CSIRO									
Private laboratory									
Private veterinarian with special interest in fish									
Private non-veterinary aquatic animal health consultant									
University									
Researcher									

6. Has an AAH problem ever affected your business through inability to fish (e.g. closures) or unsaleable catch (e.g. redspot), inability to access bait (due to quarantine restriction)?

	Yes
	No

7. What AAH outcome are you seeking? (Mark “X” in appropriate box in each row)

Desired Outcomes	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree
Minimal impact of existing diseases on sustainability of wild fish stocks					
Protection from incursion of new enzootic/exotic diseases					
Maintain Australia’s “clean green” relatively disease free status for marketing edge					
Disease free status on product to facilitate market access and protect domestic market position					
Ensure aquaculture practices do not spread diseases into wild fishery					

8. How would you prefer to incorporate more AAH services into your industry? (Mark appropriate boxes with “X”)

Training professional fishermen	
Enhance training for govt field officers	
Use contractors on an as needs basis	
No more service required	

9. Would you like to see a minimum competency/accreditation standard brought into the areas of AAH service provision that your industry utilises? (e.g. Veterinary advice, Laboratory services) to assist in selecting suitably qualified persons to undertake work for the industry.

	Yes
	No

Survey Questions to Aquaculture Feed Industry

1.
 - a. What skills are required to fulfil your business requirements for Aquatic Animal Health (AAH)? (For each skill, mark most appropriate box with "X")
 - b. Can you access sufficient information in this skill area? (Answer Yes or No)

Skill	Not required	Basic skill - used rarely (once a year)	Basic skill used regularly	Advanced skill used occasionally	Advanced skill used regularly	Is information available? (Yes/No)
Understanding of the impact of nutrition on fish health						
Understanding of impacts of the formulation and processing / manufacturing on nutritional value						
Government regulators require knowledge of disease translocation risks posed by domestic and international movement of stock feed.						
Research into improved feed formulations that improve fish health under aquaculture conditions						
Understanding the impact of feed storage and dietary deterioration on fish health						
Ability to understand scientific research papers on nutrition and additives that can impact on AAH.						

2. Do you utilise, or have any aquatic animal health (AAH) services impact on your industry sector currently? Mark “X” in most appropriate box.

AAH Services	Yes	No	No, but would like to if service was available
Restriction or Screening tests on imported constituents of feed, or imported whole feed			
Diet formulation advice sought to maximise fish health			
Premix additives supply (e.g. probiotics, immunomodulators, antibiotics)			
Ensuring feed has not been associated with losses where it has been implicated in a disease outbreak			
Nutritional research on formulation for improved fish health and on additives for enhancing fish health and resistance to disease			
Other (specify)			

3. Have you or your feed mill staff received education to acquire the AAH skills they currently possess? (Mark each box with “X” and specify which institution provided the training (e.g. UTAS, Flinders, Deakin, Spencer TAFE, Natfish etc)

Operator level	Source of Aquatic Animal Health Education and Training	
	On-the-job Training	TAFE (including Seafood Industry Training Package) University
Farm hand staff		
Farm manager		
Fish health vet or consultant (if used)		

4. How relevant have the off-farm AAH education & training components been for practical application to the feed business? (Mark with “X”, or leave line blank if not applicable to your situation)

	Irrelevant	Relevant but of insufficient depth to be of value	Relevant but required modification to be of practical value on the farm	Relevant, quickly applicable to work on farm to maintain current AAH standards	Highly Relevant and increased the AAH standards on the farm
Seafood Industry Training Package					
TAFE					
University Aquaculture degree					
University veterinary degree					
Other training (please specify)					

5. Use of AAH services is likely to increase in the next 5-10 years. (Mark “X” in appropriate box in response to this statement)

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

6. a. Who provides these services to your business? (Mark “X” if use the service provider)
- b. How adequate was the technical knowledge you received? i.e. Were the questions you asked able to be answered?
 Score 1 - Poor
 Score 2 - Adequate
 Score 3 – Excellent

c. How timely was the service provided?

Score 1 - Too slow

Score 2 - Sometimes adequate

Score 3 - Adequate

d. How cost effective is the service offered?

Score 1 - It is free- but would pay market rate if required

Score 2 - It is free- would not use if had to pay

Score 3 - Cost beneficial: service more than pays for itself

Score 4 - Cost neutral

Score 5 - Too expensive- minimise use due to cost concerns

Service provider	Use service	Technical knowledge (1,2,3)	Timeliness (1,2,3)	Cost effective (1,2,3,4,5)
No services sought				
No service available				
Self-taught / published literature / internet				
Other feed industry members				
Government extension/ veterinary officer				
Laboratory (inc. CSIRO)				
Researchers				
Private veterinary consultant				
University				
Other (specify)				

7. Are you aware of any educational programs in Australia that are able to provide you/ your staff with training in the required AAH areas?

No, training unavailable	Yes, but insufficient depth	Yes, sufficient

Specify courses you are aware of:.....

8. Do you feel your business would benefit from improved AAH input?

Very unlikely	Unlikely	Possibly	Likely	Definitely

9. How would you prefer to incorporate AAH services into your operations?

Training existing staff	
Hire new staff who have been trained	
Use contractors on an as needs basis	
Service not required	

10. Would you like to see a minimum competency/accreditation standard brought into the areas of AAH service provision that your industry utilises? (Veterinary advice, Laboratory services) to assist in selecting suitably qualified persons to undertake work for your industry. Would you use such an accreditation standard to find appropriately trained people to assist?

Yes	No

Aquatic Animal Health (AAH) Survey Questions to Ornamental Fish Industry

1.
 - a. Does your business use any of the Aquatic Animal Health Services? Mark most appropriate box with "X" for each service.
 - b. Frequency
 - Score 1 - once a year
 - Score 2 - four times a year
 - Score 3 - monthly
 - Score 4 - weekly
 - Score 5 - all the time

	AAH Services	Yes	No	No, but would like to access, if service/ skills were available	Frequency (1,2,3,4,5)
In house services (i.e. you and your staff)	Awareness of signs of sickness				
	Collect samples to facilitate a disease investigation				
	Select and administer control and treatment				
	Keeping records of fish health				
	General feeding and handling				
	Water quality measurement and interpretation				
	Import Risk Assessment				
	Market access through disease certification undertaken by an overseas authority				
	Inspection of imported fish by AQIS				
	Domestic surveillance for incursion of exotic disease at State by State level				
Government services	Domestic certification for translocation of fish within Australia (e.g. goldfish into Tasmania)				
	Field Investigation of sickness of mortality event				
	Parasite identification				
	Histopathology (microscopic examination of tissues to determine cause of sickness)				
	Bacterial culture and identification, antibiotic sensitivity testing				
	Provision of disease control, prevention and treatment advice				
	Supply of pharmaceuticals including antibiotics and parasiticides				
	Development of farm/shop disease prevention plan (biosecurity measures)				
Field and Laboratory Aquatic Animal Health Services					

2. Where have your farm staff (you included) received education to acquire the AAH skills they currently possess? (Mark each box with “X” and specify which institution provided the training (e.g. UTAS, Flinders, Deakin, Spencer TAFE, Natfish etc)

Operator level	Source of Aquatic Animal Health Education and Training		
	On-the-job Training	TAFE (including Seafood Industry Training Package)	University
Farm hand staff			
Farm manager			
Fish health vet or consultant (if used)			

- 3.
- a. Would you undertake training courses (for yourself or staff) covering this skill area if they were made available? (Answer Yes or No)
 - b. What skills do you require the service provider to have to meet your AAH needs? (Place score in box)
 - Score 1 - not required at all
 - Score 2 - Basic skill - used occasionally
 - Score 3 - Basic skill used regularly
 - Score 4 - Advanced skill used occasionally
 - Score 5 - Advanced skill used regularly
 - c. For each of the skills, score how much study/training you would expect a competent individual to undertake, to perform optimally for the ornamental fish industry/your business.
 - Score 1 - Two day course
 - Score 2 - One week course
 - Score 3 - One semester course
 - Score 4 - One year diploma
 - Score 5 – University degree (Veterinary Science, Marine Biology)

	Training needed (Y/N)	Aquarist (includes aquarium shop owners)		State/Commonwealth Fisheries Management		Government extension service		Laboratory service		Private veterinarian or AAH consultant	
		Skill level (1-5)	Amt of training (1-5)	Skill level (1-5)	Amt of training (1-5)	Skill level (1-5)	Amt of training (1-5)	Skill level (1-5)	Amt of training (1-5)	Skill level (1-5)	Amt of training (1-5)
Field skills											
Awareness of signs of sickness											
Ability to thoroughly investigate a disease outbreak including field/shop investigation											
collecting accurate information about the outbreak, collection of diagnostic samples											
Ability to provide a disease diagnosis											
Ability to design and implement prevention/control and treatment strategies to minimise disease impacts											
Laboratory skills											
Rapid, reliable accurate laboratory testing capacity to exclude exotic diseases and identify causative agent in ornamental fish.											

4. Use of AAH services is likely to increase in the next 5-10 years. (Mark “X” in appropriate box in response to this statement)

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

- 5.
- a. Have you had the need to seek professional level AAH services from **off** the farm, if so from where and how frequently? (Rank providers from those you would contact first, through to those you contact last (1-11) - mark any you never use with n/a) (Mark “X” in box that best describes the frequency with which you seek out the service provider)
 - b. How adequate was the technical knowledge you received for diagnosis? Did they work out the cause of your problem? (Place score 1,2,3 in box)
 - Score 1 - Poor
 - Score 2 - Adequate
 - Score 3 – Excellent
 - c. How adequate was the technical knowledge you received to implement practical control and treatment for the problem? Were they able to fix the problem? (Place score 1,2,3 in box)
 - Score 1 - Poor
 - Score 2 - Adequate
 - Score 3 – Excellent
 - d. How timely was the service provided? (Place score 1,2,3 in box)
 - Score 1 - Too slow
 - Score 2 - Sometimes adequate
 - Score 3 – Adequate

- e. How cost effective is the service offered? (Place score 1,2,3,4,5 in box)
- Score 1 - It is free- but would pay market rate if required
 - Score 2 - It is free- would not use if had to pay
 - Score 3 - Cost beneficial: service more than pays for itself
 - Score 4 - Cost neutral
 - Score 5 - Too expensive- minimise use due to cost concerns

	Rank order	Frequency of service use				Diagnostic Technical Adequacy	Treatment technical adequacy	Timeliness	Cost effectiveness
		Never	Once a year	Three monthly	Monthly				
Off Farm AAH Service provider	1-11				Weekly	1,2,3	1,2,3	1,2,3,4,5	
Self-taught									
Other aquarists									
Govt. extension officer (non-vet)									
Govt veterinary officer									
Govt aquaculture manager									
Govt laboratory (inc. CSIRO)									
Private laboratory									
Private veterinarian with special interest in fish									
Private non-veterinary aquatic animal health consultant									
University									
Researcher									

6. Are you aware of any educational programs in Australia that are able to provide your staff with training in the required AAH areas?

No, training unavailable	Yes, but insufficient depth	Yes, sufficient

Examples of training:

7. Do you feel your business would benefit from improved AAH input?

Very unlikely	Unlikely	Possibly	Likely	Definitely

8. Has your aquaculture business experienced significant losses due to health/disease problems?

Yes	No

9. How would you prefer to incorporate more AAH services into your business/industry? (Mark appropriate boxes with "X")

Training Aquarium shop proprietors	
Enhance training for govt field officers	
Run training courses for the private aquarists/ ornamental fish farmers	
Use contractors on an as needs basis	
Run training courses for import quarantine operators	
Service not required	

10. Would you like to see a minimum competency/accreditation standard brought into the areas of AAH service provision that your business/industry utilises? (e.g. Veterinary advice, Laboratory services) to assist in selecting suitably qualified persons to undertake work for your business/industry.

Yes	No	Uncertain

Survey of University undergraduate courses which include significant AAH components

1. Fill in table below to represent all education and training in Aquatic Animal Health subject areas within the courses that your institution offers. (If a subject is taught, without specific reference to fish although the general principles of the subject do apply, please note those hours in parentheses.
 - a. No. of hours of lectures of each subject
 - b. No. of hours of practical classes in each subject
 - c. Grading of the anticipated skill level acquired by the graduate

Subject	Lecture hours	Practical class hours	Basic	Intermediate	Advanced/ specialist
Epidemiology					
Biology					
Anatomy					
Medicine					
Physiology					
Pharmacology					
Pathology					
Virology					
Molecular biology					
Immunology					
Parasitology					
Field observation and recording					
Certification/competent authority					
Water quality/chemistry assessment					
Algal identification					
Nutrition					
Other(specify)					

2. What skills do you anticipate students will acquire in AAH?

AAH Skills	Level of skill acquired through education course				
	Skill Not acquired	General awareness of issues only	Basic skills with no practical experience provided	Sound skills with some practical experience	Advanced skills with considerable practical experience
Keeping fish health records					
Recognise diseased fish-					
Define clinical signs					
Describe appearance of gross lesions					
Collect appropriate samples to facilitate investigation					
Generate a differential diagnosis list					
Ability to choose an appropriate control, prevention and treatment plan					
Ability to administer appropriate treatments					
Design a farm biosecurity plan					
Histopathology – describe microscopic tissue changes in diseased fish					
Microbiology – identify micro-organism associated with fish disease					
Molecular Biology – ability to develop and run molecular assays on fish pathogens					
Parasitology- ability to identify parasites on fish					
Virology – ability to undertake cell culture and identify viral pathogens					

Algal identification (toxic and nutritional algae)								
Water quality analysis								
Understand legislative requirements of making a disease diagnosis and providing therapeutic treatment advice								
Understand environmental and food safety issues associated with application of treatments								
Understand zoonotic disease risks								
Awareness of the National List of reportable diseases								
Awareness of State legislation requiring reporting and investigations of suspect exotic disease outbreaks								

3. What position(s) do you perceive the AAH skills taught will equip students for in the workforce? Mark all relevant boxes with “X”

Graduation job positions	AAH education and training provided
Farm hand	
Farm manager	
Laboratory diagnostician	
Government AAH management	
Private Veterinarian	
Aquatic animal health post-graduate researcher (PhD student)	

4. Course emphasis on AAH subjects is likely to increase in the next 5-10 years. (Mark “X” in appropriate box in response to this statement)

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

5. Have you requested and received any direct industry input to your AAH curricula? (Mark appropriate box with “X”)

Yes	
No	

6. Would you see significant benefit in development of a comprehensive National Veterinary Curricula for Aquatic Animal Health with transferable modules with the subject areas outlined above? This material would be available as a National resource. (Mark appropriate box with “X”)

Yes	
No	

7. Would you like to see a minimum competency/accreditation standard brought into the areas of AAH service provision that your institution teaches to make valid comparisons of units between institutions? (Mark appropriate box with “X”)

Yes	
No	

8. Reflecting the diversity of industries utilising AAH services, the proposed AAH curricula would comprise a general section plus specialised industry components developed in collaboration with the major industries. This would facilitate institutions teaching material relevant to the important industries of their geographic region. Is this approach considered appropriate? (Mark appropriate box with “X”)

Yes	
No (please state alternatives)	

9. Would your institution support the setting up of a single centre of excellence for AAH education and training in Australia, as was recommended in the McShane report 2004? This single centre would provide both in depth undergraduate training options in AAH and post-graduate specialisation in certain areas of AAH. The post-graduate training opportunities are envisaged to be of equal transferable value between universities, which would not be requiring of a degree? Post graduate opportunities would likely be offered in a module format for flexible learning. (Mark appropriate box with "X")

Yes	
No	

10. Profile of staff who teach AAH?

Type of experience	Years of experience
Hands on commercial industry experience on operation with >\$200K turnover	
AAH research project	
Aquatic Animal Diagnostic Laboratory	
Lecturing	
Aquaculture or biology degree	

11. Would you utilise curriculum material developed by another institution?

Yes	
No	

12. Would you contribute to curriculum development?

Yes	
No	

13. Would you utilise academic services provided by another veterinary school, for example a veterinary academic?

Yes	
No	

**APPENDIX 2:
Additional NAAH-TWG survey of State and Commonwealth Government full time equivalent staff requirements to cover various legislative responsibilities for Aquatic Animal Health**

Government area of AAH need	Prescribed responsibilities	Specific aquatic health tasks required of Government	Est. current FTE	Est. required FTE	Est. future (10 years) FTE †
<p>Policy to meet various State Government legislative responsibilities</p>	<p>Development of AAH policies Assessment and issue of leases and licences Development of conditions that licences and leases will be subject to Efficient administration of the act Requires licence holders to provide periodic reports Reporting on the administration of the Act</p> <p>Requires approvals for off-label use of chemicals Requires reporting of unusually high mortality rates Prevents movement of diseased stock without approval Requires health certification for stock to be translocated to navigable vessels</p>	<p>Development of AAH policy Assessment of health implications of new aquaculture licences and leases Development of health associated lease and licence conditions Analysis of reports from licence holders Development of reports on the implementation of the Act</p> <p>Receipt, assessment, development of recommendations, communication of recommendations and administration in response to requests for approvals related to chemical use, translocation, health certification Receipt, assessment and administration of health certification</p>			

	<p>Licences and describes the powers of Livestock Inspectors</p> <p>Establishment of a list of notifiable diseases and contaminants</p> <p>Prevention of movement of stock infected with notifiable diseases or contaminants</p> <p>Investigation of suspect cases of notifiable disease/contamination</p> <p>Production of gazettal notices to enhance the objectives of the Act</p>	<p>Emergency response activities</p> <p>Maintenance of notifiable diseases/contaminants list</p> <p>Receipt and analysis of surveillance data</p> <p>Production of gazette notices</p>			
	<p>Control of translocation of stock from within and outside the State.</p>	<p>Receipt of documentation for translocations</p> <p>Assessment of translocations</p> <p>Production of approvals and other correspondence</p> <p>Assessment of periodic returns against</p>			
	<p>Administration of a framework for the legal harvest of wild fish</p>	<p>Assessment of licence applications involving ranching</p> <p>Assessment of broodstock collection requests</p>			
	<p>Control of exotic fish species including aquarium species</p>	<p>Assessment of licence applications involving exotic species</p> <p>Assessment of translocations of exotic species</p>			

Tasks relevant to the intent of legislation

Govt area of AAH need	Objectives / duties of care	Tasks carried out by Government	Est. current FTE	Est. required FTE	Est. future (10 years) FTE
.Aquaculture development and management	<p>Efficient administration of the Act</p> <p>To manage the development and operation of the aquaculture industry in a sustainable manner</p>	<p>Aquatic animal health activity reviews</p> <p>Development of an industry-government working group</p> <p>Residue surveillance studies</p> <p>Ecotoxicology studies on medicines of interest</p> <p>Hatchery certification program - development and implementation</p> <p>Emergency response exercises</p>			

Aquaculture development	Extension service	Deliver on farm transfer of research findings, provide assistance with AAH issues Transfer information from the field to management on AAH issues- surveillance input.			
State Govt commitments to National programs	Control of notifiable disease/contaminants Control of movement of stock	Participation in NAAH-TWG / AAHC Aquatic animal health communication strategy Participation in AQUAPLAN Import risk assessment Emergency response exercises			
Fisheries conservation	Control of exotic fish species including aquarium species Investigation of wild fish kills	Health and sustainability reviews of lists of developments involving exotic fish Undertake full investigation of reported fish kills			
Laboratory AAH diagnostic services	Identification of causes of disease in aquaculture and wild fisheries, assistance with development of control strategy. Assistance with testing to comply with pre-translocation testing requirements Vaccine manufacture	Diagnostic, referral and testing services for commercial submissions and research. Residue testing Water Quality testing Algal identification Certification Services Communication with policy/fisheries & aquaculture managers and CVO's significant findings. Technical detail for quarterly surveillance report.			

Compliance activities

Govt Area of AAH Need	Objectives / duties of care	Tasks carried out by Government	Est. current FTE	Est. required FTE	Est. future (10years) FTE
Compliance in Aquaculture, commercial and recreational fisheries	Enforcement of all legislation associated with aquaculture. Movement controls of equipment/stock between disease zones	General compliance / enforcement			
Total					