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## Review

# Conservation action in Saudi Arabia: Challenges and opportunities

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## ABSTRACT

The conservation of biological diversity is gaining an increasing amount of global attention. In particular, in Saudi Arabia, conservation actions have become a topic of focus, with many successful initiatives being implemented. Despite these efforts, several wild animal species in Saudi Arabia still require special attention to ensure their long-term conservation and survival. If not effectively controlled, certain challenges could threaten the conservation status of local wildlife. Various conservation strategies are employed in Saudi Arabia to control these challenges, minimize their influence, and promote conservation action. Such strategies have proven to be effective; however, further efforts are still required, particularly outside protected areas. The conservation of species in critical situations primarily depends on the creation of protected areas and human intervention. Wildlife conservation is a collaborative effort; every individual has a role to play in protecting wild animals in each unique ecosystem to ensure their survival and the sustainability of their habitats for future generations.

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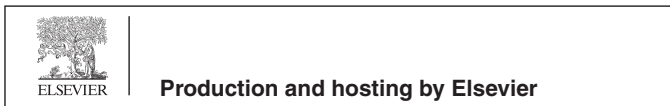
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## 1. Introduction

Biodiversity conservation is crucial to ensure the sustainability of natural resources (Rands et al., 2010). However, biodiversity is

declining for several reasons (Butchart et al., 2010), resulting in an unprecedented, increased rate of extinction (Ceballos et al., 2015). This increase is primarily due to human activities (Ceballos et al., 2015). As a result, biological diversity conservation has gained considerable global attention, with international meetings such as the Convention on Biological Diversity helping to raise awareness and propose solutions. In one such meeting, various conservation targets were proposed. One target was to increase the coverage of terrestrial and marine protected areas worldwide to ensure the adequate protection of biological diversity (UNEP, 2010). A recent report has shown that most of the targets proposed in that meeting have only been partially achieved or not achieved

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at all (SCBD, 2020). However, a noticeable expansion in the size and number of protected areas has been observed (UNEP-WCMC et al., 2018). This will significantly maximize conservation efforts and bolster investments for the protection of wild animals, particularly in critical areas (Kaky, 2020).

Saudi Arabia is a large country with an approximate area of 2,149,690 km<sup>2</sup> (Vincent, 2008). It has diverse flora, fauna, climatic conditions, and topographic characteristics (Abuzinada et al., 2004; Anashwan, 2017). The climate is mostly arid, with hot weather resulting from limited annual rainfall; however, several locations receive a higher rainfall rate (Gosling et al., 2011). Geographical characteristics are distinguished and varied across Saudi Arabia (Vincent, 2008; Anashwan, 2017). This geographical variation and the location of Saudi Arabia between Eurasia and Africa influence the diversity of its flora and fauna (Abuzinada et al., 2004; Al Midfa et al., 2011). Its location also means it is an important route for migratory birds in the region (Abuzinada et al., 2004; Czudek, 2006; Al Midfa et al., 2011; Alyousefi, 2020). There is significant biological diversity in Saudi Arabia; 79 terrestrial mammals and 432 birds have been recorded (Abuzinada et al., 2004). Regarding herpetofauna, 128 species and subspecies of terrestrial, marine, and freshwater animals have been described in Saudi Arabia (Aloufi et al., 2019).

Wildlife conservation and the sustainability of natural habitats are important topics in Saudi Arabia due to the typically limited availability of resources in arid habitats. Maintaining a healthy and biologically diverse ecosystem is crucial in such an environment; the destruction of natural resources can have catastrophic effects. For instance, the destruction of a juniper forest can adversely affect the Asir magpie (*Pica asirensis*) population in Saudi Arabia (BirdLife International, 2017). By joining the Convention on Biological Diversity, Saudi Arabia ensures the protection of its biological diversity (Abuzinada et al., 2004). Since joining the Convention, Saudi Arabia has shown remarkable commitment and considerable progress in conserving its biological diversity and overcoming conservation challenges. Local agencies and authorities have engaged in substantial efforts to conserve vulnerable species and restore or maintain populations of species, such as the Arabian gazelle (*Gazella arabica*), Arabian oryx (*Oryx leucoryx*), and Arabian sand gazelle (*Gazella marica*) (Barichievy et al., 2018). Overall, a significant amount of research has been undertaken to understand the ecology and biology of local species to ensure appropriate conservation measures are taken (Wilms et al., 2011; Alatawi et al., 2020; AlRashidi et al., 2021).

Compared to other countries, conservation action in Saudi Arabia is relatively new (Barichievy et al., 2018). Due to the harsh desert conditions and other challenges, conservation efforts can be difficult (Barichievy et al., 2018). With Saudi Arabia becoming significantly more socially developed and urbanized, wild animals and other biodiversity components have been subjected to overexploitation. Recently, conservation in Saudi Arabia has gained increasing attention, with a new conservation plan aiming to cover several vast ecological and biological regions (Al-Saadon and Saudi Wildlife Authority, 2012). However, several challenges may impact effective conservation action. Therefore, it is vital for Saudi Arabia to consider all possible scenarios to control these challenges and create effective solutions. Here, I briefly review some of these challenges along with strategies and efforts to further promote conservation and discuss how they affect the conservation of local wild animals.

## 2. Poaching and hunting

Poaching is considered one of the main threats to the existence of wild animals. Excessive illegal hunting is responsible for the

extinction of multiple species and significantly reduces population numbers to critically low points (Giangaspero and Al Ghafri, 2014; AlKharusi et al., 2017). For instance, poaching is a major driver of population decline among African savanna elephants (*Loxodonta africana*; Gobush et al., 2021) and white rhinos (*Ceratotherium simum*; Emslie, 2020). Saudi Arabia does not escape the negative impacts of poaching on conservation efforts. Several wild native species face significant population decline due to poaching and overhunting activities, ultimately affecting their conservation status. For instance, the Arabian oryx was previously pronounced extinct in the wild, primarily due to overhunting (Henderson, 1974). Despite no longer being classified as extinct in the wild, poaching remains a major challenge for the survival of Arabian oryx (IUCN SSC Antelope Specialist Group, 2017a). Notably, several native ungulate species in Saudi Arabia remain under pressure (Barichievy et al., 2018). For instance, the populations of Nubian ibex (*Capra nubiana*) and Arabian sand gazelle have dramatically declined in their native habitats, primarily due to overhunting (IUCN SSC Antelope Specialist Group, 2017b; Ross et al., 2020). Poaching is considered one of the main drivers of population decline and poses a serious threat to the survival of other wild animals in Saudi Arabia, such as particular carnivores (Mallon and Budd, 2011). The practice of hunting and killing Arabian leopards (*Panthera pardus nimr*) within Saudi Arabia threatens their existence in the wild. As a result, these leopards have a critically endangered conservation status (Al-Johany, 2007; Islam et al., 2018). Additionally, the population of striped hyaena (*Hyaena hyaena*) is sharply declining in its known range, which includes Saudi Arabia, due to hunting (Mallon and Budd, 2011).

The avian community is also affected by overhunting practices, which negatively impact their conservation status. There are many cases in which birds are illegally hunted in Saudi Arabia and surrounding regions (Brochet et al., 2019), which may lead to a future conservation issue if not properly controlled. For instance, the houbara bustard (*Chlamydotis macqueenii*) is a game species in Saudi Arabia that has been subjected to extensive hunting. As a result, this species has been extirpated from most of its natural range (Alwelaie, 1994; Seddon et al., 1995). Another clear demonstration of the catastrophic effect of excessive poaching on populations (and hence their conservation status) is the Egyptian spiny-tailed lizard (*Uromastix aegyptia*). The overexploitation of this species primarily occurs for food and trade, which has resulted in its conservation classification as a vulnerable species (Wilms et al., 2012).

Overhunting might influence the diet of local wildlife. The rarity of some prey species—such as the Nubian ibex and gazelles in Saudi Arabia (Al-Johany, 2007; Islam et al., 2018)—due to overhunting has forced the Arabian leopard to begin attacking livestock in search of an alternative food source (Islam et al., 2018). Such behavior likely indicates that this species may change its foraging habits and roam further to meet its diet requirements, which may increase human-wildlife conflict. Additionally, Mallon and Budd (2011) have listed the loss of prey species as a threat to certain carnivores in the Arabian Peninsula region. Hunting has greatly increased over the last few years, in part due to the ease of access to previously isolated areas (e.g., via 4x4 vehicles) and the development of new hunting techniques (Barichievy et al., 2018). As a result, a species may change its geographical distribution and habitat requirements to cope with this anthropogenic pressure (Alatawi et al., 2020).

The poaching and hunting of wild animals primarily occur due to the high demand for their skin, meat, and bones for trade, sports, and their medicinal value. For instance, the flesh of the Indian crested porcupine (*Hystrix indica*) is used as a traditional medicine in Saudi Arabia (Aloufi and Eid, 2016). In some situations, hunting occurs to protect livestock from predation (Fig. 1a, b). Poaching and its negative effects on conservation actions and species survival

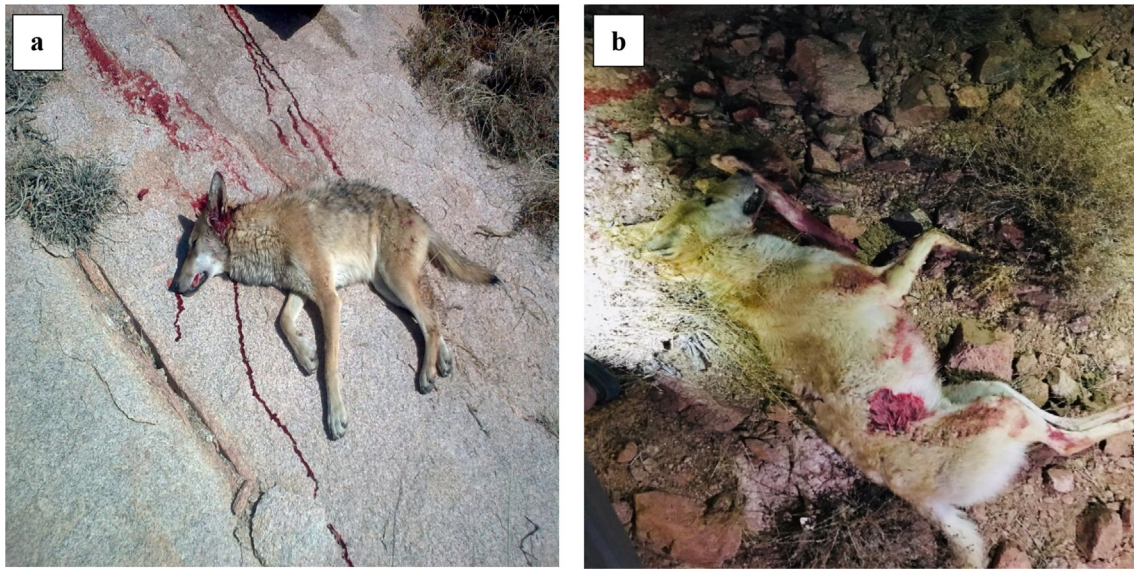


Fig. 1. Wolves were hunted in Tabuk Province based on the locally held belief that they were responsible for attacks on livestock.

cannot be ignored, particularly when hunting is part of traditional cultural practices related to food, income, and sports in a local community. Conservation investments are easily jeopardized, and illegal overhunting can quickly negate prior conservation efforts (Barichiev et al., 2018).

### 3. Habitat loss and overgrazing

Wild animals are threatened by the fragmentation and loss of their natural habitats (Mallon and Budd, 2011), which subsequently impacts habitat suitability and the geographical distribution of species (Alatawi et al., 2020; Kaky, 2020). A species will normally inhabit a particular niche depending on its habitat type, foraging needs, and interactions with the surrounding environment (Soberón and Peterson, 2005). Losing their natural habitat can force a species to adjust their habitat requirements and, consequently, compete with other species for the same food sources. Therefore, ensuring the sustainability of natural habitats and resources should be a conservation priority, particularly outside of protected areas. However, this can be challenging when dealing with vulnerable habitats and critical species as the desert ecosystem already has limited natural resources that are in high demand.

Saudi Arabia is currently undergoing major construction and development projects at all levels (e.g., infrastructure, industry, urbanization). These expansions should be well-planned to ensure they are free from human-wildlife conflict and sustain natural habitats as much as possible. In Saudi Arabia, certain incidents have been reported to threaten local wildlife via the loss of their natural habitats, thereby affecting their conservation status. Cox et al. (2012) indicated that habitat loss is one of the most significant threats to terrestrial reptiles in the Arabian Peninsula. Aloufi et al. (2019) also noted that the loss of natural habitat threatens reptilian communities in Saudi Arabia, as an increase in the proportion of cultivated areas and the desertification process could lead to a reduction of the suitable natural habitats for some reptiles. Another example of the consequences of habitat loss and degradation in favor of other activities (e.g., the construction of road networks and urbanization) has been seen in wild carnivores. It is believed that the establishment of road networks in isolated mountains areas may impact the Arabian leopard by increasing the accessibility for poaching, herding, and other human activities (Islam et al., 2018). In the Arabian Peninsula region, other carnivore

species are also adversely impacted by the urbanization process and development expansion (Mallon and Budd, 2011). Such habitat degradation should be avoided or, if unavoidable, appropriately planned, particularly in sites that are identified as biodiversity hotspots (Mallon, 2011). Some of these identified hotspots in Saudi Arabia are known to be the home ranges of endangered or vulnerable species, such as the Arabian leopard and the Asir magpie. The loss of natural habitats due to logging and other related activities is known to be a threat to the Asir magpie population (BirdLife International, 2017). The increase in tourism activities in these areas is also a threat to the Asir magpie (BirdLife International, 2017). It is estimated that there are approximately 135 or fewer pairs of this species left in the wild (BirdLife International, 2017). These areas are ecologically and biologically important because they contain species relatively new to science (e.g., *Hemidactylus asirensis*; Smid et al., 2017).

Overgrazing can also lead to the loss of natural habitats (Fig. 2), especially at the vegetation cover level. This can result in poor habitat quality (Al-Rowaily et al., 2015) that may affect species dependent on it for foraging. This is one of the ongoing conservation challenges in Saudi Arabia for wild species such as the Arabian sand gazelle, Arabian oryx, and Nubian ibex (AlKharusi et al., 2017; IUCN SSC Antelope Specialist Group, 2017a, 2017b; Ross et al., 2020). Overgrazing has also been cited as a conservation threat to some carnivores as it degrades the natural habitats of their prey species, which subsequently impacts the diets of carnivores (Mallon and Budd, 2011). Overgrazing by livestock can be a source of competition (Ross et al., 2020) and can reduce habitat quality, thereby limiting the possible release sites for wild animals (IUCN SSC Antelope Specialist Group, 2017a). Consequently, vulnerable wild animals may require human intervention to ensure their species survival (AlKharusi et al., 2017). For instance, Abuzinada (2003) indicated that the ibex population in the ibex reserve benefited from the exclusion of camels from the core area. Aside from the influence of overgrazing on vegetation, it can also impact soil properties (Al-Rowaily et al., 2015).

### 4. Public awareness

Public attitude toward and awareness of the surrounding environments cannot be overlooked as a major challenging factor facing effective conservation action. Humans play a significant role

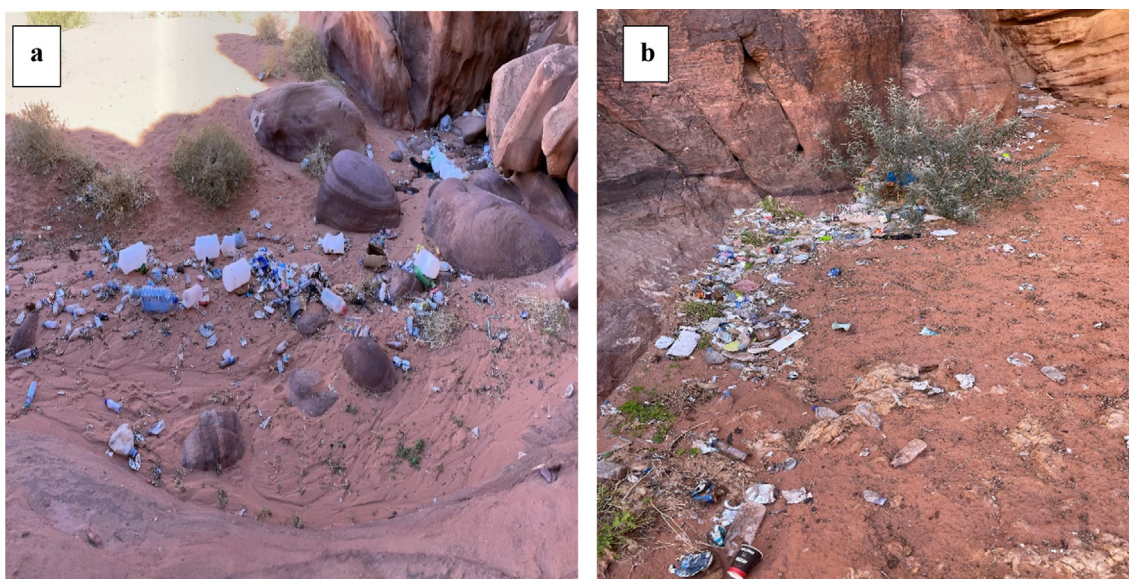




**Fig. 2.** Livestock grazing in the mountainous habitats of the Tabuk Province (Photo by Abdulaziz Alatawi).

in their local ecosystems (Kaky and Gilbert, 2019; Alatawi et al., 2020). Thus, an adequate level of conservation action cannot be achieved without the involvement of local communities (Koh and Sodhi, 2010; Al Omari, 2011; Kideghesho et al., 2013). Therefore, understanding local cultures and traditions will aid in maximizing conservation efforts. The need for increased public awareness and involvement in Saudi Arabia has gained considerable focus. It has been a topic of discussion among local scientists (Al-Johany, 2007; Islam et al., 2018) and has been mentioned in national reports on biological diversity (Abuzinada et al., 2004; Fifth National Report, 2014). Generally, convincing people to change their behavior and attitudes toward the environment and wildlife

is a challenging task, especially if their activities supply a source of income, protection, or food. Public awareness can directly and significantly threaten the existence of wild animals. For instance, there have been many cases in which the Arabian leopard species has been poisoned or hunted in Saudi Arabia by local people (Al-Johany, 2007; Islam et al., 2018). From a conservation perspective, this is concerning, as this species faces a major survival threat in the wild (Al-Johany, 2007). However, it should be noted that some poisoning cases did not intentionally target Arabian leopards (Al-Johany, 2007; Islam et al., 2018). Common hunting behaviors noted among local hunters include hanging or displaying hunted species in trees and hunting a large number of target species. Several



**Fig. 3.** Leaving unwanted refuse can adversely impact wildlife and the environment (Photos by Abdulaziz Alatawi).



published articles have shown images of carnivore carcasses being displayed hanging in trees (Cunningham and Wronski, 2010; Islam et al., 2018), while other images show a large variety of hunted species, such as the Egyptian spiny-tailed lizard (Aloufi et al., 2019). Notably, some of these species have vulnerable conservation status. One possible explanation for this behavior is hunters showing off their success, which is a common practice among hunters in the Arabian region.

In some cases, the scenery of more accessible wild areas can be unpleasant (Fig. 3a, b). Leaving or dumping unwanted refuse has an adverse impact on wildlife and the environment. Some species might consume the refuse, which could have negative health impacts or even be fatal. This applies to both wild and domestic species. The public, which is not specialized in conservation, can benefit from orientations, workshops, fliers, and visits from experts to increase their knowledge about the importance of the surrounding wildlife, environments, ecosystems, and biodiversity—particularly those who live in areas of possible human-wildlife conflict (i.e., near the habitats of endangered species or hotspots).

In Saudi Arabia, the National Center for Wildlife, as well as related authorities and institutions, have done substantial work and dedicated considerable effort to control several conservation challenges, reduce their negative impact on wildlife, and raise awareness in the local communities. Various measurements and actions have been taken to effectively increase and promote the conservation of wildlife and the sustainability of natural habitats. Below are some of the efforts used to enhance conservation in Saudi Arabia.

## 5. Protected areas

Establishing protected areas has proven ecological benefits for protecting wildlife. This is especially true for threatened taxa (Abuzinada, 2003; Barichievy et al., 2018), as species can securely and freely forage in a protected and monitored environment. In 1986, The National Commission for Wildlife Conservation and Development was established. The commission primarily aims to conserve biological diversity and restore threatened taxa through establishing protected areas, which are chosen based on set criteria (Abuzinada, 2003; Abuzinada et al., 2004). Currently, Saudi Arabia has a substantial network of protected areas, covering different regions (National Center for Wildlife, 2021) and encompassing nearly 4% of its total area (Abuzinada et al., 2004; Al-Saadon and Saudi Wildlife Authority, 2012). Many recognized and successful conservation cases have resulted from conserving and restoring endangered species, saving them from extinction (Abuzinada, 2003; AlKharusi et al., 2017; Barichievy et al., 2018). The survival of certain wild animals, such as ungulate species, greatly depends on protected areas (Barichievy et al., 2018). As previously mentioned, the Arabian oryx was declared extinct in the wild (Henderson, 1974). However, this species has now been successfully restored, managed, and reintroduced into different protected areas in Saudi Arabia (Abuzinada et al., 2004; AlKharusi et al., 2017; Barichievy et al., 2018). The number of Arabian oryx has increased, which has resulted in its conservation status being lowered to vulnerable after being classed as endangered for many years (IUCN SSC Antelope Specialist Group, 2017a). Islam et al. (2014) reported on the reintroduction of the Arabian gazelle into a fenced protected area known as Mahazat as-Sayd, where the breeding of new individuals was observed. The establishment of protected areas where livestock grazing is controlled or banned also benefits wild animals (Abuzinada, 2003).

Previous success in conserving and restoring threatened wild species has been primarily achieved via captive breeding and reintroduction programs (Abuzinada et al., 2004). For instance, the

population of the houbara bustard has increased considerably due to its specific captivity breeding and reintroduction program (Hemon et al., 2000; Abuzinada, 2003). Similarly, it was recently reported that two Arabian leopard cubs were born in captivity at the Prince Saud Al Faisal Wildlife Research Centre in Taif (Royal Commission for AlUla, 2021). The Royal Commission for AlUla has proposed a plan to increase the breeding program of Arabian leopards by establishing a new breeding center in AlUla County (Royal Commission for AlUla, 2021).

A new strategy has been adopted in Saudi Arabia, covering various bioregions across the country and encompassing up to 10% of its total area (Al-Saadon and Saudi Wildlife Authority, 2012). Furthermore, royal protected areas (i.e., royal reserves) have been created across Saudi Arabia, such as the King Salman bin Abdulaziz reserve, which currently consists of three large, protected areas (Al-Tokhais and Thapa, 2019). Additionally, a new royal protected area, the Prince Mohammed bin Salman reserve, has been announced, with a total area of 16,000 km<sup>2</sup> (Al-Tokhais and Thapa, 2019). The expansion of natural reserves demonstrate the commitment and determination of Saudi Arabian national authorities to promote conservation efforts.

## 6. Law enforcement and legislation

Due to their belief in the importance of wildlife conservation and biodiversity, the relevant authorities in Saudi Arabia have created various legislation and regulations to assist in their efforts (Abuzinada et al., 2004). The overarching goal is to conserve and sustain biological diversity and reduce or control any activities or challenges that may adversely affect local wild species. Protected areas typically have administrative staff, rangers, patrol officers, and occasionally, aerial surveillance technology to monitor the species and ensure wildlife regulations are upheld (Abuzinada, 2003; National Center for Wildlife, 2021). Furthermore, a new force called the Special Forces for Environmental Security (SFES) has been established to monitor the application, guidelines, and regulations regarding the protection of biodiversity and wildlife. The formal social media of SFES, namely its Twitter account, demonstrates the significant efforts the force has made to promote conservation action by controlling illegal activities. For instance, violations such as illegal hunting, logging, grazing in banned areas, and the sale of wild animals were all reported and prosecuted by SFES members (source; formal social media of SFES on Twitter, accessed at 17–11-2021). The SFES is still a relatively new force and has just begun its patrol activities in some provinces in Saudi Arabia.

New executive regulations, including a maximum fine, have been announced regarding the hunting and killing of a list of wild animals, which will hopefully aid in controlling excessive poaching activities (Ministry of Environment, Water and Agriculture, 2021). The list covers different species with various conservation statuses that are primarily threatened by human-related activities. For instance, the hunting of Arabian oryx and striped hyaena can now incur fines of 90,000 and 80,000 SR, respectively. Hunting the endangered endemic Asir magpie is punishable by a 100,000 SR fine, while hunting any species belonging to the genus *Uromastyx* is punishable by a 3,000 SR fine (Ministry of Environment, Water and Agriculture, 2021). Hunting of the Indian crested porcupine is punishable by a 70,000 SR fine (Ministry of Environment, Water and Agriculture, 2021). The fines aim to deter negative activities that present a challenge to conservation actions by directly or indirectly threatening the survival of species in the wild. Additional legislation has also been promulgated to ensure an adequate level of biological diversity conservation in Saudi Arabia, such as The Wildlife Protected Areas Act and The Wild Animals

and Birds Hunting Act (Abuzinada et al., 2004). Notably, in addition to a fine, violating some of these acts can lead to detention (Abuzinada et al., 2004).

## 7. Education and research

Promoting education and awareness in local communities regarding the importance of conserving wildlife should significantly help overcome conservation challenges (Al-Johany, 2007; Kideghesho et al., 2013; Islam et al., 2018). In this manner, tangible conservation can be achieved (Koh and Sodhi, 2010). Local communities should value the biological and ecological benefits of conservation, understand its importance (Barichiev et al., 2018), and recognize the potential negative consequences of losing species and other components of biodiversity (Al-Johany, 2007). Education on the environment, biodiversity, and wildlife conservation is being provided in schools and universities in Saudi Arabia. Furthermore, ecology courses containing information on various topics related to ecology, biodiversity, the environment, and conservation are being taught to high school students. Another significant effort is known as Environment Week, an annual event organized by the Ministry of Environment, Water and Agriculture that seeks to raise awareness among the community on the importance of biodiversity, the environment, and conservation (Ministry of Environment, Water and Agriculture, 2021). For instance, the Tabuk branch of the Ministry of Environment, Water and Agriculture organized a scientific presentation on conserving the ecological system and halting biodiversity loss (Dr. Aishah Alatawi, personal communication). Local universities are also involved in promoting conservation practices and awareness. For instance, the University of Tabuk organized an international conference entitled “The Environment and Biodiversity of the Red Sea,” where experts and invited speakers discussed topics related to biodiversity, threats, conservation, and sustainability in the region. Moreover, special centers, such as the Prince Saud Al Faisal Wildlife Research Centre, have visited universities, schools, and other institutions to raise awareness about the Arabian leopard (Islam et al., 2018).

Courses and research opportunities on biodiversity and wildlife conservation are being offered to undergraduate and postgraduate students at local universities. The University of Tabuk offers a Master of Science degree majoring in biodiversity and a Higher Diploma in Environmental Sciences, with a focus on either environmental sustainability or vegetation cover. Similar trends have been observed at other local universities. Currently, conservation research covers various aspects across Saudi Arabia, such as the conservation of wild species with unique conservation situations, such as the Arabian leopard (Al-Johany, 2007; Islam et al., 2018), Egyptian spiny-tailed lizard (Wilms et al., 2011; AlRashidi et al., 2021), and Asir magpie (Boland and Burwell, 2020). Notably, the private sector is also involved in supporting conservation efforts and research innovation. For instance, Aramco, an oil company, established the Shaybah Wildlife Sanctuary, which contains 120 Arabian sand gazelle, 130 Arabian oryx, and 4 red-necked ostriches (Aramco, 2021). Additionally, the Royal Commission for AIUa announced The Global Fund for the Arabian Leopard, which focuses on the conservation of this species (Royal Commission for AIUa, 2021).

## 8. Discussion

Saudi Arabia is a unique country; new records of population occurrences (e.g., *Pseudotrapelus aqabensis*; Aloufi and Amr, 2015) and species new to science are still being discovered (Smid et al., 2017). This demonstrates the importance of

conducting further systematic applied research in Saudi Arabia and formulating and adopting new techniques to satisfy both conservation authorities and local communities or stakeholders to minimize and control the impact of conservation challenges and avoid the loss of natural habitats and resources. Comprehensive conservation action faces additional challenges not discussed in this review, including taxonomy, climate change, introduced invasive species, environmental pollution, and continuous human population growth. Investigation of these challenges is ongoing (Wilms et al., 2011; Williams et al., 2012; Al-Obaid et al., 2017; Smid et al., 2017; Alatawi et al., 2020). The window of opportunity for this type of research is open. This research will eventually help orient future conservation actions and mitigate negative impacts on species. Future studies and monitoring outside of protected areas and hotspot habitats should be considered to ensure long-term conservation, particularly for endangered species living in harsh environments.

No one can reasonably suggest that urbanization and related developments should not occur; however, a balance between human demands and wildlife must be considered. Therefore, it is important to develop reliable conservation solutions that are based on comprehensive research. The National Center for Wildlife and other relevant authorities have undertaken significant efforts, resulting in numerous successful initiatives for conserving wildlife through various conservation measures and techniques, such as captive breeding, reintroduction programs, and awareness programs. The proposed expansion of protected areas demonstrates the strong desire of local wildlife authorities to conserve biological diversity.

Effective conservation actions face numerous challenges, and there are significant efforts to halt them by certain groups. Conservation of wildlife is a collaborative effort; all individuals are indirectly or directly involved in helping to support the protection of Saudi Arabia's wildlife and their habitats in this unique ecosystem to ensure their survival for future generations.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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