

Selection pressures on zoology teaching in Australian universities: student perceptions of zoological education and how to improve it

Dieter F. Hochuli¹ and Peter B. Banks²

¹ School of Biological Sciences, Heydon-Laurence Building (A08), The University of Sydney, N.S.W. 2006, Australia

² School of Biological, Earth and Environmental Sciences, The University of New South Wales, NSW 2052 Australia

Correspondence to DFH: Phone (61-2) 9351 3992, Fax (61-2) 9351 4119,

Email: dieter@bio.usyd.edu.au

ABSTRACT

Zoology is a diverse and vibrant discipline blending natural history with modern technologies and applications to understand the biology of animals. Career paths for those trained in zoology vary dramatically, ranging from traditional roles in research and teaching to work in environmental management, planning and health sciences. Undergraduate and postgraduate students participating in the Royal Zoological Society of New South Wales' student workshops were asked to identify what they value in their tertiary education and how they would improve the experience. Student perceptions of what constitutes a good learning experience in zoology reflected the common belief that experiential learning, particularly in the field, were critical to successful undergraduate programs. Postgraduates reflected on the very specific nature of MSc and PhD projects, such that vocational elements deemed important for later success were sometimes neglected owing to the temporal constraints of completing higher degrees by research. Top-down higher education policy pressures were also perceived as impediments to improving some aspects of the zoological experience at universities. The commonalities in student opinion show that neglecting the experiential elements that had made zoology in universities so successful in the past could diminish the experience in the future, and so should be prioritised and enhanced.

Introduction

Zoology teaching has had a high profile in Australian universities since 1851 (Moyal 1986), reflecting a widespread interest in the rich and unique diversity of the Australian fauna. Indeed, Australian zoologists have made significant contributions to the conceptual underpinnings of zoology and ecology globally (Mulligan and Hill, 2002) and continue to do so despite uncertain funding for research and increased pressures on staffing and teaching. Many former departments of zoology are now merged to form larger administrative units, encompassing disciplines such as botany, genetics, environmental science, resource management and earth sciences. Enrolments in many "traditional" zoology courses at Australian universities are also declining, possibly due to the growth of adjectival programs in environmental science and molecular biology covering areas traditionally taught as part of general zoology courses (Calow 1987, Pert 1987), as well as a perceived lack of relevance to future employment. At a time where the number of students attending university is greater than at any point in Australia's short history, this is cause for concern among zoologists.

Recently, general trends in higher education in Australia suggest that efficiencies in teaching need to be achieved in order for universities to remain sustainable (DEST 2002a), and that vocational elements be incorporated in many facets of basic science degrees (DEST 2002b).

Positive responses to enhancing the quality of teaching in universities have been consistently reported (e.g. Franklin *et al.* 2002, Green 2002) although the motivations for many changes have been reduced operating budgets and shrinking staffing levels. Welch (1998) made a compelling case that the "cult of efficiency has been linked to declines in the overall quality of education even in the face of innovations in teaching". Specific trends in universities include;

- Courses with low student numbers being removed from teaching programs
- The removal/replacement of practical courses from curricula
- The use of "innovative" and "flexible" cost-saving approaches (Franklin *et al.* 2002)
- The encouragement of academics to embrace internet-based interactive learning (Zenger and Walker 2000, Brabazon 2002)
- Reductions in face-to-face teaching
- Emphasis on postgraduate courses for re-training of graduates in degrees covering fewer subject areas with less depth and opportunities for practical work (Gill and Golding 2001)

The impacts of many of the changes to higher education in Australia are amplified in zoology owing to its “risky” nature; many activities in laboratory and field require high levels of supervision and are expensive to run. The inherent risks associated with field trips and working with animals, coupled with ethical concerns over the use of animals in teaching (e.g. repeated handling of animals claimed to cause stress and sometimes death, (Monamy and Gott 2001) mean that teachers of zoology face dilemmas which do not lend themselves to computer-based solutions (Zenger and Walker 2000). Similarly, a decline in numeracy among bioscience undergraduates (described for the U.K. by Tariq, 2002) is a disturbing trend requiring universities to invest resources into programs and strategies to address deficiencies in basic skills that are assumed to have been attained during secondary education. This leads to a reduction in the amounts of fundamental zoology that can be incorporated in standard three-year degrees. Despite this, better incorporation of student needs and experiences into the development of teaching materials will enhance learning outcomes across all levels of teaching. Student feedback identifying expectations from zoology teaching is vital to the professional development of the discipline.

Graduates of zoology are now entering a more diverse range of careers than ever before, reflecting the general transformation of the science of zoology (reviewed for U.K. graduates by Gill and Golding, 2001). The demand for biology-trained scientists is still strong, but there is an emerging need for training beyond “basic” degrees and a developing culture that encourages and expects specialist post-graduate training for specific disciplines (Baxter et al. 1999, DEST 2002b). Thus many people with basic training in zoology can identify with a range of disciplines, such as environmental science, ecology, physiology and molecular biology, reflecting shifts in contexts for zoology as well as rapid developments in emerging research fields (Calow 1987, Pethen and Calow 1988, Baxter et al. 1999). In addition to being competent in a range of discipline-specific techniques and skills, employers expect graduates to be proficient in “generic” or “transferable” skills”. Essentially it is required that they are proficient writers, speakers, thinkers and problem solvers (Clarkeburn et al. 2000) and capable of adapting to a number of different tasks in their workplace. Consequently, the expectations of zoology training at the undergraduate and postgraduate levels are likely to be distinctly different.

In this paper we report on the outcomes of an interactive session at “Transitions and decisions: Navigating career paths in zoology”, a workshop run by the (RZS) Zoological Society of New South Wales in 2002 and 2004 for undergraduate and postgraduate students in zoology. The workshop began with a forum where speakers offered advice about attaining careers in a variety of aspects of zoology, including academia, environmental consulting and conservation agencies, from policy and research perspectives. In the interactive session we sought responses from students to a range of issues that they faced in studying zoology. In reporting those responses, we discuss the changing faces of zoology and higher

education and how these may affect student perceptions of their university experience. We acknowledge that the motivations and destinations of undergraduates and postgraduates involvement are substantially different and partition results when appropriate. However, we also examine commonalities in experience during the transition from undergraduate to postgraduate in the university experience, noting that these experiences forge the foundation for most professional zoologists.

The feedback workshop

The theme of professional development for zoologists pervaded presentations in the forum component of the day. Participants were encouraged to embrace their professional responsibility to feed back into the process of developing curricula for higher education, addressing the common themes; “How would you improve your experience in zoology?” and “What advice would you give someone about to follow in your footsteps?”. The aim of the workshop, attended voluntarily by 47 students from 7 Australian higher education institutions, was to gauge perceptions of satisfaction among motivated students and identify common themes (positive and negative) in their educational history. By approaching from a disciplinary rather than a institutional perspective we hoped to be able to generate general advice pertinent to all students and academics contributing to the study and teaching of zoology in Australian institutions.

Students were stratified into workgroups according their career stage, then asked group-specific questions targeting their most recent experiences. Students were advised that we sought tangible outcomes such that their responses could be consolidated and that one of the major goals of the workshop was to facilitate interactions among students from a range of institutions. Each workgroup (5-8 students) was facilitated by a professional zoologist (a councillor of the RZS of NSW) and roaming facilitators monitored progress among groups. Students were encouraged to follow the process below;

- Introductions (identifying their background, broader interests and institutional affiliation)
- Scoping the questions (general and stage-specific)
- Identifying common personal themes and shared experiences
- Identifying and targeting cross-institutional themes
- Addressing the main questions relevant to their career stage
- Reporting back

Responses were then summarised by a member of the workshop group and presented to the workshop. General themes were discussed at the end of the workshop in an open session led by students.

The zoological experience for undergraduates

We advised undergraduates that the specific themes we wished for them to address were;

- How could a better course (or courses) be designed?

- To reflect on experiences to date
- To identify core experiences and skills essential to a program in zoology
- To identify approaches/content that could be modified
- To offer advice to incoming students

Table 1 summarises the major themes that emerged from discussions targeting the zoological experience for undergraduates. These generally younger students enjoyed the diversity offered in zoology courses and valued the opportunity for cross-institutional study to meet their needs. Field trips were also a highlight, but many undergraduates considered that there was too little zoological fieldwork, too much online or computer based teaching but not enough statistical training in current courses. The opportunity for independent research during the honours years was a major attraction for most junior undergraduates, and recent honours graduates highlighted the value of the honours research year and the vast differences in experiences during this year.

These results reflect very common responses in evaluations seeking feedback on courses that we have taught and confirm many preconceptions regarding the value of various teaching tools and approaches. In evaluating the adequacy of undergraduate training in Australian universities for wildlife management, Baxter et al. (1999) found that syllabus content in undergraduate training in Australia did not reflect trends in the practice of wildlife management, suggesting that only postgraduate training would provide future conservation managers with the range of disciplinary understanding required in their day to day job. This reflects the strong desire of undergraduates to be exposed to real world and current examples of zoology, particularly with respect to ongoing and current research.

The notion that biology comes alive outside of a classroom and that learning is enhanced by the chance to do rather than read or talk about zoology is one that all professional

zoologists would relate to and it is no surprise that undergraduates identified this as something of which they wanted more. Unfortunately, the desire for cost effective teaching and the risk-averse nature of many universities has lead to the decline of field courses across many subjects. The importance of field work and experiential learning in a British context (Barker et al. 2003) showed that this decline has also filtered down to teaching for senior school students, owing partially to a lack of teaching expertise, to the extent that the culture of learning outside the class room was being lost. It is clear that students and teachers of zoology desire the opportunity to learn and teach in field contexts and that the benefits of expanding these elements in curricula would be reflected in graduate outcomes enhancing employment opportunities. These activities, coupled with the increased emphasis on skills that can be transferred into job markets (Clarkeburn et al. 2000) are essential to make the undergraduate experience both enjoyable and productive.

The zoological experience for postgraduates

Postgraduates were specifically asked to;

- Reflect on their experiences to date
- Discuss what constitutes a successful PhD/MSc
- Identify how postgraduate success can be facilitated?
- Consider what mechanisms they would put in place to improve the postgraduate experience.
- Offer advice to incoming students - what would they have done differently?

Postgraduate responses in the workshop are summarised in Table 2 and reflected a wider range of concerns. Post-graduates appreciated that a PhD requires a range of professional skills beyond those specific to particular projects or techniques, including generic writing skills, administration of research project and skills in publishing. People skills were also identified as important in terms of networking with future colleagues and being active in their

Table 1. Summary of responses by undergraduates at student workshop evaluating perceptions of their zoological education.

Strengths?	Field trips with an emphasis on doing Diversity of courses available, especially from across the range of universities Independent research in Honours Year
Weaknesses?	1 st year too theoretical and general Too little statistical training No direct linkages to industry Too little diversity in zoology courses
How to improve the undergraduate experience?	More information on job opportunities More field experience More funding for facilities Less online teaching More stats training
Advice for students starting Zoology Honours	Choose supervisor carefully Honours is a quantum leap in what is expected and what is learnt Get involved in other opportunities

Table 2. Summary of responses by postgraduates at student workshop evaluating perceptions of their zoological education.

Elements of a successful PhD?	Skills in writing, lab techniques, field biology, administration of research, publishing
What helps?	Active research group at uni and in lab
	Networking with colleagues and employers
	Looking beyond project specific issues
	Being an active member of department
Advice to those starting PhD in Zoology	Pick supervisor carefully
	Pick project and species carefully
	Be involved
	Publish now
	Be prepared for inevitable setback but don't be discouraged

departmental cultures. Successful PhD graduates were also perceived as those that graduate with skills beyond their specific taxa and project, enabling them to enter the workforce in other areas. The keys to such success were seen to be in the choice of supervisor and project as well as pursuing publishing early on during the PhD and active involvement in the zoological community.

Changes to higher education policy and cultures of postgraduate research were also seen as leading to dramatic differences in the types of projects students pursued. For example, changes in the time allowed for PhDs to be completed (i.e. all PhD must be completed within 4 years of full time candidature or the part time equivalent) were noted as being responsible for driving the design of projects in directions where innovation and significance were traded away for “guaranteed” results. It was suggested that the pressure to produce theses in a timely fashion had led to changes in the themes of research being pursued, with a diminished desire to independently pursue “big questions” in favour of smaller, more directed projects.

The need to generate papers from theses was also alluded to by most students. The belief that a minimum of five papers was required to be even moderately competitive for postdoctoral funding from the Australian Research Council is pervasive in academia. This is a considerable hurdle for many aspiring doctoral students, given the lags in publishing time and the inherently long-term nature of many aspects of zoology, particularly ecology. It also reflects a dramatic change in the way that students pursue postgraduate degrees in a climate where funding and measures of success are driven by timely completions rather than content. The historical “luxury” enjoyed by graduate students spending extra time pursue the endpoints of experiments and data from them were fully explored was no longer part of the PhD culture in zoology.

The inconsistent nature of professional training (e.g. degree to which generic skills and attributes were incorporated) and mentoring in PhD programs was noted by some students. Whilst some of these aspects reflect individual nuances among supervisors, it also reflects the nature of graduate programs based wholly on research and examined wholly by thesis. The merits of practical experience outside of academia relevant to the breadth of professions biologists end up in was outlined by Noss

(1997), suggesting that a background in the philosophical underpinnings, value dimensions and historical context of science was critical to better graduate outcomes. Although the gap between effective professional development and graduate student education is closing slowly (Perez 2005), the need to prepare postgraduates for a dynamic and variable workplace is still prominent in student thinking. Nevertheless, the pursuit of postgraduate qualifications still attracts those with passionate (and refreshing) ideals; one student staunchly advocated that their motivations for undertaking a PhD were “to learn, not get a job”.

Much of the advice in the workshop for those pursuing PhDs and those who have recently completed reflects that offered in texts offering career advice for aspiring academics and career researchers (e.g. Medawar 1979, Feibelmann 1993, Sindermann 2000). Among the several common threads that emerge from these is the importance of interpersonal skills across a range of interactions in which professional scientists are involved, acknowledging their need for strategies and “game-playing” in a professional context. The need for longer term planning looking at employment options needs to be moderated by the desire to keep as many doors open as possible. This is critical given the destinations many PhD graduates ultimately arrive at. Finally, stories of success in zoology often reflect ability, luck, networking skills and simply being in the right place at the right time. Common traits among those succeeding in zoology include being prepared to seize opportunities when they present and being able to make something of them, often with extensive lateral thinking.

A view from the Ivory Tower

Higher education in Australia has been described as being at a crossroads (DEST 2002a) and more commonly as in crisis (e.g. Brabazon 2002). The system is “relentlessly attacked for its poor standards and inept teaching” (Brabazon, 2002; p. x. in preface) and dissatisfaction reigns among students, employers of graduates, government and those providing the university experience. Much is made of innovation, efficiency and the importance of new technologies in an environment where resources for teaching are dwindling and changes are dictated by a desire to open up the halls of higher education to as many people as possible.

Change in universities is inevitable and, arguably, a tradition upon which universities are founded (Taylor 1999). However, the current climate of change is a combination of policies advocating changes in the fundamental roles for universities (DEST 2002b) as well as perceptions of what students expect from our teaching.

This is reflected in the radical shift in the ways in which students embrace their responsibility as part of the partnership in learning – many students exhibit the behaviour of customers rather than learners. Whilst we acknowledge the necessity for students to work to support their lifestyles, the prioritisation of activities outside of universities has seriously compromised goals for universities in their quest to produce self-motivated and life-long learners.

One major positive change in zoology has been the willingness of industry partners, government agencies involved in conservation, land and resource management, to participate in higher education, particularly with respect to postgraduate training. Australian Research Council schemes fostering and promoting links with relevant industries, often state and federal government agencies charged with managing the natural world for both resource production and conservation, are another successful way in which graduates can develop research skills in an environment where research products are put to use.

Whilst we are both avid advocates of many aspects of internet-based teaching and the opportunities new technologies present for teaching, the constraints imposed from below and above reinforce the prediction that “our students will know how to send an email, but have nothing to say in it.” (Brabazon 2002, p. xiii). The fundamentally

practical, active and intuitive nature of zoology dictates that we expose them to the diversity of animals in the natural world and how we, as scientists, ask and answer questions about the biology of animals.

Conclusions

Much of what we teach and how we wish to teach it reflects our formative, life-changing experiences as undergraduates being exposed to the beauty, wonder and mystery of the natural world. We were fortunate to be exposed to inspiring teachers giving us the opportunity to learn about animals in their natural habitats, creating the desire to further our understanding. Zoology remains a cornerstone of natural resource management and environmental science; maintaining its role as a fundamental component of degree programs pursuing these applications of zoology is paramount to the future of the discipline.

As zoologists in the privileged position of working at universities, we feel an obligation to preserve the spirit of enquiry and learning in an environment that is supportive and challenging. In our experience, the comments made during workshop discussions and in consolidated responses reflect the concerns of an overwhelming majority of our students. Student perceptions of the zoological experience and their expectations of what we must deliver are clear. Preserving hands-on field components in zoology curricula in the context of how acquired skills contribute to both a deeper understanding of the natural world and future employment in a myriad of careers is central to the success of teaching efforts. The challenges of doing this in a climate where efficiency is seemingly valued over genuine quality are great – as are the rewards.

Acknowledgements

We thank the Council of the Royal Zoological Society of New South Wales for supporting the student forum. Special thanks go to Dan Lunney, Peggy Eby, Ron Strahan, Shelley Burgin, Chris Dickman, Arthur White, Matt Hayward and Angie Penn for their contributions

(facilitation and beyond) to workshops. We are also grateful for the active and enthusiastic efforts of workshop participants who embraced the opportunity to contribute their ideas on how to improve the zoological experience in our universities.

References

- Barker, S., Slingsby, D. and Tilling, S. 2003. Teaching Biology Outside the Classroom: Is it heading for extinction? Field Studies Council and British Ecological Society, London.
- Baxter, G.S., Hockings, M., Carter, R.W. and Beeton, R.J.S. 1999. Trends in wildlife management and the appropriateness of Australian university training. *Conservation Biology* 13: 842-849.
- Brabazon, T. 2002. Digital Hemlock: Internet education and the poisoning of teaching. UNSW Press, Sydney.
- Calow P. 1987. Zoology adapts to meet the market. *New Scientist*, 116: 39 – 40.
- Clarkeburn, H., Beaumont, E. , Downie, R. and Reid, N. 2000. Teaching biology students transferable skills. *Journal of Biological Education*. 34: 124-129.
- DEST (Commonwealth Department of Education, Science & Training). 2002a. Higher education at the crossroads. Ministerial Discussion Paper. Commonwealth Department of Education, Science & Training, Canberra.
- DEST (Commonwealth Department of Education, Science & Training). 2002b. Varieties of learning: the interface between higher education and vocational education and training. Commonwealth Department of Education, Science & Training, Canberra.
- Feibelman, P.J. 1994. A Ph.D. is not enough: A Guide to Survival in Science. Perseus Books New York
- Franklin, S., Peat, M. and Richards, A. 2002. Traditional versus computer-based dissections in enhancing learning in a tertiary setting: a student perspective. *Journal of Biological Education*. 36: 124-129.
- Gill, M.E. and Golding, D.W. 2001. Career choices by biologists: a case study of destinations of graduates in marine biology and zoology, 1986 – 1998. *Journal of Biological Education*. 36: 124-129.
- Green, J. 2002. Replacing lecture by text-based flexible learning: students' performance and perceptions. *Journal of Biological Education*. 36: 176-180.

- Medawar, P.B. 1979.** Advice to a Young Scientist (The Sloan Science Series). Basic books.
- Monamy, V. and Gott M. 2001.** Practical and ethical considerations for students conducting ecological research involving wildlife. *Austral Ecology*, 26 293-300
- Moyal, A. 1986.** 'a bright and savage land': Scientists in colonial Australia. Collins, Sydney.
- Mulligan, M. and Hill, S.B. 2002.** Ecological Pioneers: A Social History of Australian Ecological Thought and Action. Cambridge University Press, Cambridge.
- Noss, R.F. 1997.** The Failure of Universities to Produce Conservation Biologists. *Conservation Biology* 11:1267-1269.
- Perez, H.E. 2005.** What Students Can Do to Improve Graduate Education in Conservation Biology. *Conservation Biology* 19:2033-2035.
- Pert J. 1987.** Zoologists need not apply. *New Scientist*, 1568: 41 – 43.
- Pethen R. W. and Calow P. 1988.** Zoology graduates of 1980 — where are they now? *Biologist*, 34, 245 – 258.
- Sindermann, C.J. 2000.** Winning the games scientist play. Perseus Books, New York.
- Tariq, V.N. 2002.** A decline in numeracy skills among bioscience graduates. *Journal of Biological Education*. 36: 76-83.
- Taylor, P.G. 1999.** Making sense of academic life: Academics, universities and change. Open University Press, Buckingham.
- Welch, A. R. 1998.** The Cult of Efficiency in Education: comparative reflections on the reality and the rhetoric. *Comparative Education*, 34: 157 - 175
- Zenger, J.T. and Walker, T.J. 2000.** Impact of the Internet on entomology teaching and research. *Annual Review of Entomology* 45: 747-767