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## **The Online MSc in Sustainable Mountain Development at the University of the Highlands and Islands, Scotland: Experiences and Impacts**

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# The Online MSc in Sustainable Mountain Development at the University of the Highlands and Islands, Scotland: Experiences and Impacts

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Since 2004, the University of the Highlands and Islands, in Scotland, has delivered an online MSc in sustainable mountain development (SMD). Students have the choice of exiting from the course with an MSc, a

postgraduate diploma, or a postgraduate certificate. This paper first describes the history and delivery of the course, complemented with statistics on past and current students. This is followed by a presentation, analysis, and discussion of the results of an email survey of the 62 people who have gained a qualification from the course and could be contacted, achieving a response rate of 81%. The survey gathered information about each

individual's motivations for taking the degree; benefits perceived with regard to its online nature; subsequent education; current location and employment; and ways in which the course had enabled them to contribute to SMD. Many quotations from graduates are presented, in response to previous findings that it has been difficult to evaluate long-term impacts of education for sustainable development. The paper concludes with some lessons learned from 15 years of experience.

**Keywords:** online education; master's degree; sustainable mountain development (SMD); education for sustainable development (ESD); postgraduate education; University of the Highlands and Islands (UHI).

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## Introduction

This paper brings together 3 themes—sustainable mountain development (SMD), education for sustainable development (ESD), and online education—in the context of the MSc in SMD at the University of the Highlands and Islands (UHI), Scotland. The course is managed from the Centre for Mountain Studies at Perth College UHI and, since 2009, it has been an activity of the United Nations Educational, Scientific and Cultural Organization (UNESCO) Chair for SMD, based at this center.

As described by Ives (2013), the concept of SMD emerged in Agenda 21, signed at the United Nations (UN) Conference on Environment and Development, or Earth Summit, in 1992 (UN 1992). SMD may be considered as a “regionally-specific process of sustainable development that concerns both mountain regions and populations living downstream or otherwise dependent on these regions in various ways” (Price and Kim 1999: 205). The chapter on SMD within Agenda 21 mentioned education, including environmental education for farmers and higher education in environmental studies (para 13.10), as well as “training and dissemination of information on the sustainable development of the economies of fragile ecosystems” (para 13.11). SMD has since been the focus of intergovernmental consultations in the mid-1990s and the International Year of Mountains in 2002 (Price and Messerli 2002); the Mountain Partnership (Ceci et al 2011; Mountain Partnership n.d.b);

reports to, and resolutions of, the UN General Assembly (see Mountain Partnership n.d.c); and numerous policy-related documents and projects (eg Ariza et al 2013; Wymann von Dach et al 2016; Bachmann et al 2019).

The concept of ESD also emerged in Chapter 36 of Agenda 21, “Promoting Education, Public Awareness, and Training” (Hopkins 2012). It has been described as “education for social transformation with the goal of creating more sustainable societies” (UNESCO 2012: 33) and includes activities from nursery school to university, as well as outside the education sector (Nolan 2012). Since the beginning of this century, ESD has expanded significantly, particularly through activities conducted within the scope of the UN Decade for ESD (2005–2014) and, subsequently, the Global Action Plan on ESD (2015–2019) (Michelsen and Wells 2017). There have been a number of evaluations and reviews of experiences within the UN Decade for ESD (eg Tilbury 2011) and ESD more widely (eg Scott 2015). More recently, in a systematic literature review of the impacts of higher education institutions on sustainable development, Findler et al (2019) concluded that it has been difficult to quantify long-term indirect impacts.

Similarly, during this century, with the rapid global expansion of the Internet and the World Wide Web, facilitated by the availability of information and communications technologies (ICT) and especially personal computers, online education (also referred to as e-learning) has grown rapidly. A number of recent reviews (Sun and

Chen 2016; Kebritchi et al 2017; Castro and Tumibay 2019) survey this phenomenon, particularly in relation to higher education. As Castro and Tumibay (2019: 1) state, “Online learning has become popular because of its potential for providing more flexible access to content and instruction at any time, from any place.”

For those concerned with SMD, ESD and the potential of online learning are of vital importance. Mountain areas are typically characterized by sparse populations, limited and challenging transport networks, and lack of higher education facilities, as shown for Europe by Nordregio (2004) and Gloersen et al (2016) and recognized on other continents, for instance, through the development of the Himalayan University Consortium (HUC) (n.d.). Consequently, access to higher—and especially postgraduate—education has been limited, and many people have had to leave their homes in the mountains to access such opportunities, as long as they are only available face-to-face. ICT has begun to change this picture, meaning that people do not have to leave their homes to access higher education. One example of this has been the development of the UHI, in one of the most sparsely populated areas of Europe. This was a major investment project from European Union funds, which provided over £ 100 million (~US\$ 133 million) of the total investment of £ 300 million (~US\$ 400 million) (Stewart 2015). A key element was the installation of high-quality videoconferencing (VC) and online equipment, which facilitated the development of a spectrum of courses, from face-to-face to “blended learning” using VC infrastructure to entirely online courses. One of these is the MSc in SMD, delivered since 2004 and the focus of this paper. Following this introduction, the paper describes the concept, structure, content, and delivery of the course, including changes since it was first approved in 2003; presents statistics regarding past and current students on the course; presents and discusses the results of a survey of all students who have gained a qualification from the course; and provides conclusions on lessons learned.

### Concept, structure, content, and delivery of the course

The MSc in SMD (referred to below as the “mountain degree”) was developed concurrently with an MSc in sustainable rural development (referred to below as the “rural degree”) in 2002–2003, recognizing similarities in issues relating to sustainable development in mountain and rural areas. These include rapid changes to their environments, economies, and societies, bringing new challenges and opportunities that demand both more sophisticated and responsive solutions and integrated and multidisciplinary approaches toward sustainable development (Price and Rennie 2005). The market for the rural degree was primarily anticipated to consist of people already working in rural development, especially for continuing professional development (CPD). This could also be true for people who might wish to take the mountain degree; but a broader market was anticipated for this, also including people wishing to change their career path and move into work with a mountain focus and “mountain people”—who enjoy being in mountain areas

and would take the course to complement an existing degree or mainly for personal interest. Price and Rennie (2005) provide a detailed history of the development and first year of delivery of the course; key points are presented below.

The 2 degrees were approved in 2003 for delivery only to residents of the United Kingdom (UK), particularly because of concerns relating to student support. The degrees were designed with a common structure: a core module with a specific focus on mountain issues (Environmental and Social Issues in Mountain Areas [ESIMA]) or on rural issues (Human Ecology in Rural Areas) and 3 further core modules on key themes that provide a foundation for sustainable development (see Table 1). In these and all other modules, the taught content was common to both degrees. However, all assessed work would have to be on the theme of the degree for which the student was registered: mountain or rural. This approach, which continues to this day, recognized that, while the principles and issues covered by these modules are similar across mountain and rural areas, their contexts—and therefore application—are different. Having successfully completed the 4 core modules, students had the option to leave with a postgraduate certificate (PGCert) or to progress by taking optional modules (Table 1). These allowed students to increase their knowledge and understanding on more specific topics, through study or a placement. All students intending to write a thesis were strongly encouraged to take an optional module on developing research skills; however, this could not be mandatory, as some students already had postgraduate degrees. Some of the optional modules were already offered within existing degrees. From an economic perspective, sharing modules between degrees made good business sense; this approach is widely used in UHI. After successfully completing 4 optional modules, students had the choice of leaving with a postgraduate diploma (PGDip) or continuing to write a 15,000-word thesis, leading to the award of an MSc.

In 2007, the degrees were reapproved, this time for delivery across Europe. Two modules were added, 1 renamed, and 1 dropped (Table 1). One of the new modules was a residential field studies module; however, this has never been delivered because of lack of demand. A further reapproval took place in 2012, now for global delivery. Earlier in this year, UHI had moved from 15-credit to 20-credit modules. This meant that students would have to take fewer (but more in-depth) modules to gain the respective awards: 3 modules for a PGCert, 6 modules for a PGDip. Building on their experience over 8 years of delivery, and recognizing the emergence of new issues, the program team dropped 3 modules that had not attracted many students, renamed 3 modules, and introduced 2 more (Table 1). One of these was on sustainable deer management, a key issue in the mountains of Scotland and developed in consultation with relevant stakeholders (Box 1).

From this point onwards, this paper refers specifically to the MSc in SMD, though most points in the present section apply equally to the rural degree, as well as other master’s degrees at UHI. Over the past 15 years, the delivery of the modules comprising the degree has been almost entirely online and asynchronous, allowing the students—who are all part time—to study when they can find time in their busy lives. However, there have been, and are, some face-to-face

**TABLE 1** Modules included in the MSc in SMD at the first approval and successive reapprovals. Modules in bold are core modules; modules in italics were already approved within other degrees. Note: the core module for the rural degree has always been available as an optional module; the 60-credit thesis is not listed.

2003 approval (15-credit modules)	2007 reapproval (15-credit modules)	2012 reapproval (20-credit modules)
<b>Environmental and Social Issues in Mountain Areas</b>	<b>Environmental and Social Issues in Mountain Areas</b>	<b>Environmental and Social Issues in Mountain Areas</b>
<b>Sustainable Development</b>	<b>Sustainable Development</b>	<b>Sustainable Development</b>
<b>Policy Frameworks and Analysis</b>	<b>Policy Frameworks and Analysis</b>	<b>Policy Analysis</b>
<b>Developing Communities</b>	<b>Developing Communities</b>	Developing Communities
Biodiversity Management	Biodiversity Management	Biodiversity Management
<i>Developing Potential Through Placement</i>	<i>Developing Potential Through Placement</i>	<i>Developing Potential Through Placement</i>
<i>Developing Research Capability</i>	<i>Developing Research Capability</i>	<i>Research Methods and Techniques</i>
Environmental Impact Assessment	Strategic Environmental Assessment	
Geographical Information Systems	Geographical Information Systems	
Human Ecology in Rural Areas	Human Ecology in Rural Areas	People and Nature (renamed Communities and Nature in 2016)
ICT and Professional Development		
The Information Society and Rural Development	The Information Society and Rural Development	
<i>Sustainable Tourism and Interpretation</i>	<i>Sustainable Tourism and Interpretation</i>	<i>Sustainable Tourism</i>
Water Management	Water Management	Water Management
	Local Economic Development	Local Economic Development
	Field Studies	Field Studies
		Sustainable Deer Management
		Sustainable Land Use and Renewable Energy

elements. In the first 3 years, all students were required to attend a weekend induction, giving them time to learn about UHI and its extensive online library facilities, to practice using the virtual learning environment (VLE), and, crucially, to meet the lecturers and each other—which greatly helped in subsequent interactions online. The induction became optional following the 2007 reapproval, with the recognition that it would not be reasonable to expect all new students, including some from outside the UK, to travel to Scotland, though some have done so. In 2020, only an online induction was offered, because of the travel restrictions relating to the COVID-19 pandemic. Nearly all of the incoming cohort attended this; in future years, this option is likely to continue. The other non-online element is the placement module, taken by a very small number of students (never more than 3) in some years.

For most of the period during which the degree has been delivered, the VLE was Blackboard™, on which all modules were hosted. This continuously available password-protected platform has easily identifiable signposts to learning resources (course information, course documents, reading lists, etc), which are consistently structured across all modules. The VLE hosts documents, hyperlinks, graphics, and videos, as well as a space that students use for interactive discussion on the weekly theme; this is an essential element of the degree, as it facilitates peer learning, allowing students

to share their very diverse knowledge and experience. In 2019, UHI moved to a new VLE, Brightspace™, with similar functionality. All students have access to UHI's extensive online library.

While students are free to study according to their own schedules, they are expected to contribute to the weekly discussions, and have to submit assignments on time. Methods of assessment vary to some extent across the modules, including essays, PowerPoint presentations, individual and joint reports, outline plans (eg for water catchments in the Water Management module) and a research proposal (in the Research Methods and Techniques module). In some modules, the discussions are assessed (counting for 10–20% of module marks), either through continuous assessment or through a reflective evaluation at the end of the semester.

In summary, the degree is very flexible. First, students can choose whether to take 1 or 2 modules a semester, and should they need to suspend their studies for a time, they can do this easily. Consequently, students have taken from 2 to 6 years to complete an MSc. Second, they have a choice of optional modules. Third, apart from having to submit assignments on time, they can set their own schedule. Finally, they can choose whether to exit with a PGCert, PGDip, or MSc.

**BOX 1: The Sustainable Deer Management module**

Deer are iconic elements of upland diversity in many countries, valued both as a popular component of native fauna and as an economic resource. While they are important for maintaining diverse habitats, higher densities can cause ecological damage. In Scotland, questions over how deer (particularly red deer, *Cervus elaphus*) should be managed to deliver both private and public benefits have been at the core of debates among stakeholders in upland management and policy for decades. In recent years, there has been growing awareness of the importance of deer management in ensuring that upland areas deliver public benefits in light of ongoing biodiversity loss and climate change.

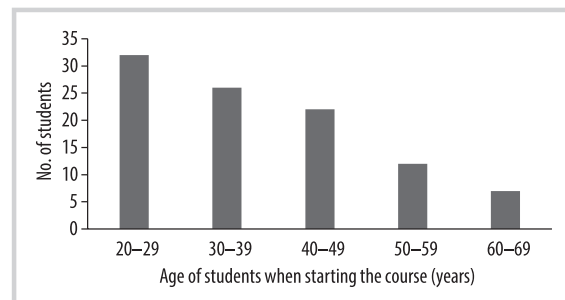
The Sustainable Deer Management module was developed in response to needs expressed by a wide range of organizations active in managing and regulating deer in Scotland, and in collaboration with these organizations. The module is taken both by students enrolled on the MSc and as a stand-alone module by practitioners for CPD. It aims to promote an evidence-based approach to deer management, with lectures on social and economic dimensions, deer biology and population dynamics, habitat management, the policy environment, and practical approaches to management and conflict resolution. The module is continuously updated to reflect the rapidly evolving policy environment that influences deer management. In parallel, the content has been broadened to consider a wider range of deer species and their management, not only in the Scottish Highlands but also in lowland, periurban, and urban contexts across the UK. Students are also encouraged to study and reflect on herbivore management in other parts of the world.

Seventy-eight percent of participants who have successfully completed the module have taken it for CPD; their participation is frequently funded by their employer. Employers have included private estates, estate management agencies, government, public agencies, environmental NGOs, land and sporting NGOs, and environmental consultancies. Such organizations and businesses tend to have divergent objectives and approaches to deer management. Engaging students across diverse sectors has allowed fruitful exchange of perspectives in the weekly online discussions and has led to a more holistic understanding of the scientific evidence underpinning deer management among stakeholders actively engaged in relevant practice and policy. Reviews of deer management in Scotland (Scottish Natural Heritage 2016; Pepper et al 2020) have indicated the need for changes in practice, and, as such, the module is expected to continue as a valuable training resource that can support these changes.

**The students: qualifications, locations, and theses**

The course is open to anyone with an undergraduate degree or, in some cases, at least 3 years' professional experience; a few students have had previous postgraduate degrees,

**FIGURE 1** Age of all current and past students when they started the course, from academic year 2004–2005 to academic year 2019–2020.



including doctorates. The course has attracted between 3 and 15 new students a year. Data collected when the students registered show that all were mature students, aged between 20 and 69 when they started the course (Figure 1); 44 were female, 55 male. In addition, since 2011, many individuals not enrolled on the MSc have taken the Sustainable Deer Management module for CPD (Figure 2; Box 1). All students enrolled on the MSc take the ESIMA module first. Every year, some students do not complete this module, usually because they realize that they do not have the time to undertake postgraduate study online. However, almost every student who completes this module gets a qualification. As shown in Figure 3, of the 79 students who have gained a qualification to date, just over half (53%) have gained an MSc, 20% a PGDip, and 27% a PGCert. This shows the value of the flexible strategy for gaining qualifications.

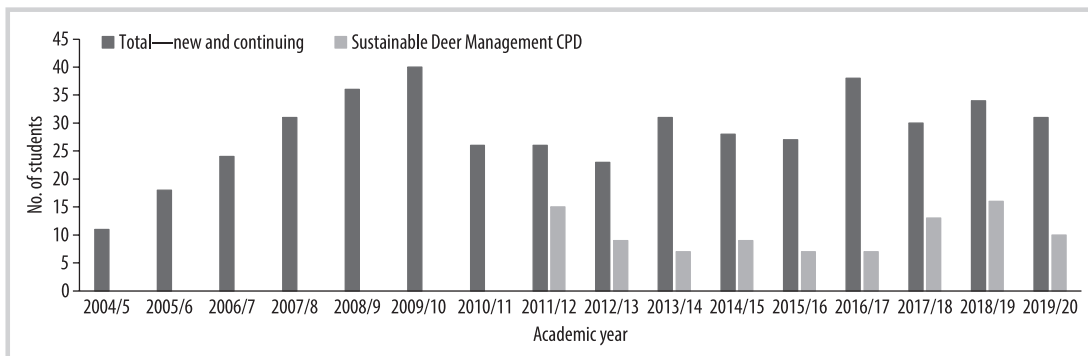
Of the students who have gained a qualification or are currently on the course, over half (57%) were or are resident in Scotland, and another 22% in other parts of the UK (Table S1, *Supplemental material*, <https://doi.org/10.1659/MRD-JOURNAL-D-20-00020.1.S1>). Since the reapproval in 2007, a further 15% have been from Europe; notably, many of these are expatriates, such as English men living in France and Bulgaria, a Canadian woman in Italy, and an Italian woman in France. The participation of the 2 Bulgarian women living in their own country was made possible by scholarships. Since the reapproval in 2012, there have also been small numbers of students from the United States and Canada, as well as India (who did not gain a qualification) and Lesotho (made possible through a scholarship). It should be noted that the UHI applies the same fees to all international students living outside Europe, and these are not affordable to most people living in developing countries.

The theses have been on a very wide range of topics relating to SMD. Notably, 3 of these have been further developed into peer-reviewed papers (Brown et al 2012; Ferrario and Price 2014; Weir and Price 2019), and 2 of the students gained awards for their theses, from the Alpine Convention and the Royal Geographical Society.

**Survey of students who gained qualifications**

In January 2020, all individuals who had gained a qualification (PGCert, PGDip, or MSc; referred to below as “graduates”) were contacted by email, where possible: for 8, there was no functional email address, and 2 had died. Each individual received a short survey. One reminder was sent by email in February 2020. The aim of the survey was to gather

**FIGURE 2** Number of enrolled students, and number of students only taking the Sustainable Deer Management module for continuing professional development (CPD), from academic year 2004–2005 to academic year 2019–2020.



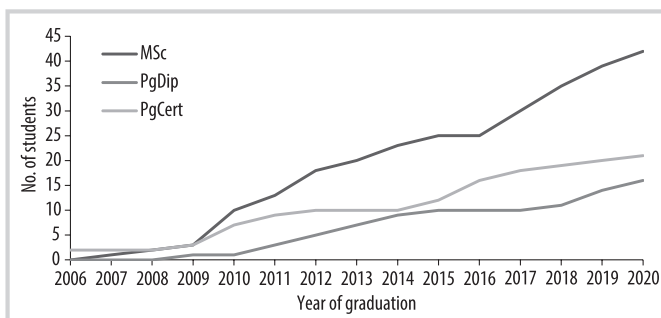
information about each individual's motivations for taking the degree, benefits they perceived with regard to its online nature, subsequent education, current location and employment, and ways in which the course had enabled them to contribute to SMD. All questions were open-ended to encourage reflective responses. The latter question in particular was designed to respond to the recommendation of Findler et al (2019: 32) for “qualitative approaches that use narratives” to evaluate long-term indirect impacts of ESD.

The response rates were very high: 32 of 37 (86%) for MSc graduates, and 10 of 11 (91%) and 8 of 14 (57%) for those with a PGDip and a PGCert award, respectively, for a total of 50 respondents. Thematic analysis was used to generate codes from the open-ended survey responses (Braun and Clarke 2012). The responses were manually coded to generate a set of codes for the responses to each survey question. The codes were then collated to create the themes that are described within the response categories below. The coding was done by the main author and verified by the second author.

### Reasons for taking the course

Most (36 of 50) of the graduates specifically mentioned their personal love of, passion for, or interest in mountain areas as a reason for taking the course. Beyond this, they gave 5 main types of reasons for taking the course: to continue their education, usually following an undergraduate degree; to facilitate a career change; for professional or personal development with a mountain and/or sustainable development focus; and because the course was online.

**FIGURE 3** Cumulative number of students who have gained an award: MSc; postgraduate diploma (PGDip); postgraduate certificate (PGCert), 2006–2020.



Sixteen graduates specifically mentioned progression from an undergraduate degree as a reason for taking the course. Their previous degrees varied very widely, within both the natural sciences (eg environmental science, geology, geosciences, physics) and the social sciences (eg international studies, political science, social science), as well as more integrated or applied subjects (eg environmental management, environment and heritage studies, tourism management, wildlife conservation). Six graduates (including 3 of the above group) stated that 1 reason for taking the course was to change their career path.

Seven graduates already had jobs relating to mountain areas—in national park management, upland conservation, policy development and implementation, mountaineering, and teaching on related undergraduate courses—and took the course for professional development. A further 9 stated a more general desire to gain a deeper understanding of issues relating to mountain areas and/or their sustainable development as part of their professional development; 2 of these also hoped that this would improve their opportunities to be employed in the mountains. A final group of 12 graduates mentioned a similar general desire, but mainly for personal development. Finally, 6 graduates specifically mentioned the online nature of the course, which is explored in more detail next.

### Benefits of taking the course online

Six graduates stated that they could have “only” taken a course online, and all graduates identified benefits of doing so. These benefits fell into 4 main categories: work/life balance and the use of available time; location; interactions; and the value of having materials online. The most frequent benefit given (32 of 50) was that it was possible to fit online study around work commitments. Eight of these graduates also mentioned family commitments (mainly children; in 1 case, nursing a parent through a terminal illness); a further 2 were mothers who were not working. Eighteen graduates mentioned the flexibility of being able to study whenever they could find or create the necessary time:

- “Studying when I was in the right mindset which for me was early mornings or night time”;
- “Chipping away at the work in the small hours of the night”;
- “Whenever I could find time for it (weekends, evenings).”

**BOX 2: Quotes from graduates about the benefits of studying online****Membership of a virtual community**

- “A friendly, supportive atmosphere existed between the students.”
- “I felt part of the Centre for Mountain Studies’ community, through active online engagement, sharing knowledge with staff and other students.”
- “The online content allowed ... interacting with other students, in different parts of the world with widely differing perspectives to my own.”
- “Online discussions were hugely beneficial in cementing our understanding and learning from others with experience in different fields/posts/locations.”
- “The great online community of tutors and students makes this a really interesting, enjoyable ‘think tank’ where you can meet individuals from all over the place and discuss issues that matter to you.”
- “I loved that it being online means meeting students from all over the world.”

**Availability of materials online**

- “The online content allowed me to revisit the course work continually, rewatch online lectures.”
- “Where lectures provided examples, they could be further researched and the taught material picked back up at a later date.”
- “I was able to access all the reading materials and journal articles I needed via online platforms.”
- “Much of the background reading of the course was online and the University’s library facility functioned well.”
- “Having the course online ... made integration with other resources easier ... and encouraged self-directed learning.”
- “I could access materials on any device, phone tablet, PC.”

One commented that “I wouldn’t have even considered applying for the course if it hadn’t been online, even if a class-based course was offered locally.” Others noted the benefits of working at their own pace, within the constraints of submitting assignments. However, I noted that the asynchronous nature of the course could have drawbacks, for example: “I did sometimes find time lapses frustrating—for instance whereby much of a discussion had already taken place—and had often petered out—before I had the opportunity to contribute.”

As noted in the previous section, the graduates live in many different countries, and 30 of them mentioned location—the fact that they could study from home, or while traveling—as a factor in choosing to take the course. At the time they were taking the course, some (8 of 50) lived in rural mountain locations either seasonally or permanently. However, the majority lived in small or large urban centers. Although they were distributed very widely, 12 graduates recognized the benefits of being members of a virtual community (Box 2), and 3 mentioned that they stayed in contact with other graduates after they completed the course. A final set of benefits, noted by 6 graduates, related

**BOX 3: Current employment and location of graduates**

Note: some graduates have more than 1 job.

- Management of volunteers in a national park (UK) and a national forest (United States)—both of these indicated that their MSc qualification was influential in obtaining their job;
- Development manager for community-led charity (UK); manager of a community-based NGO in Nepal (United States);
- Project officer/manager with a national park (UK), a biosphere reserve (UK), a regional government (Canada), a national environment agency (UK), an international NGO (Bulgaria), and consultancies (Nepal, Spain);
- Policy officer (UK);
- Station leader of a research station (South Georgia); safety manager for a glaciological research program (Spain);
- Instructor/guide in outdoor mountain activities (UK: 4; Spain);
- Academic research (Chile, France, Germany);
- Designer of low-energy houses (UK);
- Deputy head teacher (UK);
- Tour guide (UK);
- Industrial electrician (Canada); previously working with a conservation charity (UK).

to the availability of materials online (Box 2). However, 6 graduates (some the same as above) did mention drawbacks of studying online. Most of these related to the lack of opportunities to interact directly with staff and students; 1 student commented that “studying remotely can be a lonely endeavor, requiring self-motivation, and I found regaining the momentum following the summer difficult.”

**Subsequent qualifications**

Almost a fifth (7 of 37) of the individuals who graduated with an MSc continued with their postgraduate education and have either completed or are still working on doctoral degrees. In all but 2 cases, these have had an explicit or partial focus on mountain issues, including tourism, land-use visions, rewilding, foraging, and glaciology. Four other graduates, including 2 who did not achieve an MSc, did other master’s degrees; only 1 of these has been on a mountain topic. One of these graduates subsequently continued to do a PhD in low-energy building design and is now designing low-energy buildings in a mountain area.

**Current location and employment**

Almost half of the graduates live and work in mountain areas (11) or are employed in positions in which some of their work is in, or relates to, mountain areas (12). Their jobs may be categorized as shown in Box 3. Five of the graduates are retired.

**Contributions to SMD**

In their responses, many of the graduates emphasized the value of the course in giving them a broad and deeper



understanding both of sustainable development, particularly in mountain areas, and of the underlying forces or “issues affecting mountains in Europe” (a quote from a graduate who stated that this knowledge was valuable for her work with the European Commission). In a similar vein, graduates also noted their recognition that human and environmental interactions are complex, and of the need to address competing priorities. In addition, many graduates noted specific skills that they had gained from the course, including taking “a more methodical, analytical, and critical approach to work”; time management; and research, communications, and writing skills. A graduate working for the Government of Yukon stated that she “felt more confident in my delivery of practice.”

Half of the graduates (26 of 50) stated that, since completing their qualification, they have contributed directly to SMD, and some provided specific examples of how they had used the knowledge, skills, or perspectives gained from the course (Box 4). The types of contributions to SMD may be divided into the following categories:

- Project design and/or management (6 of 50): subdivision planning (Canada: Box 4); a tool to adapt to climate change through improving resilience in mountain socio-ecosystems (Spain: Territorios Vivos 2019); pro-biodiversity economic opportunities (Bulgaria: European Commission 2016); road construction and postdisaster management planning (Nepal: Box 4); volunteer projects on public lands (United States: Volunteers for Outdoor Colorado n.d.); volunteer projects on prevention and repair of erosion caused by visitors (UK: Fix the Fells n.d.);
- Policy development and implementation (6 of 50): contributions to river basin management plans, and assessments of protected area plans and infringements of these (Bulgaria: Box 4); depopulation and retention of young people in a mountain area (Italy: Box 4); mountain protection and sustainable development (Ireland: McCarthy 2019); hill tracks (UK: Scottish Environment LINK n.d.); protected area management in national park or biosphere reserve (UK);
- Building social capital (4 of 50): community development (Nepal: The Small World USA n.d., Box 4; UK); meeting of entrepreneurs (Spain: Territorios Vivos 2015); creation of mountain municipalities association (Spain: Esmontañas n.d.);
- Public awareness and education (5 of 50): video arts projects on wild land areas (UK: GO/AT 2018); teaching geography and on tourism courses (UK: Box 4); values of local resources (Bulgaria: JA Bulgaria 2020, Box 4); article on visions for mountain areas (Bulgaria: Petkantchin 2018; Box 4); presentations at conferences on sustainable development in mountain areas;
- Research (3 of 50): atmospheric chemistry (Chile; Maynard 2019; Box 4); glaciology (Argentina, United States: Miles 2017); wilderness mapping (France: Carruthers-Jones et al 2019).

## Discussion and conclusions

This paper widens the scope of the literature on online ESD (eg Azeiteiro et al 2015; Bjørke 2015; Pérez Salgado and Rikers 2017) through a case study of an online MSc course on SMD and analysis of the graduates’ perceptions of the online format, their qualifications, and how these qualifications

supported them in fostering SMD. It should be emphasized that, while this is the only MSc worldwide with this focus, there are other online courses with a mountain focus, as listed in the Mountain Education Database of the Mountain Partnership (n.d.a), as well as other courses on education for SMD (Ueno et al 2020 and other papers in this focus issue).

The paper shows that, over the past 15 years, the MSc in SMD at UHI has evolved, with modules being added or removed in response to demand (or lack of it) from students, as well as from stakeholders. The course has allowed a highly diverse group of people to complement their previous education and work experience, creating a set of practitioners who understand the principles of SMD and have developed new skills. The findings also show that the online nature of the course was critical in allowing them to do so. Very few of the graduates identified drawbacks of studying online; even those who did stated that the benefits outweighed the disadvantages. In terms of impacts, the graduates have applied their learning in many different mountain contexts, on 4 continents, with positive impacts for mountain environments and a very wide range of beneficiaries, including children, entrepreneurs, and mountain communities. Some have continued on to careers in research; here the benefits of the course have typically been to widen their perspective to become more interdisciplinary, particularly recognizing the importance of knowledge exchange to nonscientific audiences.

Nevertheless, of the people who have taken the course to date, only 3 have been from developing countries. The principal reason is that, as required by Scottish Government policy, the UHI charges the same “international” fees to all students living outside Europe, and these are not affordable to most people living in developing countries. At the same time, it should also be recognized that, while many of the principles and themes of SMD, as taught on this course, are relevant for mountains around the world, their application—and the necessary skills—generally differs between industrialized and developing countries. Consequently, the authors have worked, and are working, with organizations such as the HUC and the Afromontane Research Unit (n.d.) in South Africa to develop courses that are better contextualized to these mountain regions.

Whether or not such courses will be online will depend, to a large extent, on the availability of adequate Internet connectivity, a continuing challenge in these mountainous, especially rural, areas (eg Regmi and Chautari 2017), and for the current student in Lesotho. However, if reliable Internet access is available, the experience of this course shows that the opportunity to study part time is of great value to many people. Thus, based on the findings of this paper, the following recommendations can be made. First, for higher education institutions working in mountain areas (or consortia of these, such as the HUC), and the agencies supporting them: a course focusing on SMD can bring real opportunities to many different types of individuals, and they can then go on apply their knowledge in many contexts that contribute to SMD. Such courses should therefore be supported, though their content should be contextualized for the regional situation. Second, for both national and regional governments: as reliable Internet access is a prerequisite for online education, as well as many other economic activities, it should be prioritized in mountain

#### BOX 4: Quotes from graduates regarding how they used knowledge, skills, or perspectives from the course toward SMD (Box continued on next page)

Note: the country indicated is the country of application, not necessarily the country where the graduate currently lives.

##### Project design/management

*This course has advanced my ability to manage multiple facets of development in a balanced and thoughtful manner. Where I was once driven by a best practice I could reference but not articulate, I now find my most frequent approach: we must remain on top of our research and modelling if we wish to develop in a sustainable way, especially in a mountainous region.*

(Canada)

*I have been involved in several projects in Nepal and this course has always guided me in my pursuit for sustainable development in mountain areas ... the overarching theme that I gained from this course is people-centric sustainable development with end goal of environmental development, which I have applied throughout my career, especially relevant in a developing country like Nepal.*

(Nepal)

##### Policy development and implementation

*There were several infringement cases, related to Natura 2000 sites in Bulgarian mountains (Pirin, Rila), and the course helped me in my work of assessing infringements and understanding better the underlying forces.*

(Bulgaria)

*[My dissertation] research was presented to the local population ... including its policymakers... The research and the public presentation created a rich moment of exchange and reflection among the inhabitants, and in particular the youngsters, on the reasons for settling in the valley after higher education. Policymakers were (once more) faced with the reasons why the young generations leave the area, and had to reflect and respond to questions related to accessing services, quality of life, jobs, remoteness, etc ... I was recently contacted by the team of evaluators working on the national strategy ... dedicated to the development of remote areas in Italy that need specific attention to fight depopulation (they are not necessarily mountain areas, but simply remote areas)... The team of evaluators of this program was interested in the work done for the dissertation.*

(Italy)

##### Building social capital

*The course was also instrumental in my involvement with SMD in rural Nepal in the Himalayas. My dissertation work focused on a girls' education program ... Subsequent to completing the research, the executive director of The Small World ... asked me to found a USA-based branch of the organization. Following completing my master's degree I formed The Small World USA to support the work of The Small World in Nepal.*

(Nepal)

##### Public awareness and education

*I have tried to influence the general approach of my organization to regional development based on what I learned during the course, especially about mountain areas' economic development. In one of our current projects ... we have several participating schools from mountain regions and we focus on making teachers pay attention to and value the local characteristics and resources (water, clean air, preserved landscapes, herb diversity and biodiversity in general, traditional crafts, etc), as well as the potential for diversified economic development based on small entrepreneurship as a livelihood.*

(Bulgaria)

*The knowledge gained during the course also enabled me to try to influence public opinion about the desired development path for mountain regions in Bulgaria. I published an article at the height of citizens' protests against illegal developments in Pirin National Park at the beginning of 2018 and outlined my vision about how our mountain areas, which comprise some 40% of our country's territory, could develop in a meaningful way. The initial version of the article drew much attention (more than 2000 reads), as it was published in the daily news online media investor.bg, which has thousands of readership.*

(Bulgaria)

*The course has enabled me to educate and inform hundreds of children and adults through my greater understanding of the role mountains play in the wider environment. This was particularly relevant when working in Nepal, engaging teenagers from the UK to work in community projects.*

(Nepal)

**BOX 4: Continued. (First part of Box 4 on previous page.)**

The degree program gave a context to my interest in sustainability and this has developed or matured with time into a commitment forming part of my life. Although I'm teaching tourism-related modules, sustainability has multifaceted implications for everyone who interacts with a natural environment, and I'm able to integrate my knowledge of sustainable development in mountains into most of the material I teach.

(UK)

**Research**

I am an atmospheric chemist and the course didn't teach me any more about this but it gave me the confidence to use my skills for more social issues.

(Chile)

The most direct contribution is that the skills and knowledge learned have led to me working on the development of a wilderness map of France.

(France)

areas—not only in developing countries, but also in industrialized countries (eg Bürgin and Mayer 2020).

To conclude, it seems appropriate to give the last words to 2 of the graduates. The first lives in Italy and teaches an online university course:

*I often had the sensation of being in a living classroom, in that I encountered the material/themes we discussed during the week in the mountains where I lived. This interconnection of theory and practice (or practical life issues) made the program very invigorating and helped me recognize the mountain environment with a depth of vision, functioning on many levels below the surface—whereas previously I'd seen and interacted only on a surface level.*

The second lives, and teaches at a university, in Ireland and is also active in mountain-related nongovernmental organizations (NGOs) both in Ireland and internationally:

*This is a unique course, probably ahead of its time when it was established. However, its importance must be acknowledged given the growing recognition of the vital role [that] mountains, their catchments, and biodiversity have in providing vital resources for life and water supply for growing urban populations. Sustainable mountain development has a key role in climate action and securing a sustainable and equitable future for all.*

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## Supplemental material

**Table S1** Country of residence of current students and those who obtained a qualification, from academic year 2004–2005 to academic year 2019–2020, at the time they took the course.

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