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WILDLIFE CONSERVATION EDUCATION AND INTERNATIONAL PROGRAMMES

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ABSTRACT

Wildlife and habitat conservation has become increasingly important in the 21st century. Destruction and loss of habitat, illegal use of wildlife, overexploitation of resources, and lack of conservation awareness, have a negative impact on biodiversity and ecosystems. The unforeseeable expectation by 2050 is that few large marine species will remain and majority of coral reefs, mangrove swamps and saltmarshes will be degraded. The wildlife carrying capacity in many protected areas will significantly reduce due to global warming, pollution, invasive species, and illegal hunting. One of the concerns is the rapidly increasing human population on the planet with 6.4 billion individuals in 2005. For global conservation a sustainable approach means that strict legislation and ethics have to be developed, together with regulating human attitudes. Conservation education and outreach techniques including learning and thinking, developing skills, and undertaking activities are described. The responsibility of Zoos to teaching their visitors by 'effective education' about the causes and types of threats, their decline and measures for conservation is more holistic. I apply as a model the role of the Zoological Society of London and its two Zoos in the development of critical and scientifically valid evaluation techniques and conservation activities, and their impact on species sanctuary in the wild. International educational programmes, are chiefly targeted towards poverty alleviation, and play an important role in delivering sustainable outputs. This review concludes with case studies of UK and Pakistan collaborative programmes involving national experts and local community participation.

INTRODUCTION

As we embark on the 21st century, we face a number of growing challenges, some of which include wildlife, species, and habitat and ecosystem destruction. Conservation of these species and ecosystems is therefore becoming increasingly important. This is evident in the continuing wide-scale destruction and loss of habitat, illegal use of wildlife, and lack of conservation awareness and understanding, and has impacted negatively on biodiversity and ecosystems (Savidge, 1987; Robinson and Redford, 1991; Meadows and Meadows, 1999; Mackay, 2002; Woodroffe *et al.*, 2005; Ausden, 2007). IUCN quotes show that 23% of all mammals, 12% of birds, 12% of reptiles, 51% of amphibians, and 40% fishes are under threat of extinction. It is envisaged that alteration of terrestrial habitats will rise, with a decline in terrestrial wildlife. The overexploitation of marine resources will increase, leading to shoreline habitat-destruction, expansion of aquaculture schemes, and shrinkage of marine wildlife (Rizvi *et al.*, 1999; Ausden, 2007). The current expectations are that by 2050 few large marine species will remain and a majority of coral reefs, mangrove swamps and saltmarshes will be degraded (Campbell, 1999; Jenkins, 2003). In many protected areas issues such as global warming, pollution, invasive species, illegal hunting, will significantly reduce their wildlife carrying capacity (Hobbs and Huenneke, 1992; Johnson, 1993; Simberloff, 1998; Sutherland, 1998, 2000; Ahmad, 1999; Lewis and Jackson, 2005). The role of scientific knowledge and education has played a significant role in promoting conservation objectives, and a correctly designed conservation education would affect people's attitudes and behaviour towards wildlife conservation and protecting their environment (Adams, 1998; Sterling *et al.*, 2007).

Wildlife Conservation Education Programmes: It is believed that the concept of public education as a chief objective of zoos only came into mainstream in mid- to late 20th century. A study in the United States showed that prior to the 1950s only 4% zoos and aquariums had educational departments as compared with 77% in 1977 (Hensel 1978; Sterling *et al.,* 2007). With educational programmes taking more conservation roles – elementary school children were being involved, themes such as animal adaptations and endangered species were put forward. This approach led pupils to become 'responsible for' or 'responsive to' wildlife sustainability. Another approach that followed was that of building audiences who became aware of the concepts of conservation issues. For example targeting adults could result in a direct impact (Lovejoy, 1974), and many zoos hence directed their focus towards parents, teachers and university students (Tompson, 1989).

Currently Zoos are effectively offering educational programmes which engage in conservation activities (Zimmermann *et al.*, 2007). A typical zoo may include animal displays, live animal demonstrations, interactive displays, hands on experience exhibits, outreach programmes and communication with staff. Kellert and Dunlap (1989) showed that the before and after attitudes of visitors to a zoo can be affected positively if the animals are displayed in their natural environment, whereas under a traditional environment people had increased fear of or became indifferent to wildlife. Many modern zoos aim to promote conservation projects, by educating, informing and inspiring the public on these issues. Some zoo-based messages encourage visitors to create wildlife habitats, select appropriate pets, adopt eco-friendly modes of travel, and spread the word round by engaging with other people.

At a higher education level, the success of collaborative programmes between universities, zoos, public aquaria and wildlife parks has emanated from a common educational goal. This has led to design of educational curricula, encompassing a broader view of conservation matters.

The Durrell Institute for Conservation and Ecology (DICE) was established at the University of Kent, UK in 1989, after the famous conservationist Gerald Durrell. DICE is an example of an institute that offers degree courses, diplomas and certificates in a range of conservation and biodiversity areas. The very successful M.Sc. degree in conservation biology management is internationally known and covers biological, economic, legal, political and social aspects. The emphasis of the course is on giving the student a knowledge base as well as practical experience in the broader conservation context. The course focuses on a number of topics. These include minimising the negative impact of development on species and their habitats, promoting biodiversity conservation awareness at both national and international levels, and involving and respecting the local communities who inhabit areas of conservation. The course also covers planning and management of species conservation and the integration of this with education, research and sustainable development. The course is popular with conservation and wildlife biologists, managers, NGOs, staff from consultancy firms, and international donor agencies. DICE has trained postgraduates from over 80 countries, which reflects the accomplishment of this programme.

DICE also undertakes scientific research under two research themes namely Ecology and Conservation Biology, and Biodiversity Management and Sustainable Conservation. There are five and six staff members in the respective groups engaged in research worldwide (Rosser *et al.*, 2005; Smith *et al.*, 2007; Gubbi and MacMillan, 2008).

An example of an applied output from DICE has been a community-based ecotourism initiative. A Rwandan graduate from DICE was successful in founding the Cultural Village in Northern Rwanda, aiming to protect gorilla habitats. This was a result of his dissertation on 'Ecotourism as a potential conservation incentive for local communities around Rwanda's Parc National des Volcans' at DICE. The results have been hugely successful, with local communities benefiting from a sustainable income, and a 60% reduction in poaching. For his success Mr Sabuhoro was named 'Young Conservationist of the Year' by IUCN in September 2008.
http://www.kent.ac.uk/news/stories/conservationistsdoubleachievement/2008

Conservation Education and Outreach Techniques: There is a need for conservation education and outreach and it is known that the public affects the success or failure of environmental protection efforts. Figure 1 outlines the impacts of conservation programmes through education and outreach. These mainly foster sustainable behaviour, improve public support, and reduce vandalism and poaching. They also raise compliance with environmental regulations, increase recreation-carrying capacity, and influence policy and decisions. Public support and involvement is vital in achieving conservation goals. The focus of conservation outreach programmes is based on communication and information aimed at a non-captive audience in social and novel new surroundings. The techniques and resources used in outreach programmes are publications, presentations, posters, and exhibits that aim to enhance awareness and knowledge about conservation issues.

Another conservation marketing outreach approach deals with products or services aimed at the interests of specific audiences. This approach includes newsletters, public meetings, advertisements, TV, billboards and the Internet. Carefully designed outreach programmes, with public participation have led to an increase in Canadian sea bird populations and to an increase in the number of endangered primates in Brazil. The role of the media in exposing the public to conservation issues includes modes such as print media, radio, television, and the internet. The interpersonal activities cover demonstrations, workshops, forums, lobby groups, school systems, and informal clubs. Results from public polls have shown that 61% of survey respondents in the USA appreciate that humans are the main cause of species extinction. 30% responded that they heard of biodiversity loss and a significant majority said that maintaining biodiversity was important (Biodiversity Project, 2002). There have been studies which show that proper education and outreach programmes contribute to sustainable behaviour, promote public support for conservation, reduce vandalism and

poaching practices in protected areas, and raise compliance with environmental regulations. They also increase recreation-carrying capacities and have an impact on policies and decisions that influence the environment and natural resources (Fig. 1) (Knudson *et al*. 1995; Jacobson, 1999; Day and Monroe, 2000, Jacobson *et al*., 2006).

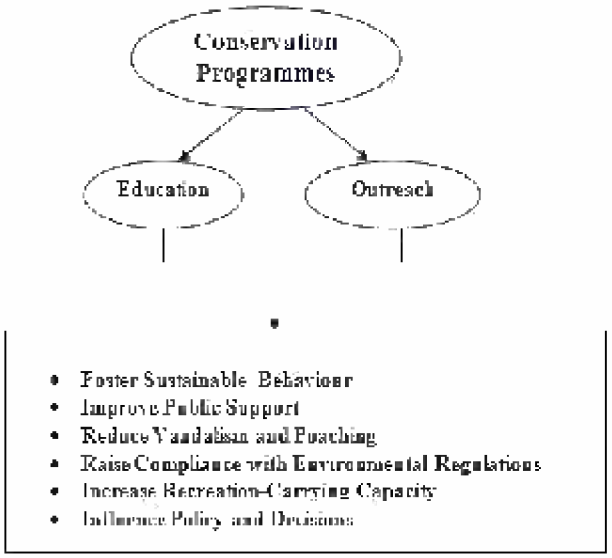

Figure 1. Types of conservation education and outreach programmes and their impacts.

A Gallup International survey showed that Eastern and Central European and Latin American citizens consider that the quality of their environment has deteriorated in the last decade (Gallup International, 2002). Furthermore seven out of 10 Europeans believe that an urgent and immediate problem is to face environmental protection and fight pollution. A number of them felt badly informed about environmental problems and the inadequate actions taken by their governments to tackle these problems.

People may think that they understand the concept of wildlife conservation, but their actual knowledge about conservation is lacking. It is common that public awareness of wildlife is largely limited to big, attractive and emotionally appealing species. Public awareness of the importance of invertebrates in the ecosystem is minimal. This is exemplified by a survey in the USA where 89% people believed that the endangered bald eagle should be protected while only 24% were of the opinion that the Kauai wolf spider should be protected (Kellert, 1996).

A number of school curricula include issues of protecting the ecosystem, but not many provide comprehensive programmes that focus on achieving conservation goals. Conservation agencies and organizations offer education and outreach programmes, with an emphasis on natural resources and wildlife. For conservation education which lies under the broader environmental education field, a number of capacity building blocks can be identified such as awareness, knowledge, attitudes, skills and participation (UNESCO, 1978).

An easy Planning-Implementation-Evaluation process (PIE) – may also be used in designing education and outreach programmes (Jacobson *et al.,* 2006).

Planning would include:

- What is the conservation problem or issue?
- What are the goals and objectives?
- What audiences or stakeholders are involved?
- What are their backgrounds, needs, interests and actions?
- What changes or actions are needed for each audience type?
- How can audience members be involved in the planning process?
- What are the constraints and resources present?
- What messages must be sent?
- What channels and activities will be most effective in changing knowledge, attitudes and behaviour?

Implementation would ask:

- What modifications do the pilot tests of activities and materials indicate?
- Is the planning, staffing and funding adequate?

Evaluation would involve questions such as:

- How would you know if the strategy has been successful?
- What are the programme outputs and outcomes?
- Have the key indicators of success been assessed, such as changes in the environment or in the audience knowledge levels, attitudes or behaviours?

Techniques that involve learning and teaching with adults and youth provide educational theories that support effective programmes. Despite the difference in adult and youth learners there are a number of commonalities in the learning process. Table 1 lists some of the learning theories that help educators formulate useful learning programmes (Jacobson *et al.*, 2006). The types of learning theories include brain-based learning, experiential learning, learning cycle, learning styles, and multiple intelligences. They also cover constructivism, cooperative learning, creative thinking, critical thinking and systems thinking. The learning processes contribute to education in a number of ways. They include building mental models, using experience to design learning opportunities, developing programmes that appeal to the diverse audience, and involving enquiry and experience to construct knowledge. They also cover improving social and group communication skills, offering opportunities that involve synthesis, interpretation, and evaluation

analysis, and promoting understanding of the structure and function of complex systems. A detailed explanation of these contributions is given by Jacobson *et al.* (2006).

Table 1. Approaches to learning theories and their contribution to the process of education (Jacobson *et al.*, 2006).

Learning theories	Contribution to education
Brain-based learning	Construct learning opportunities to reinforce neural networks and build mental models
Experiential learning	Base learning opportunities on experiences
Learning cycle	Design learning opportunities to include an experience, then processing, generalizing, and applying that experience to better understand the concept
Learning styles	Recognise that learners might have different preferred learning styles hence develop programmes to appeal to the diversity
Multiple intelligences	Recognise that intelligence comes in a variety of skills and abilities hence develop programmes to appeal to the diversity
Constructivism	Engage learners in constructing their own knowledge, through inquiry, experiences, and questions
Cooperative learning	Develop learning opportunities to use groups of learners, each with a special role, to achieve a common goal. Help learners improve social and group communication skills
Creative thinking	Provide opportunities to generate and synthesis
Critical thinking	Provide opportunities to interpret, evaluate and analyse
Systems thinking	Provide learning opportunities to understand the structure and function of complex systems

As an example I briefly expand on creative, critical and systems thinking. The act of thinking builds mental structures, and is made up of processes such as generalisation, reflection, accommodation, and assimilation. A number of educators encourage their pupils to build their thinking abilities. This is also the case in conservation education. Creative and critical thinking are used in problem solving. Creativity is a desire to create something new or different and to play with options. Critical thinking involves reasoning, assessing complex information and understanding prejudice. These lead to building future actions. Critical thinking skills are commonly divided into decision-making skills, problem-solving skills, and responsible citizenship skills. Facione (1998) gives a core set of skills that can help learners to develop their critical thinking. Systems' thinking takes into account a bigger picture applied to ecosystems, astronomy, business, social and information technology. As the world becomes more complex, so does problem solving, and there is a need to educate people to view problems and solutions under a larger domain of relationships and interactions (Hough and Day, 2000). An illustrative example is of a weekly newspaper column entitled 'The Global Citizen' where people were introduced to systems dynamics using analogies and stories so as to understand how systems operated (Meadows, 1991). In conservation education these techniques stimulate the public to think about environmental problems, ask questions, anticipate outcomes and propose solutions.

Where thinking is encouraged, Bloom's Taxonomy of Cognitive Domain is often practised. This approach facilitates structuring and evaluating of lessons (Trowbridge and Bybee, 1986), and includes six levels of thinking skills and the associated activities (Table 2). The first step in this process is knowledge, which includes recall, recognition and memorisation. This is followed by comprehension where one interprets information and describes it one's own words. Comprehension may also include explaining the further use of the particular information. Application is the third step, where the learner applies the relevant information. Knowledge, comprehension and application are sometimes called the 'lower-order thinking skills'. The remaining three levels, namely analysis, synthesis and evaluation, are grouped together as 'higher-order thinking skills'. Analysis is the competence level that breaks down material into separate components and relationships. Synthesis puts the pieces together into meaningful organization. Evaluation enables one to judge ideas, solutions, methods and plans to establish their value and usefulness. Standards should be set during evaluation. It is important for educators to prompt learners with questions and terms that trigger answers or solutions. I have personally found triggering very helpful in a teaching context.

The systems thinking approach is another mode of developing conservation education and outreach programmes. This approach aims to build responsible behaviour. In order to develop sustainable communities there should be an understanding of the way communities and ecosystems are organized and operate (Capra, 2000). At the Centre for Ecoliteracy, California USA the systems thinking approach has helped a school community and tutors to reform their educational approach. A local project-based approach is applied to identify an interesting local problem. This enables the students to learn from a range of resources and people, and also builds awareness of the environmental issues

which have a significant impact on the area (Barlow, 2000).

The Centre for Ecoliteracy used a model in its school programme that promotes systems thinking. Figure 2 illustrates the main components of the model as being vision, action, place and community. Vision includes learning theory and systems thinking, while maintaining a clear vision, and a common language. It is based on ecology, science and systems. Action involves project-based learning through the conduct of an eco-action project near to the school. Place-based education inculcates a sense of place ecologically and culturally by experiencing and exploring. Community with shared leadership includes active learning with a teacher facilitator. This encourages school-wide leadership and builds community relationships that help to sustain the programme.

Table 2. Bloom's Taxonomy of Cognitive Domain with six levels of competence thinking skills and the associated activities (Learning Skills Programme, 2003; Jacobson *et al.*, 2006).

Competence	Skills	Activities
Knowledge	Observe events and processes, know species and concepts	List, define, tell, describe, identify, show, label, collect, examine
Comprehension	Understand information, translate and interpret, order, infer, predict outcomes	Summarise, describe, interpret, contrast, predict, distinguish, estimate discuss, extend
Application	Use methods, theories and information in new situations, solve problems using skills or knowledge	Apply, demonstrate, complete, illustrate, show, solve, examine, modify, relate, classify, experiment
Analysis	See patterns and organization, identify components, recognize meaning	Analyse, separate, order, connect, classify, arrange, divide, compare, select, infer
Synthesis	Generalise from facts, relate ideas from separate areas, draw conclusions	Combine, integrate, modify, rearrange, plan, create, design, compose, formulate, generalize , rewrite
Evaluation	Compare and discriminate between ideas, make choices based on reasoned arguments, verify evidence	Assess, decide, measure, recommend, convince, judge, support, conclude, summarise

The success of conservation education and outreach programmes will eventually be judged by the level of biodiversity that is conserved globally. It is vital that environmental conservation is linked with the quality of life of individuals, groups, and institutions in the communities. Conservation goals can only be accomplished if real community issues are taken up. Consider the Global Rivers Environmental Education Network (GREEN) (Stapp *et al.,* 1996). This very successful environmental education programme connects classrooms with communities. It involves students from 130 countries and is action-orientated towards monitoring water quality in their water-shed regions. GREEN uses 'action research' and 'community-based problem-solving' techniques. It is far more important to appreciate intended goals of your programme than to associate with a single technique.

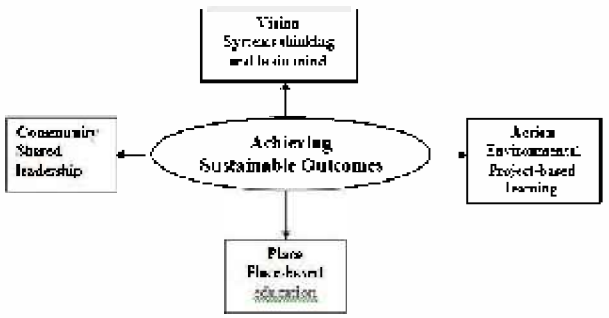

Figure 2. Model for developing school programmes that promote systems thinking suggested by the Centre for Ecoliteracy (Neumann, 2000; Jacobson *et al.*, 2006).

A range of learning techniques that are relevant to conservation and outreach have been considered by Jacobson *et al.* (2006). Table 3 illustrates these different techniques, their associated historical roots, their goals and the type of communities involved. The result of the applied techniques should shape attitudes, knowledge and skills for improving environmental and social change, and have a positive impact on people's lives and their surroundings. The six techniques used are service-learning, issue investigation, project-based learning, community-based research (CBR), citizen science and mapping. An example of a service-learning project, run at the Service Learning Office, Warren Wilson College, Asheville, North Carolina, involves removing invasive species from community parks by students. Such projects provide mutual benefits to conservation organizations, schools and communities (Cairn, 2003; Jacobson *et al.,* 2006).

The issue investigation technique has been applied to middle, high school and college students where knowledge and skills have had a positive impact on behaviour (Ramsay *et al.,* 1981; Ramsay and Hungerford,

1989, Jacobson *et al.*, 2006). In this technique students analyse environmental issues and also their own views and beliefs. This is followed by identifying local environmental issues, developing research questions, conducting background research, interpreting data and developing strategies for environmental application.

Project-based learning and problem-based learning are interchangeable terms that build knowledge content and problem-solving skills. Human ability is tested when real-life situations require appropriate solutions to resolve problems. In the case of student project-based learning it offers the students the opportunity to plan, design, implement and assess outcomes, and to present the findings (Rogers and Andres, 2004).

Table 3. Historical roots, primary goals, and instigators of different learning techniques (Jacobson *et al.*, 2006).

Technique	Historical roots	Primary goals	Instigator
1- Service-learning	Experiential education, community service	Impact on community needs and student learning	Teacher, community group, students
2- Issue investigation	Goals for curriculum development in environmental education	Student learning	Teacher
3- Project-based learning	Experiential education, Neuroscience and Psychology	Student-learning	Teacher, students
4- Community-based Research(CBR)	Participatory research, action research, service learning	Collaborative research, meeting community-defined needs, social and environmental change	Community members, researchers
5- Citizen science	Field research, public participation in science	Collaborative research	Researchers
6- Mapping	Participatory research methods	Data collection	Researchers, facilitator

The fourth technique is Community-based research. This involves a partnership between researchers and community members that addresses social and environmental problems (Stoecker, 2001, Jacobson *et al.*, 2006). The Y2Y connected corridor project connecting the Yellowstone National Park in the US to the Yukon in Canada is an example. As reported by Krajnc (2002) this involves both scientists and local communities, where American and Canadian biologists link up with environmental organizations to work for improved ecosystem-based land-use planning and the protection of species. Another example is the Glasgow Natural History Society in Scotland which regularly conducts tutorials and workshops. The society also organises outdoor excursions with experts who work closely with society members. These activities include studying aspects of natural history including species identification, field techniques and photography (http:// www. glasgownaturalhistory. org.uk/meetings.html).

Citizen science refers to an organized project that involves the general public, teachers, or students in any or all steps of the scientific project (Prysby, 2001). In most cases citizen science starts with a key scientist posing a question, with the task of main data collection being undertaken by the public. This is contrary to the CBR where the community poses the question which is directly linked to the community needs. Examples of monitoring projects involving citizen volunteers have a long history. Stevenson (2004) quotes recording schemes in England that cover a wide range of taxa and produce databases that guide conservation issues.

Mapping allows people or groups of people to create visual representations of their resources, communities, region, country and the world (Feuerstein, 1986). The practice of mapping is simple and even people with low literacy can attempt to create maps about resources, land and water use, health problems and environmental issues. One of the advantages of mapping is that it establishes mutual understanding among groups. Examples are local land users, administrators, politicians, and elderly residents. They have different levels of awareness but a common access to resources. The practice of creating maps by community groups can also be judged against existing professionally developed maps.

Zoological Society of London – its role in Wildlife Conservation and Education: The Zoological Society of London (ZSL) is a registered charity in England and Wales with a total of 1774 fellows out of which 81 are from overseas (http://www.zsl.org).

It was founded by Sir Stamford Raffles in 1826 as a society whose aim was to study animals. It is now dedicated to worldwide conservation and to scientific research, In 1828 London Zoo was opened to Fellows of the Society as the world's first scientific zoo. In 1829 ZSL was granted a Royal Charter by King George IV. Charles Darwin became a Fellow of ZSL in 1837. In 1847 the first paying visitors were admitted to London Zoo, to aid financial support.

ZSL's scientists, animal management teams and veterinarians possess wide-ranging skills and have long experience in practical conservation and scientific

research in the laboratory and in the field. This mix of experts provides the backbone to the successful running of ZSL. The prime mission of ZSL is 'to promote and achieve the world-wide conservation of animals and their habitats.' ZSL is made up firstly of London Zoo, secondly of Whipsnade Zoo (formerly called Whipsnade Wild Animal Park) which opened to the public in 1931, and thirdly of the Institute of Zoology. The Institute of Zoology was founded in 1960-61 under the leadership of Lord Zuckerman the then Secretary of ZSL. ZSL also undertakes national and international conservation programmes. A comparison of the numbers of staff, animal species, visitors and educational visits per year, at both zoos is shown in Table 4. London Zoo has twice the number of visitors and holds three times more species than Whipsnade Zoo.

Table 4. The Zoological Society of London - facts and figures for London Zoo and Whipsnade Zoo.

Statistics	London Zoo	Whipsnade Zoo
Staff	320	130
Area of site (acre)	36	600
Animal species	750	200
Visitors / year	1.1 million	475,000
Educational visits /year	100,000	30,000

The 'Keeper for a Day' programme at London Zoo offers members of the general public experience at close hand of some of ZSL's most popular animals. It also provides a unique opportunity to observe the day-to-day duties of the keepers and their charges. The tasks of a potential 'Keeper for a Day' include feeding animals, cleaning cages, and observing the role of workers behind the scenes. There is also a volunteer's programme which is popular.

Whipsnade Zoo is one of Europe's largest wildlife conservation parks, and houses more than 200 animal species, many of which are endangered. For example Przewalski's horse first discovered in Mongolia in 1879 by a Russian Colonel Nikolai Przewalski, is thought to be extinct in the wild. In 1945 there were only 31 individuals in captivity. By 1990 their number had increased to 1,500 and some were reintroduced in their native region of Mongolia. In 2001 a horse bred at Whipsnade Zoo was reintroduced to Mongolia. In this context Clark *et al.* (2006) edited the 'Mongolian Red List of Mammals' which highlights the status, distribution, and threats of Mongolian mammals. This publication was an output of the Mongolian Biodiversity Databank Project, to which ZSL staff contributed.

The working elements of ZSL are shown in Figure 3 where the major emphasis is on 'Living Conservation'. The three components are living collections, conservation science and conservation programmes. One of the aims of ZSL is to make it a leading centre for research and conservation biology and animal welfare by conducting national and international field conservation programmes. As a learned society ZSL's role is to arrange scientific meetings, lectures, symposia, and publications. It also awards prizes for outstanding contributions to wildlife and conservation.

ZSL is also active in running educational and information programmes, in particular for school children and families. In addition ZSL endeavours to enhance public understanding of animals and their welfare and of related conservation issues. ZSL has four publication series – Animal Conservation, the Journal of Zoology, the Conservation Biology book series, and the International Zoo Yearbook.

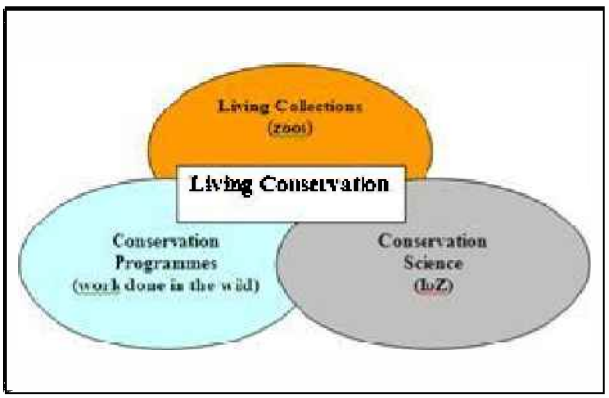

Figure 3. The three working elements of the Zoological Society of London, under the theme of Living Conservation: Living Collections, Conservation Science, and Conservation Programmes (courtesy of David Field, ZSL).

The Institute of Zoology (IoZ) is the research division of the ZSL and conducts biological research that benefits the conservation of animals and their habitats. IoZ works in partnership with the University of Cambridge, and conducts research training programmes both at an undergraduate and a postgraduate level. It also runs taught M.Sc courses jointly with the Royal Veterinary College on Wild Animal Health and Wild Animal Biology.

The conservation programmes of ZSL are being conducted both in Britain and in countries worldwide. This conservation involves maintaining long-term populations of species in natural ecosystems and habitats (Fig. 4). It includes working with local communities to conserve wildlife and their habitats, and promotes sustainable livelihoods. ZSL works with government, civil society and the private sector especially with deprived communities, to encourage the responsible utilization of natural resources. ZSL's conservation

programmes include the Gorilla Conservation project in Gabon and the Bushmeat trade in West and Central Africa. They also include UK native species, deserts and rangelands, island ecosystems, vulture rescue in the Asian Sub-continent, marine (Project Seahorse and Community-led Mangrove Rehabilitation in Panay Island, Philippines http:// www. zsl. org/ conservation/ regions/ asia/) and freshwater, and EDGE (Evolutionary Distinct and Globally Endangered) of Existence programme. ZSL has also been involved with the King Khalid Centre in Saudi Arabia to breed and re-introduce gazelles and Oryx back into the wild.

The decline in vulture species in India and Nepal, and Pakistan since the mid- 1990s has been alarming (Gilbert *et al*., 2002; Cummingham *et al*., 2003). The cause of this decline has been identified as an anti-inflammatory drug 'diclofenac' which is given to cattle. When vultures scavenge on carcasses containing diclofenac, the diclofenac is incorporated into the vulture's body and causes kidney failure. According to joint work conducted by ZSL with the Bombay Natural History Society, populations of three of the most common griffon vulture species have declined by more than 90%. The Indian white-backed vulture *Gyps bengalensis* and the long-billed vulture *Gyps indicus* are the two species which were very common but are now designated as critically endangered by IUCN. The third species, the slender-billed vulture *Gyps tenuirostris*, was uncommon, and now is considered extremely rare. An India-wide vulture survey was carried out in 2000 showing these dramatic declines. Subsequent surveys in 2002 and 2003 funded by the Darwin Initiative for the Survival of Species scheme to ZSL showed that all three species had declined dramatically during the previous 12 years. *G. indicus* and *G. tenuirostris* had declined by 97%, and *G. bengalensis* had declined by 99.5%. Research conducted in Pakistan showed the vulture populations have declined by 92% during the last five years, as a result of diclofenac (Oaks *et al*., 2004, Shultz *et al*., 2004). The impact of these declines may lead to the extinction of all three species, and are likely to have catastrophic affects on other scavenging species, humans and ecological systems. The Vulture Rescue programme which involves a number of partners, through conservation research, captive breeding and public advocacy and awareness building, is actively engaged in reducing the ecological and social impact (Peregrine Fund http:// www. peregrinefund. org/ vultures.

Under its education theme ZSL runs outreach programmes where interactive presentations are delivered at schools. The education officers of ZSL give talks with biofacts (bones, skulls and skins) and also use one to two live animals when feasible. This gives a thrill factor to children and stimulates their learning. ZSL also runs courses for adults, keeper training and work experience for younger members of the community.

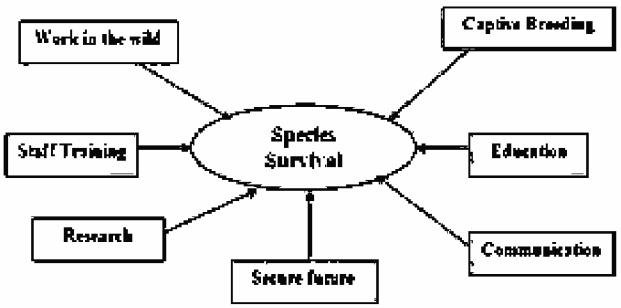

Figure 4. Conservation and Society – impact of services and programmes on species survival (courtesy of David Field, ZSL).

In summary, ZSL is the largest zoo-based conservation NGO in Europe. The following quote is from ZSL "Through our Living Collections we inspire and delight our visiting public and provide an ark for endangered species. Through the Institute of Zoology we learn more about the natural world and focus our efforts on finding ways to protect our planets diversity. Through our Conservation Programmes we apply our knowledge and commitment in over 30 countries worldwide. BUT we want to do even more".

Conservation / biodiversity programmes between the United Kingdom and Pakistan: There are a number of UK / Pakistan partnership projects studying conservation, biodiversity and environmental issues. These projects are mainly funded by the Department for International Development (DFID), Department for Environment Food and Rural Affairs (DEFRA), the British Council and the Foreign and Commonwealth Office (FCO). I will give a few examples.

I have been the UK joint co-ordinator with Peter Meadows, of two DFID funded British Council Higher Education Link Programmes (for fuller details see paper by Peter Meadows in this volume). These were undertaken between the University of Glasgow and the University of Karachi and the Centre of Excellence in Marine Biology. The first project was on 'Coastal Zone Management and EIA of the Mangrove swamps in the Indus Delta' 1997-2001 (Figure 6), and the second was on 'Socio-environmental uplift of coastal rural communities in Sindh and Baluchistan' 2003-2006. These links were aimed at poverty alleviation, sustainable use of natural resources, clean drinking water issues, rural community participation especially of women, staff training, and publications leading to career development (Meadows and Meadows, 2001).

The Higher Education Commission (HEC) Pakistan in partnership with the British Council Pakistan, initiated a Higher Education Links programme using the HELinks template, and funding came from HEC. These links focus on answering Pakistan's needs and on strengthening the science and technological capacity of

the staff and institutions. An example was the HEC link on 'Marine Biodiversity Conservation in Pakistan' 2004-2007, between the Centre of Excellence in Marine Biology at the University of Karachi and the University Marine Biological Station Millport, Scotland.

The DFID HELink programmes were terminated in 2006 and have been replaced by the DFID funded British Council managed Development Partnerships in Higher Education (DelPHE) programme. The overall objective of the DelPHE links are to build partnerships between HEIs and to allow them to act as a catalyst towards the UN Millennium Development Goals. At the same time they aim to increase the institutional capacity and promote science and technology related knowledge and skills. The Association of Commonwealth Universities (ACU) is responsible for the part of the programme delivery that supports South-South (developing-developing) partnerships. It is expected that 200 DelPHE progarmmes will be funded during 2006-2013. Out of the 24 DFID focus countries in Africa and Asia, Pakistan and Vietnam received the highest country funding for DelPHE projects, each receiving £120,000 during 2007-08 (DFID, 2008). http:// www. British council.org/delphe.htm

I am pleased to report that the current DelPHE project running from 2007-2010 on 'Developing Sustainable Livelihoods for Communities in a Ramsar Site: the Makran Coastal Wetlands Complex (MCWC), Pakistan.' under which this conference was organised is developing a conservation economy with rural coastal community involvement. The project is between the University of Veterinary and Animal Sciences, Lahore, the University of Glasgow, Scotland and James Cook University, Queensland, Australia.

The UK Department for Environment Food and Rural Affairs (DEFRA) funds the Darwin Initiative for the Survival of Species projects. The aim of these partnerships is to assist countries that are rich in biodiversity but do not have adequate financial resources to implement the Convention on Biological Diversity (CBD). It does this by funding collaborative projects that mobilize UK biodiversity expertise (see above, the Darwin Initiative project on vulture decline in India). http://darwin.defra.gov.uk

A Darwin Initiative project on 'Conservation of Pakistan's Marine Cetacean Biodiversity and Pelagic Environment' was undertaken during 2005-2008 between the University Marine Biological Station Millport, Scotland, WWF Pakistan, and the Centre of Excellence in Marine Biology, University of Karachi. The main purpose of this project was to investigate the conservation and management of whale and dolphin biodiversity in the NE Indian Ocean (Pakistan). The project also included staff capacity building and public awareness, and participation programmes, and joint publications (Gore *et al*., 2007).

The British Council / FCO initiative 'Connecting Futures' was a five-year programme aimed at building mutual understanding, learning, and respect between young people from different cultural backgrounds. 'Connecting Cultures through Science and Arts' was a project under this scheme, which I jointly co-ordinated with Peter Meadows. Three female and two male students from the University of Baluchistan, Fatima Jinnah Women's University, the University of Karachi, Lahore College for Women University and the University of Peshawar visited London in 2003. The activities focused on awareness building of environmental perceptions and analyses by scientists and artists in a multicultural context, and included the importance of past and future global environments, the central role of biodiversity, and the environmental impact of human societies. The participants took back new ideas from their UK experience.

All these programmes are promoting mutual partnerships between institutions and their participants in Pakistan and internationally, and will hopefully be sustainable on the long term. They will then contribute towards Pakistan's human resource development, and strengthen Pakistan's wildlife and conservation strategy.

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Note: *For references where there are 10 or more authors the Royal Society of London format for publications has been applied, quoting the first author followed by the number of remaining authors in brackets.*

Why study wildlife ecology and conservation? Conserving biodiversity, and avoiding the mass extinction of species, are huge global challenges. We need ecologists who can use their skills and scientific knowledge to help tackle these issues, and explore new and novel approaches to conserving wildlife.Â You'll be well prepared to go into a wide range of jobs. You could work in national and international wildlife conservation, conservation consultancy, media and wildlife film-making, wildlife and enterprise, or wildlife conservation research. As a science graduate, your skills will be highly valued, and you could go into a range of non-science graduate positions. The Wildlife Conservation Society supports zoos and aquariums, while also promoting environmental education and conservation of wild populations and habitats. Its efforts are focused on a select group of animals, including bears, big cats, elephants, great apes, hoofed mammals, cetaceans, and carnivores. The WCS was established in 1895 as the New York Zoological Society, when its mission was, and still is, to promote wildlife protection, foster the study of zoology, and create a top-notch zoo. Today, there five Wildlife Conservation Zoos in the state of New York alone: the Bronx Zoo, the Centr