

The Feasibility of Introducing Undergraduates in Biodiversity Science in the Arabian Gulf Area



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Abstract Museums have an unexploited possibility to occupy students who wish to learn. In this chapter, a description of the growth of a multistage museum-based package at the University of California, Berkeley, as a paradigm for attracting undergraduates in biota variety science was given. This work to upsurge student contribution in collections proves the shared welfares of learner participation. Museums advantage forms the great assistance in collections maintenance and an augmented knowledgeable energy, whereas students concurrently attain vital research talents and an extreme contact to biota variety. The aim of the description of the training programme in this chapter is to draw the attention of the policy makers in the Arabian Gulf States to an important point and that the public are not aware of the biodiversity that present in their environment. This biodiversity needs to be known and look after, and such care should transfer from one generation to another. The natural history learning should be one of the roles of the natural history museums in the Arabian Gulf Countries and the natural history societies. The governments in these countries should involve the undergraduate students in such training to offer a future natural history scientist that can look after the biodiversity of their countries.

Keywords Students · Museums · Training · Collections · Environment · Learning · Natural history

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1 Introduction

The Arabian Gulf countries as with the other Arab countries have more or less social and cultural principles, religious views and historical occasions and confirm Arabic as the formal language and however diverge significantly from one another in regard to the societies, area, capital and political inspiration (Dagher and Boujaoude 2011).

Progression in science and technology arenas is a decisive objective for many Arab states including those of the Arabian Gulf as scientific and technical affluence which are deliberated important for financial and community growth (Hiller et al. 2017). Achieving this aim depends greatly on creating educational strategies that regard the gaining of necessary scientific information and endorsing educational performs that backing commitment in science. These plans frequently contain the reshaping of educational schemes heading to the progress and application of work-books that endorse gaining of scientific information, scientific conducts of mind and difficult resolving talents (Hiller et al. 2017).

At the natural history museums, there were a tremendous but largely unexploited possibility to enable undergraduate education over specimen-based research and instruction using the biodiversity collections, which were considered powerful educational gears a workshop to train future generations about the role of natural history in the life of human (Cook et al. 2014; Powers et al. 2014). Several factors might discourage undergraduates in seeking training and learning in natural history and biodiversity fields, and these can be foreseen in capital discontinues and augmented guiding oversight (Hiller et al. 2017). Nevertheless, such contests can be overwhelmed via instructive schemes such as the Advancing Integration of Museums into Undergraduate Programs (AIM-UP) course modules (Cook et al. 2014) and Course-Based Undergraduate Research Experiences (CUREs) (Bangera and Brownell 2014).

At the museums, undergraduates can see nature in 3D view and can hold specimens of different creatures in their hands. Such learning that involve hands and 3D viewing teaches students with a remarkably profound thoughtful of ecology and evolution (Sundberg 2003). Moreover, the students attain wide experience to both organismal research and applied talents such as data administration. The profits of such training are not together, though. In the present time of staff decreases, finance withholds and substructure deteriorations, museums have ample to add by linking undergraduates as an additional form of staffs (Hiller et al. 2017). Similarly significant, students offer an important intelligent which helps to museums by fetching new viewpoints and novelties. The two-sided welfares of involving students in museums can direct to motivating new chances in biota variety knowledge (Hiller et al. 2017).

In spite of the presence of natural history museums and science in the Arabian Gulf countries, the programmes that involve the publics and in particular undergraduate students in research and biodiversity activities are rare or almost absent (Hiller et al. 2017). The museums in these countries as in the case with the other Arab countries were designed to serve mainly as show cases for visitors with less or no

involvement of the public in the catching, preparing and identification of the natural history specimens. Therefore, a revolutionary step/s should be taken in this aspect and change the role of the natural history museums to more effective and more useful and let the biodiversity collections connect the nature and the students to realise the benefits and the reality of these creatures (Hiller et al. 2017).

In the present chapter, a model of a remarkably real and comprehensive package that includes vigorous, at spot education at the university level teaching is presented. This platform was created and implemented by the Museum of Vertebrate Zoology (MVZ), University of California, Berkeley. The features of the structure of the package were given as a paradigm for appealing students in biota variety knowledge and to accomplish with numerous endorsements for other museums in the Arabian Gulf countries interested in developing similar programmes (Dagher and Boujaoude 2011; Hiller et al. 2017).

2 Why the Natural History of the Arabian Gulf Countries?

2.1 Geography and Landscape

The Arabian Gulf is a northward extension of the Indian Ocean located on the eastern boarder of the Arabian Peninsula. The gulf is affected by the ecological features of the Arabian Sea (Spalding et al. 2007). It is one of those non-deep seas, with average depth of 35 m and an entire area of about 240,000 km² (Barth and Khan 2008). It characterised in having an extreme ecological settings, with high temperature, humidity and salinity. Therefore the marine creatures inhabiting this area are facing harsh habitats (Price et al. 1993). With such unfavourable environmental setting, there are still in the Arabian Gulf a range of marine creatures living in a peculiar high salinity ecosystems (Naser 2011). Though such habitats are facing a continuous stress due to the man-made events that are linked with the fast profitable, communal and business growths in the Arabian Gulf states. The Arabian Gulf is believed to be among the main human affected areas worldwide (Halpern et al. 2008). The shorelines of the Arabian Gulf are perceiving quick development and expansion that add to the dilapidation of the marine ecosystems. The shores and marine habitats are stressed by severe dig up and land retrieval events and numerous supplies of contamination, containing manufacturing discarded, salted waste waters, ports and refiners, oil spills and urban sewage (Sheppard et al. 2010).

Owing to its sole environmental location, the Arabian Gulf is gradually getting worldwide scientific attention to investigate the influences of habitat excesses on marine inhabitants and to explore the possible effects of future weather alteration on the ecology of marine habitats (Feary et al. 2013).

2.2 *The Diversity of the Environment in the Arabian Gulf Area*

For centuries, inhabitants of the Arabian Gulf are associated in several aspects with sea and have different social events and rituals that linked to this natural ecosystem. Numerous ecological niches, containing seagrass beds, coral reefs, mangroves and mudflats offer meaningfully to the output of sea supplies in the Arabian Gulf (Khan and Munawar 2002). These systems are recognised as an appreciated habitat constituents since they offer vital ecological materials and services (Treweek 1999). The majority of these areas are plentiful in varieties of fish, which are a main supply of food for the inhabitants of the Arabian Gulf. Ecological niches benefit in the Arabian Gulf are not restricted to the straight eating value of seafood but spread to other amenities fluctuating from primary production and nutrient cycling to erosion and sedimentation regulator.

Among the distinctive ecological niches are the seagrass beds, which are extremely fruitful that offer significant natural purposes and financial facilities (Sheppard et al. 1992). From the ecological point of view, seagrass habitats deliver food supplies and nursing areas for numerous endangered species in the Arabian Gulf like turtles and dugongs (Abdulqader and Miller 2012; Preen et al. 2012). Such species of seagrass take place in the Arabian Gulf; viz., *Halodule uninervis*, *Halophila stipulacea* and *Halophila ovalis* (Phillips 2003).

The coral reef environments are another distinguishing ecological niches in the Arabian Gulf area as they offer a diversity of ecological needs such as sustainable supplies of food from the sea, conservation of genetic, biological and ecosystem variety, entertaining standards and financial profits such as using reefs for generating land (Naser 2014).

Mangrove ecosystems are among the important environmental habitats in the Arabian Gulf area as they offer food, lodging and caring areas for a diversity of land and sea fauna. Mangrove niches of the Arabian Gulf backing a diversity of significant species of fish, shrimps, turtles and birds, considerably add to the coastal output (Al-Maslamani et al. 2013). The Arabian Gulf shorelines are subjugated by only one species of mangroves, *Avicennia marina*. The procedures of osmoregulation and salt secretion permit this species to survive with high salinity environments in the Arabian Gulf (Dodd et al. 1999).

Among the widely distributed and common habitats in the Arabian Gulf area are the mudflats. This is because the sedimentary feature of the Arabian Gulf. They range from intertidal salt marshes to the extreme depth and related for more than 97% of the bottom substrate of the Arabian Gulf (Al-Ghadban 2002). Such ecosystems are favourable places for the settlement by mangroves, algal and cyanobacterial mats, which have vital parts in primary productions and food webs. Subtidal and tidal muddy areas are enormously rich in macrobenthic groupings, which create the major and utmost varied marine habitat in the Arabian Gulf. Commonly, biota variety and dispersal of macrobenthos in the Arabian Gulf are chiefly ruled by sediment kind, temperature, salinity, primary productivity, depth and physical

disruption (Coles and MacCain 1990). Moreover, mudflat areas offer feeding and resting places for significant shorebird groups. Some of such significant bird places are acknowledged as wetlands of international significance (Ramsar Convention of Wetlands).

3 Natural History Museums and Societies in the Arabian Gulf Areas

3.1 Natural History Museums

In recent years, the establishment of natural history and scientific museums and national aquarium became evident in the Arabian Gulf States. As it is mentioned above, these institutions were found to be a display show boxes to visitors to look and admire and with less role as natural history learning and teaching aids for the society and especially the students. Besides, these centres hold a limited number of specimens of different animal and plant groups. This is may be due to the policy of these institutions to limit their activities in serving the visitors from the members of the society. An additional reason could not be involved in the scientific researches that should be perform on the preserved specimens through making available a professional staffs to carry on such researches. The following is a list of the main museums found in the Arabian Gulf States and their roles.

3.1.1 The Scientific Centre, Kuwait

This centre has three main sections that attract mainly visitors, the aquarium, the sighting building and a movie. Other than this, the Dhow Dock is situated right on the waterside. The aquarium is one of the biggest aquariums in the Middle East, with large number of marine creatures (<https://www.ecsite.eu/members/directory/scientific-center-kuwait>). A tour through the aquarium will reveal three diverse habitats presenting samples of the life. Among the interesting parts of the centre is the desert habitats, which contains animals living in desert like the hedgehog and caracal. The other unit is the shoreline habitats with their variable inhabitants. The full marine ecosystem is given in the third compartment of the centre showing reefs, sharks and rays (<https://www.ecsite.eu/members/directory/scientific-center-kuwait>).

In the Discovery Place, a packed of learning and pleasurable displays relating to numerous sectors of science, like easy methods to acquire about magnetic, solar and kinetic energies, and numerous means to generate it were present. No collection of specimens and no natural history researches were performed in this centre.

3.1.2 National Museum of Qatar

As with the other national and natural history museums in the Gulf States, the National Museum of Qatar is an exhibition more than a natural history research institute.

In this museum, several exhibitions are present, and the [natural history](#) is one of them. The other exhibition related to nature is the Arabian Gulf.

3.1.3 Natural History and Botanical Museum, Sharjah, UAE

You can expect some natural history research, collections and preserved specimens, but it seems that the main role of the museum is to provide public with a possibility to attain quickly about the plant and animals of the Arabian Desert, while at the same time having a calming and entertaining time. There is a small chance for the visitors to know the great variety of plants and animals and the amazing ways in which these have adapted to life in a dry, hot weather; they will begin to appreciate and relish these favours of nature.

3.1.4 Bahrain National Museum

This museum holds mainly archaeological artefacts. Recently, single hall was open, which includes natural history exhibits that focus on the natural environment of Bahrain. No natural history collection and no researches were among the role of this museum.

3.1.5 Natural History Museum of Oman

This museum houses a limited number of natural history specimens including land vertebrates and marine creatures. In addition, there are a number of invertebrate collections of both land and marine origins. The main specimens in the museums were the skeletons of different marine mammals.

From the short review of the museums and science centres in the Gulf States, it is clear that the role of these institutes was to exhibit the natural history life of the Arabian Gulf area, with no attempt to include research that involve preserved specimens. Therefore, these museums and centres were not suitable for training the undergraduate student to do research on the natural history collections unless the main roles of these institutions will be changed and collections of fauna and flora are started to be included. Then, the step of training undergraduate will follow.

3.2 *Natural History Societies*

The European and American expatriates in the Gulf States have gone for the last few decades in forming natural history societies and groups that their members have interest in special animal and plant groups of the area. Among these groups are the followings:

3.2.1 Qatar Natural History Group

The Qatar Natural History Group created in November 1978 to gather those with the curiosity in the natural history of Qatar and the Gulf. The objectives include the features of natural history in addition to the culture, history and archaeology of Qatar. This group enhanced the acquaintance of Qatar's Biota variety by introducing a citizen science plan to discover the locations of the plants and animals of the Qatari desert.

3.2.2 Bahrain Natural History Society

This group is specialised in the observation of birds in Bahrain, and its members have a regular trip around the country to record and report about the different species of birds present in Bahrain. The aim of the society is spread the knowledge about the wildlife and specifically birds in Bahrain.

3.2.3 Emirates Natural History Group

This group is the largest among other natural history groups in the gulf area. It aims to embolden and support individuals concerned in the investigation and enjoyment of the natural history and archaeology in this part of the world and globally. This group is also involving in the habitat subjects in the United Arab Emirates and delivers an energetic and broadminded opportunity, for specialists and fans equally. The group has four campuses, Abu Dhabi, Dubai, Al-Ain and Fujairah, with the oldest one is that at Abu Dhabi, where established in 1976.

The group organises seminars given by specialists from a variety of areas such as natural history, archaeology, palaeontology, Arabic culture/history, geology and astronomy. Among the other main task of the group is arranging field trips to explore the nature of the country. The group publishes a biannually regular journal "Tribulus" which contains articles on different aspects of natural history of the United Arab Emirates and the Arabian Gulf in general, and it is the only critically assessed English language scientific journal of its kind in the UAE.

3.2.4 Environment Society of Oman

Environment Society of Oman purposes to assist in conserving Oman's natural culture and increase consciousness regarding diverse habitat matters. It initiated in March 2004 by Omanis signifying diverse areas and numerous dissimilar specialised qualifications. Affiliation is available to anyone above the age of 18 who has an awareness in protecting the habitat and confirming that Oman's natural inheritance rests undamaged for future generations to relish.

It is clear from the above short review of the natural history societies and assemblies in the Arabian Gulf countries that these forums are suitable and competent to take the role of training the undergraduate students on natural history research more than the natural history museums in the Arabian Gulf countries. These societies need to be supported by the local governments to achieve this goal such a support can be seen in providing small laboratories and reference rooms to hold specimens and financial support.

4 The Role of Field Work in the Training of the Undergraduates (Scott et al. 2012)

Fieldwork is assumed by utmost authorities to be a crucial, and frequently significant, component of undergraduate schemes in the habitat education (Maskall and Stokes 2008; Scott et al. 2012). Profound teachers who deliver field investigation are frequently normal in the view that examination of the nature is a worthy issue. This is regularly on the foundation of their vision of the assistances of excursions done in the nature (Scott et al. 2012). As a consequence of budget constraint on field trip programmes and on the availability of people who can run such courses, certain private companies were established to provide assistance to educators via taking charge for traits of outdoor learning.

5 What Makes Undergraduate Students Not Pursuing Independent Research Experiences?

There were some difficulties confronted by undergraduates who are interested in pursuing undergraduate independent research experiences, which may restrict research chances to select groups of people. Bangera and Brownell (2014) have recognised the following set of difficulties that may stand as an obstacle in the way of the undergraduate students pursuing independent research experience: (1) knowledge of existing research chances; (2) awareness of the possible benefits of research experiences; (3) awareness of cultural norms associated with scientific research;

(4) perceived difficulties to interactions with faculty; and (5) financial and personal restrictions.

6 Outline of Package Configuration

Usage of a diversified construction permits students to progress as they attain exercise and involvement. The work inside the museum dealing with specimens of different flora and fauna varies between preliminary and advanced jobs which contain direct contact with specimens, thus divulging students with an obligation for biota variety and collections. As they are getting involved more in the curatorial works, trainers can contribute straight in research that link with specimen, which includes the utmost academically technologic form of undergraduate participation.

In this programme, candidates are interrogated and then located in sites that related very much to their interests and talent grades. At the end of each yearly session, students and administrators deliver response that both assessed the scheme and to progress undergraduates via the multistage structure. Extra skilled students assist to guide the new comers of students, which dispenses learning and responsibilities through the scheme. Gradually, guides also have been established to reduce teaching time for particular jobs (Bangera and Brownell 2014).

7 Chief Programme Elements

There are several aspects that can make this scheme fruitful and inclusive, these are:

(A) Specimen preparation

Among the existing moments for students are those when they came face to face with specimens of animals, and more existing are those occasions where they watch a dissection of vertebrates' animal. The first task in training is to prepare the skeleton, and further as an effort to upgrade their skill, they asked to prepare dry skin of birds and mammals. Through such training they usually facing the problem of identifying the animal species they are handling and with their identification they become acquainted with the process of identification including using the proper identification keys. Such training is not available at the institutes, and therefore it is a valuable addition to the knowledge of the students (Bangera and Brownell 2014).

(B) Field opportunities

The field surveys can offer to the student's wide range of knowledge and experience through the experts leading such excursions. In such surveys, the students became across and get to know the methods of studying the animals in the fields and the means of capturing them without any harm or damage. Also, to note their environment and record any important field comments. In addition, the students

will be learned about the logistic side of the field trips. The field trips in addition to the museum training afterward will generate a huge comprehension to the students and integrate the image of the natural history for them (Bangera and Brownell 2014).

8 Scientific Benefits to the Museum

It seems that the results of training undergraduate students on the daily works of the museums including field trips are welcomed by most museums. For example, at the Museum of Vertebrate Zoology, such schemes are adopted, and most of the daily works of the different departments of the museum are getting used of the efforts of the trained students in their daily job. Among the jobs that the students can do in the museum and are not covered with a fund by the museums' administration are handling large number of specimens of any animal groups.

The contribution of the students to the museums' works can assist in the collection and curation of an expanded suite of samples. Likewise, students doing training at the molecular lab could upsurge the sum of genetic information gained from museum specimens. Finally, with young students, the spirit of the museum will enlightened the working life via the intellectual energy, questions and contributing ideas of the young individuals.

9 Suggestions and Future Directions

By the expansion of new technologies and evolving pressures to biota variety, the significance of research at the museums will be vital (Bi et al. 2013; Holmes et al. 2016). On the other hand, funding for museums and for exercise in natural history skills heads to a decrease. Based on these conditions, the advantages like the MVZ Undergraduate Program will upsurge in significance in the future (Bangera and Brownell 2014). As present museum experts and wildlife specialists go on retirement (Snyder et al. 2016), the subsequent emptiness needs to be occupied by a new group of researchers who have the desire to be a supporter for the applicability of natural history and museums. Additionally, while significant rules to protect biota variety have been approved over the last century, with neglecting the role of natural history teaching, there are now less people skilled to apply these guidelines (Anderson 2017).

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