Manuscript type: Report

Not teaching what we practice: undergraduate conservation training at UK universities lacks interdisciplinarity

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Email: cg399@kent.ac.uk

Words: 3690

Number of figures: 1

Number of tables: 2 (+ 1 in Supplementary Material)

SUMMARY

The practice and science of conservation have become increasingly interdisciplinary, and it is widely acknowledged that conservation training in higher education institutions should embrace interdisciplinarity in order to prepare students to address real-world conservation problems. However, there is little information on the extent to which conservation education at undergraduate level meets this objective. I carried out a systematic search of undergraduate conservation degree programmes in the UK and conducted a simple text analysis of module descriptions, to quantify the extent to which they provide social science training. I found 47 programmes of which 29 provided module descriptions. Modules containing social science content ranged from 3.8% to 52.2% of modules across programmes, but only 55.2% of programmes offered a social-focused conservation module and only one programme offered a module in social science research methods. On average, almost half the modules offered (46.2%) comprised biology and ecology modules with no conservation focus, and 17.9% comprised skills-based modules (research and vocational skills). Conservation-focused modules comprised a mean of only 22.5% of modules. These results show that undergraduate conservation teaching in the UK is still largely biocentric and failing to deliver the interdisciplinary education that is widely called for.

INTRODUCTION

Over 1 million species are threatened with extinction over the coming decades as a result of human actions (IPBES 2019), and the unravelling of ecosystem services and functions as a result of habitat loss, overharvesting, pollution and global heating threatens the very existence of human civilisation (MEA 2005, Gowdy 2020). Efforts to slow and eventually reverse this loss of biodiversity require a scientific underpinning, thus the field of conservation biology evolved in the 1980s to inform conservation action and provide conservationists with the required evidence base (Meine 2010).

Intrinsically crisis-oriented and problem-solving (Soulé 1985), the field of conservation is value-laden and adopts the normative position that biodiversity is good and should be preserved (Noss 1999). Although conservation biology emerged from ecology and was initially dominated by the biologists who first noticed and became concerned by the loss of species and ecosystems, it rapidly became clear that a purely biocentric approach is insufficient to address the ecological crisis (Hilborn & Ludwig 1993, St John et al. 2013). This is because most biodiversity loss is anthropogenic in origin, arising from human actions such as deforestation and other habitat conversion, overharvesting of plants and animals, climate change and environmental pollution of various kinds (Mazor et al. 2018), and so efforts to address it necessarily involve changing human behaviour and mitigating its impacts. As a result, the field transitioned from conservation biology to conservation science, and began to embrace disciplines as diverse as economics, anthropology, sociology, political ecology, human geography and psychology (Daily & Ehrlich 1999, Mascia et al. 2003). Defined more by its goal than the academic disciplines it draws from, conservation science can be considered a pragmatic metadiscipline (Gardner 2015).

As conservation scientists have increasingly embraced interdisciplinarity, they have long recognised the need for conservation education to do similarly in order to train and prepare students for the complexities of real-world conservation policy and practice (e.g. Jacobson & Robinson 1990, Touval & Dietz 1994, Noss 1997, Bonine et al. 2003). Such calls have continued into more recent times (Andrade et al. 2014, Schedlbauer et al. 2016, Drakou et al. 2017, Kroll 2017). An interdisciplinary education is also desired by conservation students (Fisher et al. 2009, Ameyaw et al. 2017), because it makes them more versatile and enhances their job prospects in a field where current training is mismatched to the capacity requirements of the conservation job market (Muir & Schwartz 2009, Andrade et al 2014, Lucas et al. 2017, Elliott et al. 2018). However, understanding of the extent to which the provision of conservation education by higher education institutions meets these recommendations remains patchy.

While there has been a range of research investigating the degree of interdisciplinarity of degree programmes in conservation and related disciplines such as restoration ecology (Baxter et al. 1999, Bonine et al. 2003, Niesenbaum & Lewis 2003, Van-Heezik & Seddon 2005, Estevez et al. 2010, Vincent & Focht 2011, Elliott et al. 2018, Sansevero et al. 2018), this has been largely focused at postgraduate levels, namely masters and doctoral programmes. A number of papers have also highlighted the interdisciplinary approach adopted by particular degree programmes (Farnsworth et al. 2001; Zarin et al. 2003; Kainer et al. 2006; Fitzgerald & Stronza 2009; Vinhateiro et al. 2012; Welch-Devine et al. 2014; Battisti 2018; Kelley et al. 2019), however these have also focused on postgraduate teaching. As a result, there is no information on the focus or interdisciplinarity of undergraduate conservation teaching in the UK or elsewhere, despite the belief held by over 50% of academics that undergraduate studies

88 are the most appropriate stage at which to introduce students to interdisciplinary approaches
89 (Roy et al. 2013).
90
91 Newing (2010) finds that higher education institutions define interdisciplinarity in various
92 ways in the context of conservation, including i) the interaction of different academic
93 disciplines, ii) use of integrative or practice-based exercises, iii) the provision of content
94 related to human dimensions of conservation, iv) training in vocational skills, or v) social
95 science content in general. In this paper I investigate the extent to which undergraduate
96 conservation degree programmes at British universities reflect the interdisciplinary nature of
97 the field, specifically in terms of the provision of modules focused on social-science and
98 related themes. I also quantify the provision of skills-based training alongside traditional,
99 theory-based modules.
100
101 **METHODS**
102 I conducted a systematic web search to identify all undergraduate degrees in the UK with the
103 term 'conservation' in the degree title. Searches were conducted using whatuni.com, Which
104 University and Google in February 2019, providing information on programmes available for
105 2019/2020 entry. Programmes not relevant to biological conservation, e.g. those relating to
106 architectural and textile conservation, were excluded. I searched the websites of each
107 relevant programme for information on the modules offered, and, when module descriptions
108 were available, carried out a simple text analysis using the presence and preponderance of
109 key words defined *a priori* to classify modules. No ethical approval was required as I used only
110 publicly-available materials.
111

I classified each module in a two-stage process, first categorising modules as either i) explicitly conservation-focused, ii) non-conservation focused, iii) skills-based, or iv) research project. Modules were classed as conservation-focused if they included any material addressing either threats to biodiversity or the theory, policy and practice of efforts to address biodiversity loss. Field courses were classified by subject area rather than as skills-based modules, though these (and many theory-based modules) also provided skills-based training. It was not possible to reliably differentiate between research skills-based modules and vocational skills-based modules because many skills are used in both research and practice, therefore these are grouped into a single category of skills-based modules.

I then excluded skills-based and research project modules and further subdivided remaining modules according to the principal subjects addressed within them, on a preponderance basis (Table 1): thus conservation-focused modules were classified as either biological or social if approximately 80% or more of the module content matched either of these categories, but mixed if the module content included approximately 20% or more from both categories. Biological science modules that did not include a conservation component were classified as biological if they focused primarily at the sub-organismal level, and ecological if they focused at the level of whole organisms and above. Modules addressing some broad themes were classified differently depending on their primary focus: for example, a module on climate change would be categorised as 'B3 Other natural science' if it focused on the physical science of climate change and its impacts, 'B5 Mixed' if it also focused on social aspects of climate change mitigation and/or adaptation or 'A1 Conservation – biological' if it included a focus on climate change impacts on biodiversity.

[TABLE 1]

RESULTS

I found 47 undergraduate degree programmes including the word conservation in the title, offered by 39 higher education institutions across the UK. Of programmes for which departmental information was available, 89.2% were housed in a school/department of natural science or biology (Table S1). The entry requirements of 80.9% of programmes included an A-level or AS-level in a natural science subject, and 70.2% of programmes offered a placement or sandwich year in industry. Full module descriptions were available for 29 programmes, which were subject to further analysis.

Programmes were highly heterogeneous in the extent of their provision of social science content. The percentage of (conservation and non-conservation) modules with a notable social science component ranged from 3.8% to 52.2%, with a mean of 18.8% (Figure 1); social science-focused modules comprised less than 10% of available modules on five programmes. Only 55.2% of programmes offered a social science-focused conservation module, and only one programme (3.4%) offered a module in social science research methods (Table 2).

[FIGURE 1]

[TABLE 2]

Conservation-focused content was provided in 4.7% to 44.0% of modules across programmes, with a mean of 22.5%. Overall, biology and ecology focused modules without any direct conservation focus comprised the largest component of programmes, with a mean of 46.2%

160 of modules; these comprised over 50% of available modules on 12 programmes (41.4%), and
161 over 75% on two programmes (at Edge Hill University and University of Southampton). Skills-
162 based modules comprised an average of 17.9% of modules across programmes.
163
164 **DISCUSSION**
165 Although conservationists have been calling for the provision of interdisciplinary conservation
166 education for almost three decades, this analysis shows that undergraduate conservation
167 programmes in the UK have only embraced interdisciplinarity to a limited extent. While
168 conservation practice is recognised as an inherently social endeavour, a mean of only 18.8%
169 of modules offered across the 29 degree programmes contained a notable social component.
170
171 The lack of interdisciplinarity across degree programmes is worrying given the importance of
172 such training in preparing conservationists for the real world of conservation science and
173 practice (Andrade et al. 2014, Kroll 2017). However it may be that such interdisciplinary
174 training relevant to conservation is provided on other programmes that do not include the
175 word 'conservation' in the degree title. For example, the University of Kent offered degrees
176 in Human Ecology and Environmental Social Sciences that are related to its programme in
177 Wildlife Conservation. Such programmes were not included in this analysis.
178
179 In terms of preparing students for the practical, applied nature of the field, over 70% of
180 programmes offered a placement year in industry and thus provided students with the
181 opportunity to gain experience of real-world conservation practice, while 17.9% of modules,
182 on average, focused on skills provision. My analysis, however, only permitted the
183 identification of modules that were entirely skills-based, which tended to focus on field skills,

184 professional skills, research skills and analytical skills. Numerous further skills have been
185 identified in the literature as critical to the conservationists' skillset, including the ability to
186 communicate science to the public and policy-makers, group decision-making, programme
187 design and management, critical thinking and problem solving (Canon et al. 1996, Brewer
188 2001, Bonine et al. 2003, Niesenbaum & Lewis 2003, Muir & Schwarz 2009): such skills, and
189 others, may be taught in UK undergraduate conservation degrees as components of larger
190 modules, or using particular pedagogical techniques within them, and so would not have been
191 picked up in my analysis. A deeper investigation into the learning outcomes and assessment
192 patterns of existing modules would be required to ascertain the extent to which training in
193 such skills is provided. It would have been interesting to test the suggestion that universities
194 seek to prepare students for a life in academia rather than the applied world of conservation
195 practice (Noss 1997, Lucas et al. 2017), however we were unable to reliably distinguish
196 between research skills and vocational skills because of the high overlap between them.
197
198 Given the time-constrained nature of undergraduate degree programmes, the provision of
199 interdisciplinary training necessarily involves a trade-off – any time allocated to the teaching
200 of social science-based material or vocational skills reduces the opportunities available for
201 teaching more traditional biological science-based subjects. There is therefore a risk that
202 striving for interdisciplinarity may leave students with a shallow understanding of a broad
203 range of material, but a deeper mastery of none (Lau & Pasquini 2008, Muir & Schwartz 2009,
204 Newing 2010). It has therefore been suggested that, given the breadth of the conservation
205 movement, many forms of specialist training may only be required by relatively small
206 numbers of people, and therefore that capacity building needs within the sector may be best
207 met through specialised training courses offered outside of traditional degree programmes

208 (Clark et al. 2017). Some authors go further, arguing that conservation problems requiring
209 interdisciplinary responses may be best addressed by interdisciplinary teams made up of
210 specialists, rather than interdisciplinary individuals (Dick et al. 2016).
211
212 Nevertheless, it is important that conservation graduates have at least a rudimentary
213 understanding of the social dimensions of conservation. In their review of conservation
214 teaching, Newing (2010) suggested that undergraduate conservation degrees that are
215 primarily 'natural science-based' should 'as a minimum' include an introduction to social
216 science perspectives on the environment, training in social science research methods,
217 vocational skills training, and integrative problem solving tasks. While my research method is
218 unable to evaluate the provision of the latter two components, the results show that, a
219 decade on, UK higher education institutions as a whole are still failing to provide students
220 with the interdisciplinary training that is widely believed to be necessary. In particular, it is
221 noteworthy that only one degree programme (3.4% of the sample) offered a module in social
222 science research methods, and only two programmes offered a module in human dimensions
223 of conservation other than human-wildlife conflict.
224
225 If it is true that early-career conservationists should be trained to be interdisciplinary and that
226 undergraduate degrees are an appropriate place to start this, then it is important to consider
227 why UK universities are largely failing to provide the education and training required. In part
228 this may reflect the same historical hangover that underlays the conservation movement as
229 a whole: its emergence from ecology. Indeed almost 90% of degree programmes (for which
230 the relevant information was available) were housed in a school or department of natural
231 science or biology, so it is unsurprising that their content should largely reflect their

traditional areas of teaching. Indeed in some cases the offer of conservation degrees may reflect market opportunism (i.e. the addition of some conservation modules to an existing ecology degree to market it as a conservation degree) rather than the core research interests of a particular department; this may be the case, for example, for some of the 12 programmes whose modules comprised at least 50% biology and ecology modules with no direct conservation component. Only two programmes were offered by schools not focused on natural sciences, in Bath Spa University's (School of) Culture and Environment, and University of Kent's School of Anthropology and Conservation. Unfortunately, the small sample size (module data are not available for Bath Spa) precludes any statistical test of differences in the provision of interdisciplinary content between programmes offered by natural science schools and others.

In conclusion, the undergraduate conservation degree programmes offered by higher education institutions in the UK are highly variable, but overall appear largely biocentric in focus and with only limited provision of either social science content or conservation-focused content. While conservation scientists have been calling for greater interdisciplinarity in conservation teaching for three decades, conservation education is still primarily provided by biology departments, and this may provide a barrier to training interdisciplinary conservationists and conservation scientists fully equipped to thrive in today's complex socio-ecological environments.

ACKNOWLEDGEMENTS

I thank Jennifer Leigh for comments which guided the development of this research and Dave Seaman for preparation of Fig. 1.

FINANCIAL SUPPORT

None

CONFLICTS OF INTEREST

The author works at the University of Kent and lectures on the BSc Wildlife Conservation which forms part of this study.

ETHICAL STANDARDS

None

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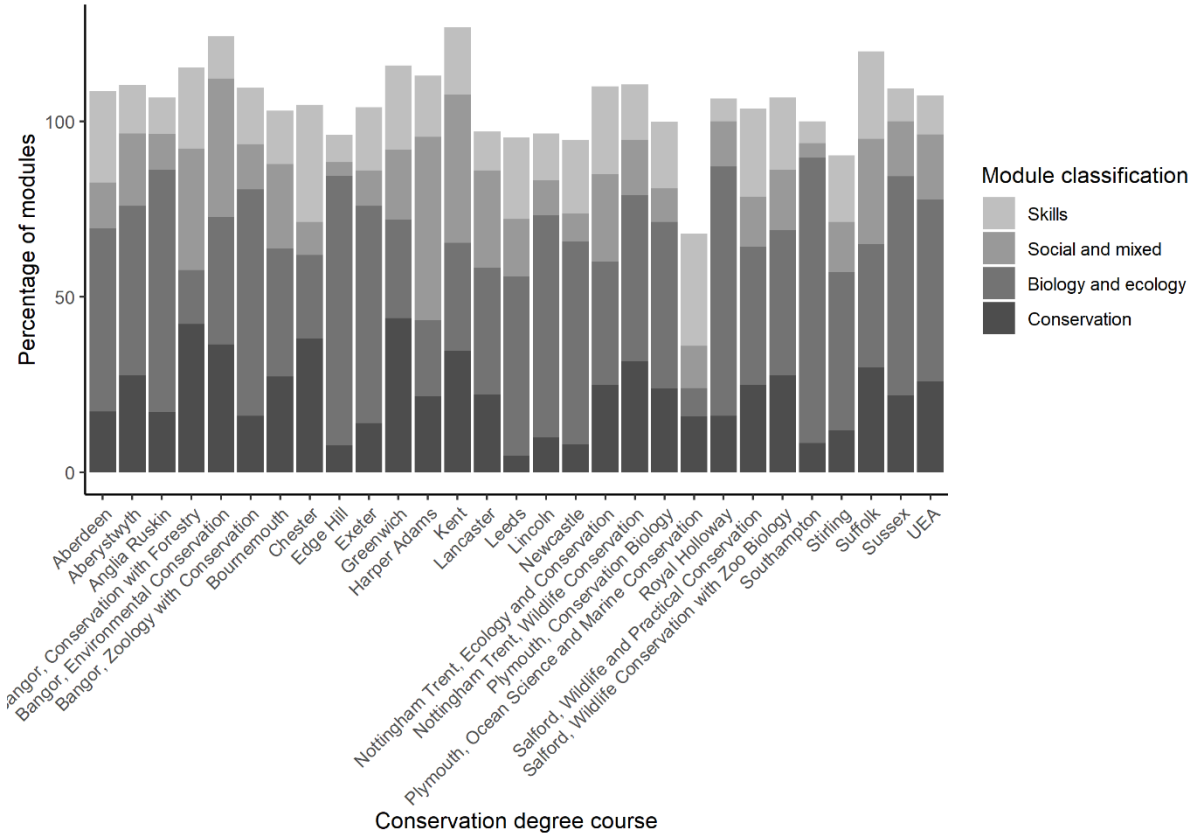
FIGURE CAPTION

Figure 1. Percentage of modules on undergraduate conservation degree programmes according to subject focus. Conservation – explicitly conservation-focused (categories A1 + A2 + A3), Biology and ecology – biological-focused (B1 + B2), Social and mixed – social-/mixed focused (A2 + A3 + B4 + B5), Skills – research and vocational skills-focused (C). Totals do not add up to 100 because not all module classifications are shown, and some modules can be both conservation- and social-focused.



426 **Table 1**. Classification of modules offered on undergraduate conservation degree programmes in the
427 UK, based on text analysis of online module descriptions.
428

Module classification	**Example topics**
A Explicitly conservation-focused	
A1 Conservation (biological)	Conservation biology, habitat management and restoration, threats to biodiversity, wildlife management, zoo biology
A2 Conservation (social)	Conservation ethics, environmental policy, community-based conservation, human-wildlife conflict, natural resource management
A3 Conservation (mixed)	Anthropogenic impacts, any combination of biological and social topics
B Not conservation-focused	
B1 Biological	Cell and molecular biology, genetics, disease biology, physiology
B2 Ecological	Animal behaviour, biodiversity, population & community ecology, evolution
B3 Other natural science	Agricultural science, physical geography, climate science, soil science, ocean science
B4 Social	Human dimensions of climate change, environmental ethics, environmental law, environment and culture, planning and development, environmental philosophy
B5 Mixed	Agriculture, sustainability, environmental policy and management, biotechnology, eco-innovation, animal welfare and ethics
C Skills-based	
C Research and vocational skills	Experimental design, data analysis & statistics, ecological survey & field skills, ecological modelling, Geographical Information Systems, laboratory skills, remote sensing, social science data collection and analysis, communication skills, study & employability skills, field courses
D Research project	
D1 Dissertation	Research projects, e.g. final year dissertation

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430
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Table 2. Summary of module classifications for the 29 undergraduate conservation degree programmes for which online module descriptions were available, showing percentage of modules classified as follows: A1 Conservation (biological); A2 Conservation (social); A3 Conservation (mixed); B1 Biological; B2 Ecological; B3 Other natural science; B4 Social; B5 Mixed; C Research and practical skills; D Research project.

University, Degree programme	No. of Modules	Conservation-focused			Non conservation-focused					Skills	Research
		A1	A2	A3	B1	B2	B3	B4	B5	C	D
Aberystwyth University, BSc Wildlife Conservation	29	6.9	0	20.7	10.3	37.9	6.9	0	0	13.8	3.4
Anglia Ruskin University, BSc Marine Biology with Biodiversity and Conservation	29	6.9	0	10.3	17.2	51.7	0	0	0	10.3	3.4
Bangor University, BSc Environmental Conservation	33	6.1	9.1	22.1	0	36.4	3.0	3.0	6.1	12.1	3.0
Bangor University, BSc Zoology with Conservation	31	3.2	0	12.9	22.6	41.9	0	0	0	16.1	3.2
Bangor University, BSc Forestry with Conservation	26	11.5	3.8	26.9	0	15.4	3.8	0	3.8	23.1	11.5
Bournemouth University, BSc Ecology and Wildlife Conservation	33	9.1	3.0	15.2	6.1	30.3	12.1	6.1	0	15.2	3.0
Edge Hill University, BSc Ecology and Conservation	26	3.8	0	3.8	42.3	34.6	3.8	0	0	7.7	3.8
Harper Adams University, BSc Wildlife Conservation and Environmental Management	23	4.3	4.3	13.0	0	21.7	0	13.0	21.7	17.4	4.3
Newcastle University, BSc Biology (Ecology and Conservation)	38	0	0	7.9	34.2	23.7	5.3	0	0	21.1	7.9
Nottingham Trent University, BSc Wildlife Conservation	19	15.8	10.5	5.3	10.5	36.8	0	0	0	15.8	5.3
Nottingham Trent University, BSc Ecology and Conservation	20	10.0	5.0	10.0	0	35.0	0	0	10.0	25.0	5.0
University of Aberdeen, BSc Conservation Biology	23	4.3	8.7	4.3	21.7	30.4	0	0	0	26.1	4.3
University of Chester, BSc Wildlife Conservation and Ecology	21	28.6	0	9.5	4.8	19.0	0	0	0	33.3	4.8
University of East Anglia, BSc Ecology and Conservation	27	7.4	7.4	11.1	14.8	37.0	7.4	0	0	11.1	3.7
University of Exeter, BSc Conservation Biology and Ecology	50	6.0	2.0	6.0	32.0	30.0	2.0	0	2.0	18.0	2.0
University of Greenwich, BSc Animal Conservation and Biodiversity	25	24.0	8.0	12.0	8.0	20.0	0	0	0	24.0	4.0
University of Kent, BSc Wildlife Conservation	26	3.8	11.5	19.2	11.5	19.2	0	7.7	3.8	19.2	3.8
University of Lancaster, BSc Ecology and Conservation	36	8.3	0	13.9	16.7	19.4	13.9	2.8	11.1	11.1	2.8

University of Leeds, BSc Ecology and Conservation Biology	43	2.3	0	2.3	18.6	32.6	7.0	2.3	11.6	23.3	0
University of Lincoln, BSc Ecology and Conservation	30	6.7	0	3.3	23.3	40.0	3.3	0	6.7	13.3	3.3
University of London Royal Holloway, BSc Ecology and Conservation	31	3.2	0	12.9	38.7	32.3	0	0	0	6.5	6.5
University of Plymouth, BSc Conservation Biology	21	19.0	0	4.8	14.3	33.3	0	0	4.8	19.0	4.8
University of Plymouth, BSc Ocean Science and Marine Conservation	25	8.0	0	8.0	0	8.0	36.0	0	4.0	32.0	4.0
University of Salford, Manchester, BSc Wildlife Conservation with Zoo Biology	29	13.8	3.4	10.3	6.9	34.5	0	0	3.4	20.7	6.9
University of Salford, Manchester, BSc Wildlife and Practical Conservation	28	14.3	3.6	7.1	3.6	35.7	0	0	3.6	25.0	7.1
University of Southampton, BSc Ecology and Conservation	48	4.2	0	4.2	56.3	25.0	2.1	0	0	6.3	2.1
University of Stirling, BSc Conservation Biology and Management	42	7.1	2.4	2.4	23.8	21.4	11.9	0	9.5	19.0	2.4
University of Suffolk, BSc Wildlife, Ecology and Conservation Science	20	0	5.0	25.0	15.0	20.0	5.0	0	0	25.0	5.0
University of Sussex, BSc Ecology, Conservation and Environment	32	9.4	3.1	9.4	12.5	50.0	0	0	3.1	9.4	3.1
Mean		**8.6**	**3.1**	**10.8**	**16.1**	**30.1**	**4.3**	**1.2**	**3.6**	**17.9**	**4.3**
Range		**0-28.6**	**0-11.5**	**0-26.9**	**0-56.3**	**8-50.0**	**0-36.0**	**0-13.0**	**0-21.7**	**6.5-33.3**	**0-11.5**

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