

Public Perception of the Benefits of Mangroves in Qurayyat, Oman: Implications for their Sustainable Utilisation and Management

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Abstract: The environment delivers a wide range of services that contribute to societal wellbeing, but their sustainable use is dependent on local utilisations, behaviours and perceptions of their benefits. This is particularly true for mangroves in Oman which are targeted to play a key role towards the country's sustainability goals (100 million mangrove trees will be planted as part of Oman's Blue project). This study examines the public perceptions of the value of the Qurayyat natural mangrove ecosystem for delivering both cultural services and the public's current and future views of the site's sustainable management. A participatory approach was used whereby locals were interviewed to elicit their views and preferences, including participatory mapping, with more open-ended questions to provide a high level of flexibility and space for the respondents to express their views as well as a snowball sampling technique to identify potential respondents. The results suggest that there has been a downward shift in the supply of provisioning services over time, and that mangroves are the second-most preferred landscape in Qurayyat where a broad variety of activities are practiced that are highly valued. Respondents were very willing to be involved in decision-making regarding the management of the ecosystem. Analysis of these preferences and behaviours can be fed into a human-centric approach to management plans for the site.

1. Introduction

Humanity has always depended on natural ecosystems and their primary resources which have also played a pivotal role in civilisations, habits, beliefs and traditions (1, 2). Although the role of ecosystems in improving human well-being has been recognised throughout history, this has been articulated through the concept of ecosystem services in the scientific literature since the 1960s and has fully emerged as an influential concept for both the publics and for policy makers through the Millennium Ecosystem Assessment (MA) in 2005 (2). Ecosystem services represent the benefits that communities in the ecosystem acquire and access. Many definitions have emerged in the literature for ecosystem services, like the one stating that '*final ecosystem services are the components of nature directly enjoyed, consumed or used to yield human well-being*' (3, p.619).

Mangrove ecosystems provide a wide range of services which arise when ecosystem structures and functions contribute directly or indirectly to the improvement of the welfare of a society (4, 5). Put simply, they are all the material and non-material benefits acquired by people from the ecosystem (4,

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6). Based on the approved categorisation of the MA for ecosystem services, mangrove services can be classified into provisioning, regulating, cultural and supporting services (5, 6, 7). The provisioning services include vital sources of food, medicine, timber fuel and fibres in certain areas (4, 6, 7) as well as freshwater, genetic resources and animal products used for ornamental resources (6, 8). Moreover, mangroves support many floral and faunal communities worldwide, including endangered and protected species (5,9). The regulating services of mangroves comprise climate regulation, biological control, including human diseases and pollination (5, p.58, 6). Mangroves also defend the coast against erosion and storms/tsunamis and support the accumulation of sediments, trapping and filtering pollutants (10, 11). Mangroves are known to act as storm buffers that reduce wave energy at the shoreline (6, p.58,12, 13), which in turn reduces loss of life and property damage in extreme cases.

These ecosystems are also vital in maintaining climate and air quality by acting as sinks for contaminants and atmospheric carbon (6, p.58, 10, 12, 13) although they occupy only 2.4% of the total area of worldwide tropical forests (14).

Cultural services are associated with human experience and perceptions towards the ecosystem, which validate the protection of ecosystems for the public (5, 9). These include the non-physical benefits gained from the ecosystem (6,15) such as cultural diversity, spiritual and religious values, traditional and formal knowledge systems, educational values, inspiration, aesthetic values, social relations, sense of place, cultural heritage values and recreation and ecotourism (6,8,12). Supporting services, such as nutrient cycling and soil formation, are vital for the production of the other services (15). They differ from the abovementioned services in their temporal direct/indirect impacts on human life and develop over a long period time (6).

These services are perceived and valued differently among different regions around the world depending on the type of ecosystem, access to the ecosystem by the public and the degree of contribution of the ecosystem to the well-being of public users (16). In their study, it has been found that people hold high values for the service of soil conservation offered by forests ecosystems in Taiwan (16). Another example is a study done by (17) which looked at the social preferences in relation to how the public perceive the ecosystem in Spain. That study found that regulating services like filtration of air pollutants are mostly valued by the participants in the study.

In Oman, a study conducted in three mangroves ecosystems in Oman (Al- Qurm, Al-Sawadi and Qurayyat) has revealed less appreciation of the provisioning services of mangroves in the three sites due to low direct utilization (18). This also can be attributed to the recent changes in the socio-economic characteristics of the Omani community. In the past, many Omani communities, including coastal ones, were poor and more dependent on fisheries and animal husbandry, with mangrove habitats playing a significant role in supporting the well-being of the Omani community (19). The move towards an oil-based economy has reduced this dependence on mangroves. The same study revealed high valuation by locals of regulating services like carbon sequestration and storm buffering, and to cultural services in general.

However, in an earlier conducted Omani study (20), provisioning services were the most prominent benefits valued by locals in the socio-economic survey they conducted (particularly fisheries, which

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they attributed to the direct link of provisioning services to human well-being as well as the poor scientific knowledge and understanding about the value of regulating services, like carbon sequestration.

Several studies sought to assess the value of mangroves to local communities through eliciting the perception and appreciation of people towards the services provided (5). Also, the perception and attitudes of the communities towards these ecosystems and their benefits play a major role in the way they are managed by both local and national authorities. In some countries like Oman, mangroves have been protected and preserved while in other countries mangroves were perceived as wastelands with no market value, particularly in developing countries, which can be cleared for aquaculture for private enterprise (21, 22, 23). It has also been argued that the perceptions of the public towards ecosystems should be considered while designing management policies (16). Many studies have highlighted the value of material services, however few have focused on the social and cultural values which are extracted from the public perceptions of these services.

In spite of the considerable amount of published literature on ecosystem services and a greater understanding about the role of mangroves in improving the well-being of communities, a UNEP survey reveals that the contribution of the Middle East in this area is considerably limited (24). In particular, the services and benefits which might flow from the natural capital of mangrove ecosystems in Oman and the perception of the public of these services are poorly researched and documented. At the global level, it has been argued that whilst there has been an increase in research of public perceptions and preferences of ecosystem services, there are varying outcomes in terms of the type of services considered highly valuable to people (16). However, they find that there is consistency of the need to conserve the ecosystem to ensure the flow of services mostly valuable to the public.

In the Middle East in general, and in Oman in particular, the utilisations of mangrove ecosystems and the perception towards cultural ecosystem services (CES) have been poorly researched (16). A few publications exist in Arabic discussing the human-nature relationship from a religious perspective, without incorporating the science related to the ecosystem services approach, and nothing has been published on non-material services of mangrove ecosystems. The study conducted between Japan and Oman (19), which is the main Omani reference for the present study, overlooked the CES of mangroves in Oman.

Ecosystem service utilisations and perceptions are becoming used by both researchers and policy makers to identify and implement the management plans for a natural site (17). The services provided by nature in meeting human needs play an important role in decision-making and management plans (25, 26, 27). Studies conducted in the 1990s (20, 28) were amongst the first to highlight the role of mangrove communities in Oman. Their main focus was to describe the biological community structure of mangroves and human activities at Mahout Island, one of the most significant mangrove sites in the country. As mentioned above, provisioning services were the most prominent benefits identified in the socio-economic survey they conducted (20), particularly fisheries, which they attributed to the direct link of provisioning services to human well-being as well as the poor scientific knowledge and understanding about the value of regulating services, such as carbon sequestration. Also, the Oman coast had not been exposed to severe cyclone events immediately before the 1990s, so the storm buffering

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role of mangroves was not appreciated, even though cyclones have been indicated as the most destructive natural phenomenon over longer time scales in Oman (29, 30).

This paper extends a previous study of people perceptions towards ecosystem services provided by Omani mangroves done in 2018 (18), which showed more linkages between cultural services and the well-being of locals in Qurayyat, consistent with the argument of the MA (6) that this linkage is region-specific. In this paper, I aim to assess a wider range of CES provided by the mangrove ecosystem at Qurayyat and perform participatory mapping of the services as well as the disservices associated with that place. A survey was conducted to elicit in-depth views of locals regarding the cultural ecosystem services provided by this ecosystem.

The study has the following objectives:

- a. to better understand the CES provided by Qurayyat mangroves.
- b. to elicit the individual preferences for landscape attributes in mangroves in relation to CES.
- c. to elicit individual views on current and potential future site management.

2. Methodology

2.1. Research area

The study was conducted in Qurayyat, part of Muscat zone (23°16'29.62"N, 58°55'11.91"E), about 80 km south from the capital (31). Fishing and agriculture were once the main source of income for locals in Qurayyat, but nowadays many people are supported by jobs in both government and private sectors (19). This site was within the ranges of cyclones Gonu (2007) and Phet (2010), among the strongest cyclones witnessed in recent Omani history.

2.2. Data collection

The study followed a participatory approach, which involved interviewing locals, eliciting views, preferences and observations (32). The study also used participatory mapping to assess cultural ecosystem services as perceived by locals. The survey was based on the studies of (25, 26, 33) and the TESSA toolkit (34). The survey design was also informed by a project within the BESS programme in the UK by Wessex-BESS consortium, available online at (<http://www.ppgis.manchester.ac.uk/bess/>). The questions of the latter survey were modified for the Omani context and aimed at people visiting mangroves at Qurayyat. The categories of cultural benefits examined in this survey were: material, aesthetic, place/heritage, activities, religious, inspirational, knowledge, social relationships, identity, employment.

The survey was relatively short with more open-ended questions. Although open-ended questions might result in ambiguous responses which cost time in analysis (Gilbert 2008), they do not restrict answers given by respondents and can often provide more information (32).

Respondents were mainly asked how frequently they visit the site and to identify the type of activities they once practiced or still practice at the site from a list provided. Participatory mapping was used to as a tool to localise those activities. Respondents were also provided with a list to identify their motivations for visiting the site.

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To elicit the individual preferences for landscape attributes in mangroves in relation to CES, photographs were also used as a tool in this study. Seven different landscape images, including mangroves, were captured by the researcher and used to elicit preferences of respondents for different landscapes (Figure1). Researchers have referred to the use of photography in qualitative research as “photo-elicitation”, providing a visual aid to stimulate the engagement of respondents (35). Also, photographs are a supportive tools for remembering places, people and events (35). To meet the objective, participatory mapping was used again to highlight individual preferences for landscape attributes, as well as any disservices provided by the sites.



Al-Sahil, sandy coast in a residential and historical site.



Hawiyat Najm, a small lake occupying deep depression.



Hail Al-Ghaf, an oasis surrounded by mountains with green fields



Dhabab, coastal area with sandy and rocky beaches.



Wadi Dyqa, the largest surface water reservoir in Oman.



Mangroves, study site.



Al-Khawbar, sand dunes with lagoon comprising grass, shrubs and trees.

Figure 1. Different landscapes in Qurayyat including mangroves, the study site. Photos by author.

To elicit individual perceptions of site management, respondents were asked of their awareness of the manager of the site and what they thought of the plan of Ministry of Regional Municipality and Water resource (MRMWR) to build a dam at the route of fresh water supply to mangroves.

A small selection of local residents was approached to ask about their willingness to participate in the study. The respondent chosen had to have visited the ecosystem at some time in the past, irrespective of when or how often. The initial respondents were then asked to propose someone else who would fulfil these characteristics (snowball sampling) (32, 35). Although this type of sampling is mainly used for minor groups (32) which are not easily accessible (35), it was more culturally suitable for me as a female

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researcher conducting the study alone. Snowball sampling may also increase the chance of collecting more responses compared to approaching people at random. Also, it has been suggested that this method is likely to be better for reaching the actual beneficiaries of CES, necessary to identify, map and localise the services for better policy implementation (37). Sampling was stopped when it became very difficult to find more people willing to participate and / or no more visitors to the site could be found. This provided a total of 34 respondents.

Data were collected by conducting face-to-face semi-structured interviews on site or at respondents' homes, depending on respondent preference. This approach is the most commonly used for qualitative interviews (37, 38). This method also provided a chance to capture the views of elderly and / or illiterate people who were excluded in the self-administered questionnaire done earlier (18). The respondents were informed of the purpose of the study and the confidentiality of the information they gave. They were also familiarised with the map before mapping-based questions were asked.

This type of qualitative interview focused on respondent views, perspectives, feelings and behaviours which were the main interest of the research and thus I obtained responses rich in detail (35, 37, 38). The decentralised format of the interviews allowed the exchange of knowledge between the researcher and the respondents, gave more freedom for the respondents to reveal their understandings and provided the researcher with a chance to clarify any ambiguous responses (37).

The interviews were recorded digitally and later transcribed. Recording supports in-depth analysis of the data. Audio recorded interviews help in fulfilling researcher interests in both '*what people say*' and '*the way they say it*' (35, p.479). The data were then coded and analysed using Microsoft Excel and SPSS. Participatory mapping was done using the Arcmap tool in ArcGIS. Full transcription of data was time-consuming, but it ensured the intact responses of respondents (35). Where answers to open questions were given, these were in Arabic. To report some of these here in the Results section, I have translated them into English to the best of my ability and the reader should be aware that there may be minor inaccuracies in translation. However, I do believe that the sense of the statements has not been altered or compromised. The interview and approach were approved by the University of York's Environment Ethics Committee prior to its implementation in the field.

3. Results

3.1. Socio-economic background of the respondents

In total the interviews comprised 34 respondents, with a slight gender bias of 18 males (52.9%) compared to 16 females (47.1%). Respondents mainly belonged to the age groups 31-40 years (29.4%) and 51-60 years (26.5%). The majority had received a high school level education (47.1%), while 32.4% received above school level education (Diploma, College and University level) and 20.6% were illiterate.

A significant proportion (35.3%) of respondents were not currently employed and were mainly housewives. Government sector was the most common employment of respondents (32.4%), with far fewer working in private firms (2.9%). A reasonable percentage of respondents, all males, were running their own businesses (14.7%). A small proportion (5.9%) of respondents stated fishing as their main profession, while 8.8% were retired.

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3.2. Frequency of visits

Most respondents were very high users of the site, visiting the mangrove area daily (more than 50%) within the last 12 months. 11.8% had not made a visit in the last 12 months.

3.3. The utilisation of mangroves by locals

When the respondents were asked about the activities they practice in the site which indicates their utilisation for the ecosystem, the following responses were given. With respect to gender, wildlife watching, walking and spiritual/faith-based activities were still at the top of the list of past and present practices for both males and females. However, some activities like horse riding were exclusively practiced by males (Figure 2), while cycling, fishing, swimming and running were either not practiced by females or the practice was restricted to their childhood (Figure 3).

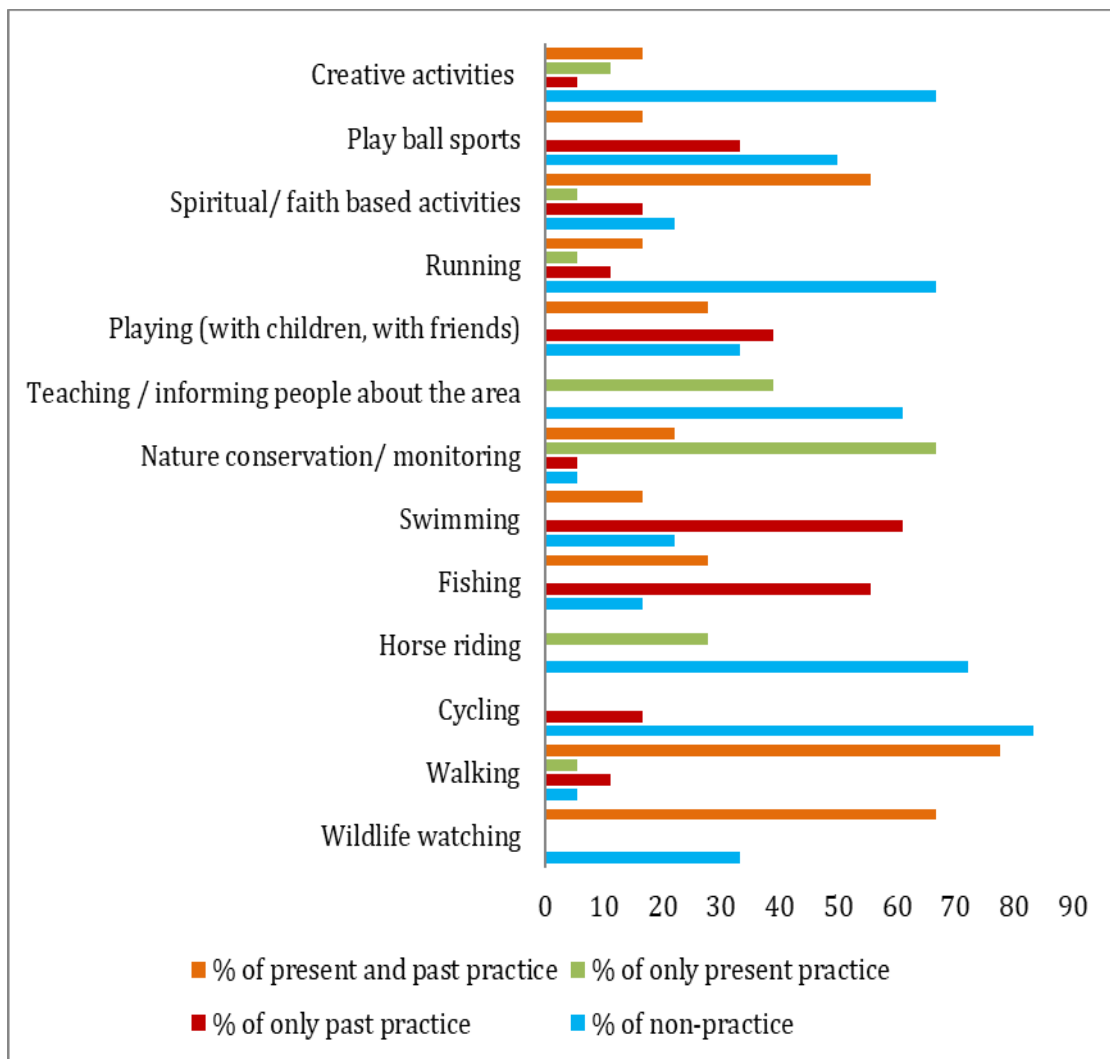


Figure 2. Activities practiced by males in the mangrove area.

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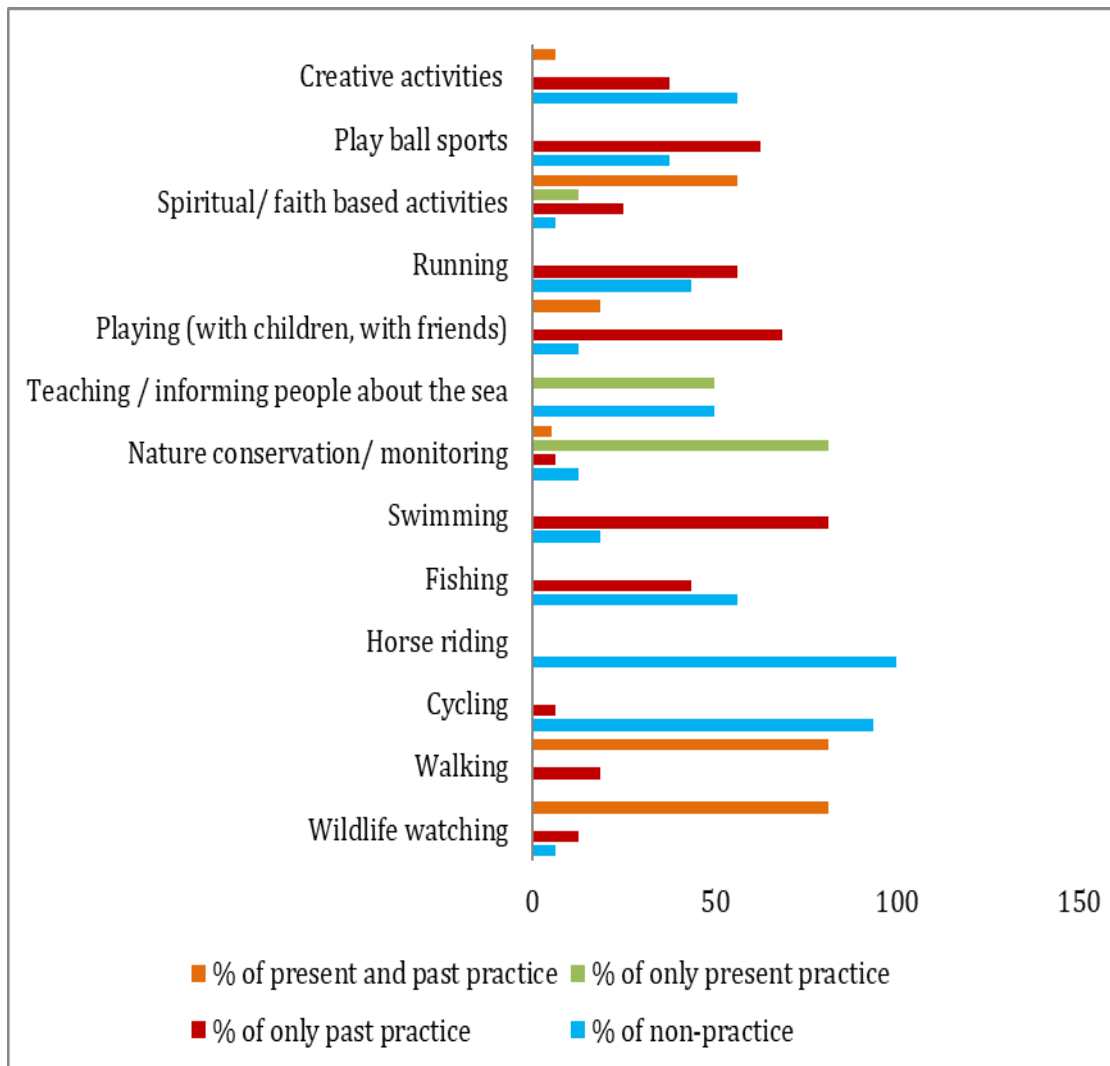


Figure 3. Activities practiced by females in the mangrove area.

Although the function of mangroves as fisheries nurseries was greatly emphasised by respondents in Qurayyat in an earlier study (Al-Afifi, 2018), fishing was not the top activity practiced by respondents in the mangrove area of this study. For example, 50% of respondents listed fishing as a past practice, and only 14.7% still fish. The main past and present fishing zones in the area are marked below (Figure 4).

Some respondents also suggested that the mangroves are not as healthy as in the past and that some types of fish have disappeared. For example, it was stated there has been a marked decline in the catch of shrimps and crabs and of conical molluscs (*Cono cono*) which have completely disappeared. One elderly man stated: “I used to fish crabs, blue crabs and a type of snail called *Cono cono*, which live on mud”. Another elderly man stated: “Mangroves, dense mangroves, we used to walk inside them, and catch shrimps and crabs, since we were little kids. The government employment opportunities at that time were very scarce, so when we do not fish in the sea, we head to estuaries for crabs. There were also shrimps in mangroves, lots of shrimps especially after wadis flow. These mangroves were existing

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here long time back even before the days of grandfathers of our grandfathers”. Another elderly man stated: “I used to fish in the estuary, with nets or with fishing rods”.

Girls also used to fish in the estuary. One young lady stated: “We used to use our scarves for fishing, so I hold the scarf from one end and my friend will hold it on the other end, then we drop it in water and then lift it after sometime, we used to get shrimps and sometimes crabs and sometimes we used to use fishing rods”.

When the activities above are merged into a single map it reveals that there are common spots where respondents practice these activities (Figure 4). For example, the main spots for wildlife watching and spiritual/faith based activities are commonly walking routes for respondents. The fishing zones are also adjacent to some spots of the other activities.



Figure 4. Merged locations of spiritual, wildlife watching, walking and fishing.

Respondents’ visits to the area were mainly driven by the need “to experience the beauty of nature” (49.1%), while the practices of family business like fishing and boat making were the less common reason to visit the area (35.3%). Also, a small percentage (5.9%) mentioned other motivations like the safe nature of the environment (Figure 5). For example, regarding boat industry, one elderly man stated:

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“Even sailors of Sur (Sur is a coastal Omani town, southern Qurayyat is known for being an ancient trade centre and still has a shipping industry), used to come to Qurayyat to get the timber supply to make ships”.

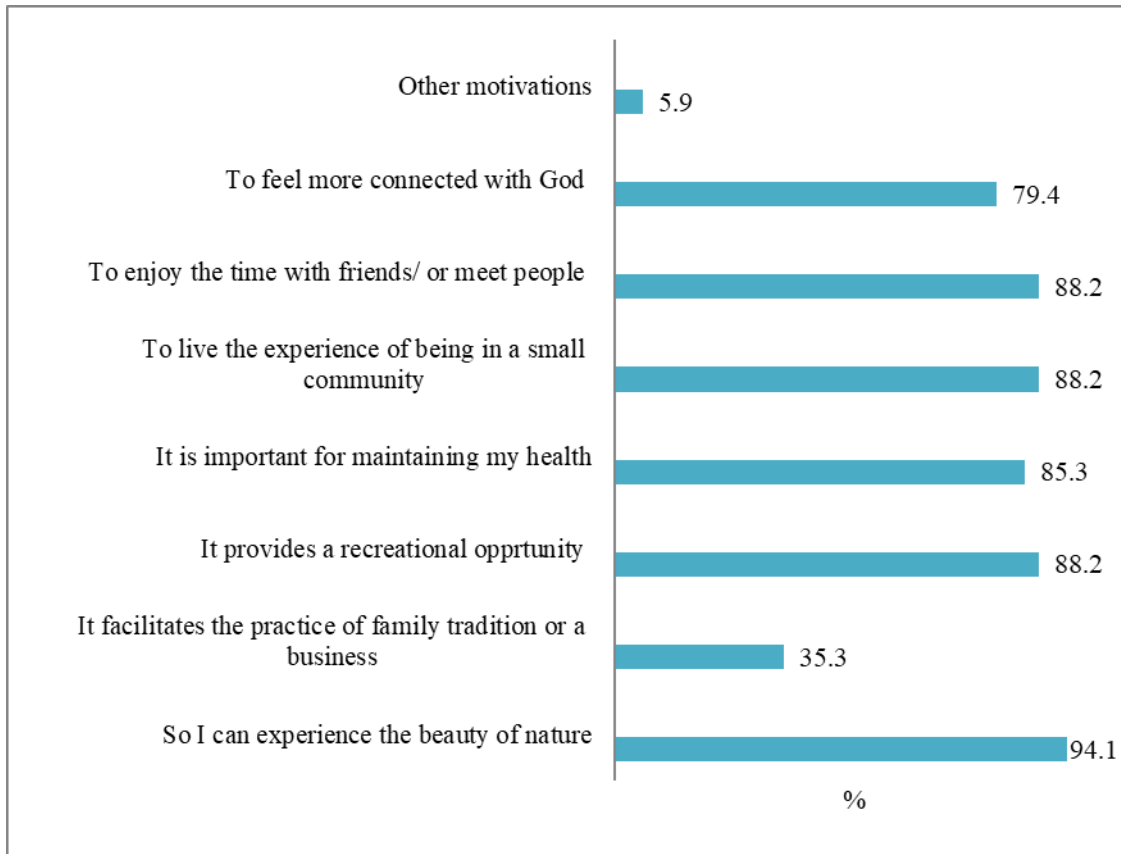


Figure 5. Motivations of respondents to visit the area.

3.4. Individual preferences for landscapes

In their preferences for different landscapes in Qurayyat (Figure 1), the majority of respondents ranked mangroves as the second preferred landscape in Qurayyat (32.4%), 29.4% ranking it as their first preferred landscape.

Respondents were also asked to mark their favourite spots. Favoured spots were linked to childhood memories of respondents (68%) and more than half of the respondents (55.9%) loved the view of the spot overlooking the mangroves, coast and the wildlife, mainly birds. More than a third of the respondents favoured spots that allowed them to conduct activities like walking (38.2%) and meditation (35.3%).

One elderly lady stated: *“I love this spot. It reminds me of my childhood. I love mangroves since I was a kid. Mangroves have lovely views. They wanted to clear mangroves (referring to authorities), but we did not like the plan. They can take anything, we don’t mind, but not mangroves. We rely on mangroves for living since we were kids”.* Also, one elderly man stated: *“Mangroves have nice spots, this one has a wide and clear field of view, you can see birds, the mountain and the whole valley meeting the coast”.* A young man also stated: *“Here, between mangroves and the mountain, you see lots of birds, you see ducks, flamingo, gulls and in winter, lots of migrating birds meet here”.*

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When these different attributes were mapped (Figure 6), it is clear that respondents chose similar spots for different attributes. For example, a favourable spot for walking on the beach is also favoured due to its linkage to childhood memories, due to its beautiful view and also due to its calmness for relaxation and meditation.



Figure 6. The localisation of different favourite spots with different attributes.

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Most of the respondents spent more than two hours on their last visit to their favourite spots in mangroves (41.2%), and 23.5% had a visit of 1-2 hours. 23.5% did not respond. One elderly man stated: *“Sometimes I spend 3 to 4 hours especially if I am chatting with friends, we sit under the shades, especially if weather is cool we could stay from morning to noon”*.

3.5. Perception of mangroves management

All respondents except one were aware that the site is managed by the Ministry of Environment and Climatic Affairs (MECA), but they all agreed on the need for better management. Many respondents (38.2%) were concerned about garbage in the area turning the mangroves into an unpleasant site. One elderly man stated: *“The Ministry of Environment does not care about mangroves, because it abandoned them and does not allow anyone to cut it. In the past, when we used to cut mangroves under the traditional system, we used to remove all the garbage and clear the dead mangroves. New more shoots emerge after cutting and new seedlings grow. The area was greener and we enjoyed it a lot. But now the Ministry of Environment is only documenting Qurayyat as a site for mangroves without any extra care”*.

If better managed in the future, 32.4% pictured it as a tourism destination with resorts, while others specifically pictured the place with parks, rowing boat facilities, restaurants and cafes. A number of respondents (23.5%) wished the area had more green cover. All these visualised images were linked with peoples' interests in mangroves and the pleasure they acquired from this ecosystem and therefore imply an instrumental value of nature. Interestingly, some respondents advocated traditional management of the site (26.5%), which reflects the relational value of nature. 35% of respondents appreciated the intrinsic value of mangroves by requesting defined protective boundaries of mangroves.

The respondents also pointed out that a better site will encourage them to regularly visit the mangroves and to spend more time there, and increase the opportunity for the area to be a top tourist destination in Qurayyat, thereby creating job opportunities for locals.

The majority of locals (76.5%) were aware of a government plan to build a dam at Wadi Mijlas, the main freshwater supply to the mangroves in Qurayyat. When asked about the impact of the dam on mangroves, the highest percentage (70.6%) of respondents believed that the dam will have a positive impact on mangroves by preventing uprooting of plants during high-energy flows of wadis. They thought seawater was more vital for more mangroves to thrive than freshwater and some of them said spring water is an additional supply of freshwater to mangroves. Some respondents (14.7%) believed that the dam will negatively impact mangroves, while the same percentage suggest that the design of the dam will define the whether or not it will negatively impact mangroves.

Those who stressed the negative impacts were aware of the dynamic role of freshwater for mangroves to thrive in their environment. They were also aware of the importance of nutrients and sediments supplied by wadis for mangroves to nourish and support the food chain in this ecosystem. Those who referred to the design of the dam, pointed out that if the main role of the dam is to re-charge groundwater aquifers, then no freshwater will be discharged to mangroves unless the precipitation is heavy, which is an unusual event in the area, and therefore mangroves will be exposed to high salinity.

An interview with one of the managers at the (MRMWR) revealed that the plan to build a dam has

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been approved. The work on the plan started in 2007 following the impact of cyclone Gonu when high precipitation caused massive floods in Qurayyat. The original plan was based only on channelling the route of the wadi and was changed to a dam construction. According to the plan, the capacity of the reservoir will be 150 million m³ and equipped with controlled discharging channels when the reserved water exceeds the capacity of the dam. Also, the manager showed no objection to the release of some water to mangroves if requested by the Ministry of Environment and Climatic Affairs. These channels are designed to discharge up to approximately 750 m³ /s. The managers also revealed that the MECA approved the Environmental Impact Assessment report of the project. The plan of the dam construction has not been followed to date due to the financial cost which has been described as huge but never exactly revealed by the manager.

4. Discussion

My results revealed an appreciation of the ecosystem by locals particularly the cultural services provided by the site, although some activities had shifted from the past to the present. The site was frequently visited by the respondents, mainly for walking, but a broad range of other activities were also engaged in. A negative shift in the health of the mangrove site was also reported by most respondents, which was perceived to be due to the management system. The section below discusses these findings in more detail and reflects on the relevance of emerging concepts and frameworks for understanding cultural ecosystem services (39).

4.1. Socio-economic characteristics of respondents

In this study, most of the interested respondents were older than 30 which might indicate that younger respondents did not have a rich experience to share about coastal systems of mangroves and therefore were less interested in participating, or that they could not meet the main criterion for survey selection, i.e. visitors to the area, or that those asked to propose new respondents (the snowballing approach) simply did not identify younger people.

4.2. Frequency of visits

The majority of respondents visited the mangroves frequently, with a high rate of daily visits. Proximity to the mangroves appears to be the main reason for frequent visits. Some of the respondents working in the capital revealed that they make mangrove visits during the weekends. The frequent visits reflect respondents' appreciation of the site, but the small sample may not be representative of the overall population of Qurayyat given that the main criterion for selection was that they visited the site. It is not known; therefore, how many people do not visit the site, that could only be revealed through a household survey of Qurayyat. However, although the sample size was small, it did reveal the substantial importance of mangroves for those people.

4.3. Identifying, understanding and mapping cultural services

The activities performed by people reflect the services flowing from the mangrove ecosystem (26, 39). The categorisation of activities to different time periods (before and after the year 2000) showed

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temporal shifts in the types of services provided by mangroves. It has been pointed out that social changes in communities have caused a remarkable shift in the dependence of humans on ecosystems for their wellbeing for the last 60 years (40). The capacity of an ecosystem to deliver its cultural benefits is mainly driven by the interests of individuals which change over time (17). It also has been suggested that the shift in the nature of practices performed by respondents is because CES tend to be place and time dependent due to changes in an individual's perceptions, norms and behaviours as their economic and social conditions change (41).

In the respondents surveyed at Qurayyat, the decline in dependence on mangroves to support fishing as a family business or a traditional profession was clearly seen. Around half of the respondents declared fishing in mangroves as a past practice, compared to only 14.7% currently. This shift reflects change in the social and economic status of communities who use mangroves, in line with the rest of the country when people generally shifted from agriculture and fisheries based income to regularly paid professions in the government or the private sectors (42).

While some activities were less practiced in recent years, walking, wildlife watching and the spiritual faith-based activities were at the top of both past and present practice for both genders. Respondents declared that walking helps them to improve their physical and mental health and relieves the stress of life.

Both wildlife watching and the spiritual faith-based activities appear to have been strongly influenced by the cultural and Islamic identity of the respondents. Wildlife and spirituality are both valued by the two sources of Islamic teachings, Quraan (the Holy Book), which is referred to here as Surat, and Sunnah (all actions, phrasing, biography or morals reported about Prophet Mohammed) here referred to as Hadith. Muslims value nature through the appreciation of its beauty and God's creation. In fact, Muslims believe that God expresses himself through non-linguistic forms of communication which is through nature (43). The Prophet Mohammed stated "*Allah being beautiful Himself, loves beauty*" (Saheeh Muslim).

Different types of ecosystems are mentioned in Quraan reflecting the appreciation of diversity of life on the planet such as in plants, birds, marine animals, insects and livestock (44). Allah has mentioned in Surat Al-Nahl "*We spread the earth, and placed stabilisers in it, and in it We grew all things in proper measure* (19). *And in it We created livelihoods for you, and for those for whom you are not the providers* (20). *There is not a thing but with Us are its stores, and We send it down only in precise measure* (21)". It also was stated in Surat Al-Nahl "*And whatsoever He created for you on earth is of diverse colours. Surely in that is a sign for people who are mindful*" (13).

The teachings of Islam also encourage humans to spiritually engage with nature and appreciate its values (43). Allah has called people to deeply think of the creation on the planet and believe in the creator himself. He has stated in Surat Al-Ana'am that "*And it is He who sends down water from the sky. With it We produce vegetation of all kinds, from which We bring greenery, from which We produce grains in clusters. And palm-trees with hanging clusters, and vineyards, and olives, and pomegranates-similar and dissimilar. Watch their fruits as they grow and ripen. Surely in this are signs for people who believe*" (99). In Sunnah, the Prophet Mohammed has asked people to praise and glorify Allah when

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seeing any symbol of nature (34). In fact, the feeling of nature spirituality is part of Muslims' beliefs in Allah as stated in Surat Yunus "Say, 'Look at what is in the heavens and the earth.' But signs and warnings are of no avail for people who do not believe" (101).

The mapping of walking, wildlife watching and spiritual faith-based activities showed that the majority of respondents performed their activities at specific locations, which resembles the findings of other studies (25), in which the cultural services of the ecosystem displayed intensity in specific spots. For some activities, gender of the respondents was a factor in the change of practice over time. For example, females never practiced horse riding and those who practiced cycling, fishing, swimming did so during their childhoods, when cultural influences on gender were less in Oman. It has also been found that the activities reflecting the services of an ecosystem may be influenced by the cultural code of the place (17). Household income may also have an influence. For example, horse riding is a recent emerging sport for affluent young men (17, 41).

The motivations to visit the mangroves reflect the services provided by the ecosystem (25). They found that the experience of the beauty of an ecosystem (which motivated more than 90% of respondents to visit mangroves in this study) is related to aesthetic ecosystem services, to live the experience of being in a small community (88.2%) related to a sense of place service. It was also found that the enjoyment of time with friends and meeting people (88.2%) relates to social-relations service and that the feeling of connection with God (79.8%) relates to a spiritual service (25).

4.4. Individual preferences for landscapes

Using photos or maps to elicit perceptions is critical for localising the landscapes or locations most appreciated by people (25). The mangroves in this study were ranked as the 2nd most preferred landscape in Qurayyat after Sahil (the coastal area located between the mangroves and the port in Qurayyat). This high ranking of mangroves appears to reflect a high appreciation by locals, living in close proximity to this landscape, although as stated earlier the respondents surveyed may not be representative of the wider population in Qurayyat.

The majority of respondents linked their appreciation of mangroves to being a valuable part of their childhood memories. Other researchers argue that, the appreciation of an ecosystem may not be interpreted as a service as such, but represents a part of a person's life, culture or experience (45). Others argue that preference is linked to the knowledge and perception of people towards the place (17). In this study, respondents had less preference for the distant landscape which they are less knowledgeable about. In some cases, respondents may never have visited some of the landscapes illustrated in the photographs and this lack of experience may have caused them to rate those landscapes lower.

For mangroves, many respondents had favourable spots, where again the links to their childhood and the beauty of the place were strongly influential. The time spent by respondents in these spots was high and indicated a very strong connection. In the past, some respondents used to play with their friends, fish, collect crabs and molluscs, harvest shrimps, collect wood and animal fodder in these favourite spots. Some of these are provisioning services which act as a channel or conduit for CES (33). In their study, provisioning services like fishing play an important role in socio-ecological relationships. For example, one respondent stated: "We used to walk inside mangrove forest since we were kids, we used

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to harvest shrimp, crabs, huge crabs and fish. We used to spend our times in mangroves when we were not fishing in the sea. All kids were gathered and cooked the shrimps and crabs they harvested and eat them on spot". One girl also said: "My grandfather used to make local nets for fishing called mahlaq and used to make them from mangrove branches. I used to help him in making these nets and fishing with his other grandchildren. He used to tell us stories when we were in mangroves as well". In addition, a young lady stated: "I walk close to mangroves with my daughter and sister every couple of weeks or every three weeks in early mornings. I had memories with my grandmother when I was a kid. I used to collect mangrove fruits with her to feed them to goats. We used to walk inside the forest and sometimes searching for honey combs".

4.5. Perception of site management

The concepts and frameworks developed for the cultural ecosystem services have been extremely useful for understanding and interpreting how people respond to the mangrove system at the site. For instance, the pictures that respondents visualised for mangroves combined all the three values (intrinsic, instrumental and relational) of nature stated in (33) who argue that both intrinsic and instrumental values of nature are pivots for conservation even in the absence of non-material rewards. They also argue that relational values motivate decision-making for management plans (33), while others find that local knowledge could significantly support policies for management (46). Without these concepts, it would have been difficult to articulate the motivations and responses of those surveyed.

While interviewed, some respondents shared their experience with the traditional management regime of mangroves, a system still in place until the early 1980s (19) when mangroves were monitored and managed by the head of the local authority at that time. My study found that mangroves used to be guarded by soldiers working for the Wali (Head of the local authority as assigned by the Sultan). Locals would be called to harvest mangroves 7-10 days per year under the soldiers' supervision. In particular, women used to meet there and harvest wood. This traditional system was part of the social regimes in the area and improved well-being by supplying people with wood for cooking. Locals also suggested that this practice, including trimming mangroves and collecting dead wood, kept mangroves clean and healthy for years. This indicated a moral responsibility towards the ecosystem (39). Relational values were also represented by the awareness of all respondents of the unique environment in which mangroves grow and their appreciation of mangroves as part of Qurayyat identity, because the mangroves have been there for hundreds of years. This corresponds with the arguments regarding the link between ecosystems and the identity of a community (47). The identity arises from the sense of the place and social, cultural and personal experience (45). Other studies find that the cultural identity and inherited knowledge acquired from an ecosystem, support better management plans for the place itself (25, 48). They also advocated the collaboration of researchers and policy makers with locals to support management and conservation plans.

5. Conclusion

This study has attempted to understand, map, and localise the CES of mangroves in Qurayyat through human perceptions and the types of activities people performed in the site. The high frequency of visits

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by respondents living close to mangroves and their ranking of its landscape as the 2nd best landscape in Qurayyat indicated a high appreciation of mangroves by the locals interviewed.

The study also revealed a change in supply and demand of CES between the past and the present. The most practiced activities, which are suggested to reflect the services, in both the past and present were wildlife watching, walking and spiritual/faith-based activities. The localisation of respondents' favourite spots was mainly linked to the intrinsic value of mangroves themselves as part of their childhood memories. It was also linked to the spirituality of these places, which was further influenced by the Islamic culture and religious background of the respondents.

It is clear that cultural ecosystem services have become relatively more important than provisioning or regulatory services to people at this site, and probably throughout Oman, as the economy has shifted from one that exploited natural resources (agriculture and fisheries) to one dominated by oil-based industries and government work. Most people now work in sectors not closely associated with the natural environment so that visits to natural areas like mangroves become increasingly important in their lives for their well-being. This makes it increasingly important that there is a focus on cultural services in future decisions about the site.

This change in supply and demand could assist to prioritise decision-making when developing management plans and policies (36). Mapping of locals' activities and favourite spots can be used as a starting point for decision-makers to decide where and what to invest in the ecosystem to ensure the delivery of the services (2). The plans of management and conservation should be human-centric and not based solely on the views of decision makers (39). The relational values in which cultural ecosystem services fit strongly should be considered in the plans (Chan et al. 2016).

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