Scientific Report

Selecting a flagship species for Arjan International Wetland in Iran

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Abstract

Selecting a flagship species is an effective strategy to promote regional conservation efforts. Arjan International Wetland in southern Iran harbors a high diversity of waterbirds, which face multiple threats imposed by humans. This study aims to select a flagship species from three candidate species: Common Crane (*Grus grus*), Eurasian Coot (*Fulica atra*), and Ruddy Shelduck (*Tadorna ferruginea*) as part of the efforts to promote future conservation of the Wetland. We based our selection on ten criteria emphasizing the physical features of the animals as well as local knowledge, attitudes, and cultural associations. We used a combination of a literature review and a questionnaire survey to obtain scores and compare them among the candidate species. Ruddy Shelduck emerged with the highest score evaluated. It was distinguished from the other two species by strong local recognition, positive associations with, and cultural relevance to the local communities. The election results demonstrated the potential of Ruddy Shelduck in local conservation efforts. This is the first case in which the Ruddy Shelduck was selected as a flagship species in Iran and globally. The selection process, driven by local insights, is also expected to enhance future conservation actions significantly. Furthermore, this approach may serve as a model for other regions considering similar conservation strategies.
Keywords: community-based conservation, local attitudes, ruddy shelduck, conservation strategies

Introduction

A flagship species is a plant or animal treated as a symbol for wildlife conservation (Heywood & Watson, 1995). Some common criteria for assessing flagship-species qualification include conservation status, endemism, connection to local cultures, and ecological importance. (Home et al., 2009; Ernoul et al., 2021). The concept of flagship species became popular in the 1980s (Frazier, 2005), with most species considered at that time being rarified mammals (Frazier, 2005), such as elephants (Barua et al., 2010), rhinos (Western, 1987; Berger, 1997), and lion tamarins (Dietz et al., 1994). While using large mammals as flagship species can effectively draw public attention, choosing less well-known species can also be advantageous in preserving threatened local

ecosystems while including community participation in conservation initiatives. (Schlegel et al., 2015). There are also cases in which birds (Veríssimo et al., 2014), reptiles (Siler et al., 2014), and insects (Preston et al., 2021) are treated as flagship species as well. In Iran, flagship species selection is a conservation strategy for protecting the species and its habitat. For instance, the selection of the leopard (Panthera pardus tulliana) in Bamu National Park led to conserving its habitat and the prey species (Ghoddousi et al., 2010). Using birds or other smaller animals as flagship species in Iran is unprecedented.

Selecting flagship species for conservation is a major tool for raising public awareness (Home et al., 2009; Smith & Sutton, 2008). It allows conservationists to gather financial support (Walpole & Leader-Williams, 2002). The flagship species may attract tourism into protected areas and increase local income (Veríssimo et al., 2009). Flagship species can also raise people's empathy for wildlife and encourage participation in conservation initiatives (Sergio et al., 2008). In some cases, the selection of flagship species leads to population recovery and habitat restoration. The iconic selection of the white-headed eagle (*Haliaeetus leucocephalus*) in the U.S., once critically endangered and even considered extinct., saved the species from the edge of extinction (Cruz et al., 2019). The selection of the giant panda (Ailuropoda melanoleuca) in China helped to restore its wild populations (Yang et al., 2018), and the manatees (genus *Trichechus*), whose recognition as flagship species played an important role in conserving the endangered mangrove forests of coastal Brazil (Normande et al., 2023).

Birds are frequently used as icons for educational programs and fundraising campaigns (Wang et al., 2023). Over the past decade, an increasing number of bird species have been selected as flagship species (Kitowski et al., 2017), which has led to the development of eco-tourism and local economic development (Schwoerer & Dawson, 2022; Maldonado et al., 2018). Although conservation status is often critical to a species' acceptance as a flagship species, charisma, beauty, and the viewpoint of local people also play an essential role in choosing a species as a flagship species (Veríssimo et al., 2009). When no species in a local animal community has been identified as endangered, selection is still possible without relying heavily on general conservation statuses. Instead, the selection may consider the local population and status and the need to conserve them. An example can be found in the black stork (*Ciconia nigra*) selected for riverine habitat reservation (BirdLife South Africa, 2018).

Building on the importance of birds as flagship species, waterbirds play a vital role in wetland ecosystems (Green & Elmberg, 2014). They are crucial in promoting biodiversity by feeding on aquatic plants and animals. They also function in pest control to protect local environments (Czech & Parsons, 2002). Waterbirds also serve as bioindicators, as their population size and distribution

can provide insights into the health of wetland environments (Kushlan, 1993), such as via predator-prey interactions that transfer nutrients through the food chain (Kleyheeg et al., 2017). Waterbird presence and population are also often treated as indicators of wetland health (Péron et al., 2013). Furthermore, waterbirds are often part of the cultural values held by the people living close to them (Green & Elmberg, 2014). As such, in this study, we focused on waterbird species, given their crucial role in the wetland environment and cultural significance.

This study aims to select a flagship for Arjan International Wetland (AIW) in southwestern Iran. The wetland harbors rich fauna and flora diversities (Dolatkhahi et al., 2012; Scott, 1992), identified by BirdLife International as an Important Bird Area (IBA) in 1994 due to the large avian populations found in this area (BirdLife International, 2024). However, AIW is currently threatened by various human activities (Scott, 1992; Monavari & Momen Bellah Fard, 2010), which contribute to major biodiversity loss, and conservation has also often proved to be complicated. Since the threats are often multiple and complex, participation from the local communities is becoming increasingly essential for conservation strategies to be more effective (Borrini-Feyerabend, 1997; Berkes, 2007; Monavari & Momen Bellah Fard, 2010).

This study aims to select a flagship species for AIW to enhance conservation efforts and mitigate habitat destruction through the active involvement of the local communities. The selection of flagship species can lead to increased conservation awareness (Wang et al., 2023). Understanding the species' appearance, habitat use, and behaviors can enhance local monitoring efforts. Influenced by cultural significance and personal experiences, positive attitudes can foster a sense of ownership and responsibility, encouraging active community involvement in conservation. (Bowen-Jones & Entwistle, 2002). In order to select a flagship species that encourages such participation, we used a method that concentrates on the attitudes and knowledge of local communities. We focus on waterbirds due to their critical role in wetland ecosystems and cultural significance at our study site.

Material and methods

Study area and candidate species

The study was conducted from April 2022 to May 2022 in Arjan International Wetland (AIW) (29°37'N, 51°59'E, elevation = 2,000m) and the surrounding areas (Fig. 1). AIW contains a freshwater lake located ~60 km southwest of Shiraz City, Fars Province in southern Iran, adjacent to Dasht-e Arjan Village (29° 39' 39" N, 51° 59' 7" E) in Persian, meaning steppe with Arjan trees (*Prunus scoparia*), family Rosaceae. The population near the study area was 2,340 (in 693 families) in 2016 (Statistical Centre of Iran, 2016). As a seasonal wetland, AIW reaches a maximum area of approximately 2,200 ha during the wet winter each year, which may shrink to several hundred hectares in some years. The study area (29°34 - 29°40 N, 52°00 - 51°57 E) is approximately 12,800 ha, with elevation ranging from 1,989 to 2,800 m. This area was selected to comprehensively assess

the core wetland and its peripheral ecosystems. The annual average temperature of this area is 13.9°C (range = 5 – 39°C), and annual precipitation is 671.4 mm on average. During the winter months (November to March), monthly precipitation is 56 mm, which drops to 8 mm during the summer months (June to August) (Sadeghi, 2018; World et al., 2024). The maximum watershed area is 1,663 ha (or 13% of the total study area), with water depth in most areas being less than 1 m. Besides rainfall, seasonal rivers, surface rainfall, numerous temporary springs, and two permanent springs are the primary water sources for the wetland (Sadeghi, 2018). Maximum water volume reaches 0.043 km³ in late summer and winter, which may reduce to 0 km³ in some drought years (Sadeghi, 2018).

In total, 393 plants have been recorded in this area. Whereas forest coverage is relatively sparse around the wetland, some major plant species include oaks, narcissuses, and hawthorns (Dolatkhahi et al., 2012). In total, 71 waterbird species have been documented, with the total population of the birds exceeding 77,000 in some peak years (Nasiri & Tabee, 2013). However, both the diversity and population of the birds at AWT have greatly decreased over the years (Nasiri & Tabee, 2013; Roomen, 2009; Hosseini Tayefeh et al., 2021), mainly due to poaching, draining of the wetland through well-drilling (for obtaining irrigation water for agriculture), and the conversion of dried wetland areas into agricultural land, building of power lines (which caused mortalities in the night-flying birds), and building of roads causing habitat loss (Scott, 1992; Monavari & Momen Bellah Fard, 2010).

Over 263 migratory and non-migratory avian species have been recorded from the study area (BirdLife International, 2024). The wetland also provides an important wintering area for waterbird species, such as the common crane (*Grus grus*), gray-legged goose (*Anser anser*), and ruddy shelduck (*Tadorna ferruginea*). The threatened imperial eagle (*Aquila heliaca*) and greater-spotted eagle (*Aquila clanga*) use the marsh as foraging ground. In addition, 44 mammals are known to have existed in AIW, the most noticeable being the Persian lion (*Panthera leo persica*). However, the lions have no longer been observed since the 1940s, and they are now declared locally extinct (Scott, 1992). Efforts were made in the 1970s to reintroduce the lions and treat them as a regional symbol. This, however, was unsuccessful, mainly due to habitat destruction and fragmentation. Also, linkage to the locals seemed missing, as the people had not seen lions for years. Also, the government made the re-introduction decision without involving any local participation.

Arjan International Wetland (AIW) has been designated as an international wetland under the Ramsar Convention (coded IR37) since 1975 (Scott, 1992; Ramsar Sites Information Service, 1997). The Ramsar Convention is an international treaty focusing on sustainable use of wetlands to maintain ecological functioning. According to the IUCN classification of wetlands (Finlayson &

van der Valk, 1995), AIW contains both the lake and marshes, representing an ideal environment for diverse waterbird species. For instance, harriers and passerines are found among reeds in the marshland, and grebes and diving ducks are found in the open waters. The area is also part of the Arjan Biosphere Reserve (Ramsar Sites Information Service, 2024) and the Arjan-Parishan Protected Area (Dolatkhahi et al., 2012). Since 1975, the wetland has been patrolled by a local ranger station with only two rangers with one car, which is insufficient to prevent large-scale habitat destruction due to the vastness of the area.

Up to the early 2000s, the wetland experienced seasonal drying, with water levels starting to drop by the end of Spring, and continued to decrease until late summer, and then began to rise again. However, in recent years, due to unauthorized agricultural activities (e.g., growing wheat- and other crops, well-drilling), the wetland is dried for most time of the year, a situation detrimental to the wildlife depending on it. (Heidarzadeh et al., 2023). Expanding road building and intensified poaching also caused severe damage to this critical wildlife habitat (Scott, 1992; Monavari & Momen Bellah Fard, 2010; Joolaee, 2009).

Figure 1. Arjan International Wetland and surrounding areas. The size of the wetland is shown at its maximum water levels measured in early spring each year.

Candidates species

Three waterbird species were used as candidate species for the selection: the ruddy shelduck (Tadorna ferruginea, Anatidae), the common crane (Grus grus, Gruidae), and the Eurasian coot (*Fulica atra*, Rallidae) (Fig. 2). Ruddy Shelduck is a mid-sized bird (body length = 58 - 70 cm, wingspan = 110 - 135 cm) mainly distributed in Asia, but also found in Europe and North Africa. Both males and females have orange-to-brown plumage with a distinctive greenish gloss. Males feature a black collar, and both sexes have a white head (paler in females), a blackish tail, and contrasting white wing covers. They prefer inland bodies such as freshwater lakes, reservoirs, and rivers for habitation. The species is primarily nocturnal, feeding on plants and invertebrates. The

study area has a resident population of about 50 individuals year-round, and an additional migratory population of approximately 250 individuals overwinters from October to the end of February. Common Crane is a big bird (body length = 100 - 130 cm, wingspan = 180 -222 cm). They are slate gray (darkest on the back and rump and palest on the breast and wings) with a red crown, a blackish forehead, and blackish lores. A black streak extends from behind the eyes to the upper back. No sexual dimorphism in plumage is found. Some preferential habitats for the common crane include flooded areas, shallow and sheltered bays, and swampy meadows. Its diet consists mainly of plant matter but may also include insects (e.g., dragonflies), spiders, rodents, and smaller birds. In the study area, a migratory population of about 300 individuals is seen from October to mid-February. Eurasian coot is a relatively small bird (body length = 36-38 cm, wingspan =70 - 80cm). It is blackish throughout, except for a white bill and frontal shield, with no sexual dimorphism in plumage. They prefer living in freshwater lakes and ponds, with an omnivorous diet including eggs of other waterbirds, algae, seeds, and fruits. These birds are found throughout the year in the study area, with about 350 individuals.

Figure 2. The three candidate species: A) Common crane (*Grus grus*), B) Eurasian coot (*Fulica atra*) and C) Ruddy shelduck (*Tadorna ferruginea*).

Selection criteria

Various methods have been proposed for flagship species selection (e.g., Verissimo et al., 2011; Jepson & Barua, 2015; Qian et al., 2020), and different criteria are used depending on specific conservation goals and target audiences. In this study, we used the Bowen and Entwistle method (Bowen-Jones & Entwistle, 2002), which emphasizes human attitudes toward a species while considering conservation statuses and ecological roles (Bowen-Jones & Entwistle, 2002). We used a scoring scale from 0 to 2 to assess each criterion and compare the summed results (Table 1).

Table 1. Selection criteria and scoring standards

	Selection criteria	Definition	Rating scale (0 – 2)
1	Geographic distribution	Being endemic to having a wide distribution in Iran	2: being endemic or seldom found in other places; 1: with restricted distributions (in ≤ 50% of the area in Iran); 0: widely distributed (in > 50% of the area in Iran)
2	Conservation status	Having a high risk of extinction to being less vulnerable at the local or national level	2: classified as "Threatened"; 1: classified as "Near-threatened"; 0: classified as "Least Concern" by the IUCN Red List
3	Ecological importance	Species' role in the ecosystem	2: considered as umbrella and keystone species; 1: considered as either umbrella or keystone species; 0: not considered as umbrella or keystone species.
4	Recognition	Being well-known to less-known by the local communities	2: with the most participants correctly identifying the species using its pictures; 1: with an intermediate number of participants correctly identifying the species; and 0: with the least participants correctly identifying the species.
5	Existing usage	Treated as flagship species elsewhere or not	2: not having been used as flagship species elsewhere; 0: having been used as flagship species
6	Charisma	How a species' appearance can attract people's attention	2: having a large body with a high color variety; 1: having a large body or high color variety; and 0: having a small body with a low color variety.
7	Cultural significance	Association with the local culture	2: present in more than one cultural heritage type [1]; 1: present in only one cultural heritage; and 0: not present in any cultural heritage.
8	Positive association	Positive emotions or connotations toward a species	2: with the most participants reporting positive emotions upon hearing the species' name; 1: with an intermediate number of participants reporting positive emotions; and 0: with the least participants reporting positive emotions.
9	Local knowledge	Local ecological knowledge on habitat use of a species	2: with the highest number of participants accurately pointing out the species' r feeding/roosting sites; 1: with an intermediate number of participants pointing out the feeding/roosting sites; 0: with the least participants pointing out the feeding/roosting sites.
10	Common name	The species' local name(s)	2: known by multiple local names; 1: known by a single local name; 0: does not have a local name.

Flagship species selection

Of the ten selection criteria above, criteria #1, #2, #3, and #5 were assessed using literature study or web research (when the information needed for the assessment was beyond the available published study). Criterion #6 was assessed via self-assessment, criterion #7 was through letter inquiry, and criteria #4, #8, #9, and #10 were assessed using interviews with the local people. (Fig. 3). To assess criterion #1 (Geographic distribution), the current distribution of each candidate species was examined using the sighting records mapped by BirdLife International (BirdLife International, 2024). Those maps are based on published scientific records, ensuring the assessment's accuracy and reliability. To assess criterion #2 (Conservation status), the IUCN Red List (*IUCN, 2024*) was used to identify each candidate species' global conservation status.

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[1] Cultural heritage included oral traditions and expressions, performing arts, social practices, rituals and festive events, knowledge and practices concerning nature and the universe and traditional craftsmanship based on UNESCO (Scovazzi, 2015).

To assess criterion #3 (Ecological Importance), we reviewed scientific publications to determine whether a candidate species has been recognized as an umbrella or keystone species. We conducted targeted searches in Google Scholar (scholar.google.com) using the scientific and common names of each species, "umbrella species", "keystone species", and "ecological role". From an initial pool of articles in the search results, we examined the abstract and, when necessary, the full texts to determine their relevance. We then excluded studies that did not explicitly evaluate or discuss the species as an umbrella or keystone. To assess criterion #5 (Existing usage), we performed targeted searches on Google (www.google.com) using English and Persian keywords. The searches combined the scientific name of each species with "'flagship species" and its Persian equivalent, "گونه پرچم". Both keywords were used to ensure comprehensive coverage of different language sources. The search results were reviewed to determine if a species had previously been designated as a flagship species. This process involved opening and examining all the links that appeared to be relevant to our topic based on their titles and snippets.

To assess criterion #6 (Charisma), we focused on the species' body size and plumage coloration. Three avian experts from AvayeBoom Bird Conservation Society performed the evaluation. They assessed the physical attributes of each candidate species by observing the animals in the field. The assessment concentrated on the visual impact of each species' size and the diversity of their color patterns, which are critical factors in their ability to attract attention and engage public interest.

To assess criterion #7 (Cultural significance), an inquiry letter was sent to the provincial office of the Ministry of Cultural Heritage, Tourism, and Handicrafts of Iran. This letter aimed to confirm whether a candidate species belonged to the cultural heritage in the local area. Here, "cultural heritage" refers to historical monuments, traditional music, dances, folklore, and festivals that are intrinsic to the region's cultural fabric. Our request sought to identify whether these species appear in significant cultural expressions or are used symbolically in traditional practices, which reflect their importance to the cultural identity of the local community.

To assess criteria #4 (Recognition), #8 (Positive associations), #9 (Local knowledge), and #10 (Common names), a public call was issued on the Arjan News Channel via WhatsApp, the primary news source for residents of Arjan village, on 15 April 2022, inviting participation in an upcoming interview session. On 23 April 2022, 45 villagers responded to this invitation and convened at the village's meeting hall. An AvayeBoom Bird Conservation Society research assistant introduced the study objectives and outlined the interview procedures to all attendees. To minimize crosstalk and ensure the privacy of responses, each participant was allocated to one of three seating arrangements spaced 15 meters apart within the hall. Additionally, separate interviews were conducted in the field on the same day to accommodate 23 villagers who could not attend due to work commitments on

their land. This approach was deliberately chosen to include a broader segment of the community and ensure that those unable to travel to the hall could still contribute their perspectives. Consistent interviewing techniques and the same set of questions were employed to uphold our survey's integrity and unbiased nature across both settings.

To assess criterion #4 (Recognition), the interview participants were given the name of each candidate species and asked to identify it using a field guide (Svensson, 2009). The participants were allowed only one attempt, but the identification process might take as long as needed. If a participant could not identify the species correctly, the identification was considered incomplete; otherwise, it was considered complete. To assess criterion #8 (Positive associations), participants were asked to describe their feelings toward each candidate species upon hearing its local name. The emotional responses were categorized as positive, neutral, or negative. Words such as "beautiful", "majestic", or "inspiring" were classified as positive emotions, words such as "unpleasant", "scary", or "ugly" indicated a negative emotion, and a "neutral" emotion was defined as the absence of any strong feelings towards the species, such as describing it as "common" or "ordinary".

To assess criterion #9 (Local knowledge), each participant was asked to identify roosting or foraging sites from a map used by a candidate species. The map displayed different habitats within the study area, including water bodies, marshes, forests, and grasslands. We assumed familiarity with a species' habitat strongly indicates local ecological knowledge. Lastly, to assess criterion #10 (Common names), each participant was asked about the candidate species' local and national names. National names are uniformly recognized nationwide, while local names can vary significantly by region, reflecting regional linguistic and cultural nuances. This criterion evaluates how deeply a species is embedded in the local culture through its naming conventions. Species recognized by more than one local name suggest a more robust cultural connection and recognition within different local communities.
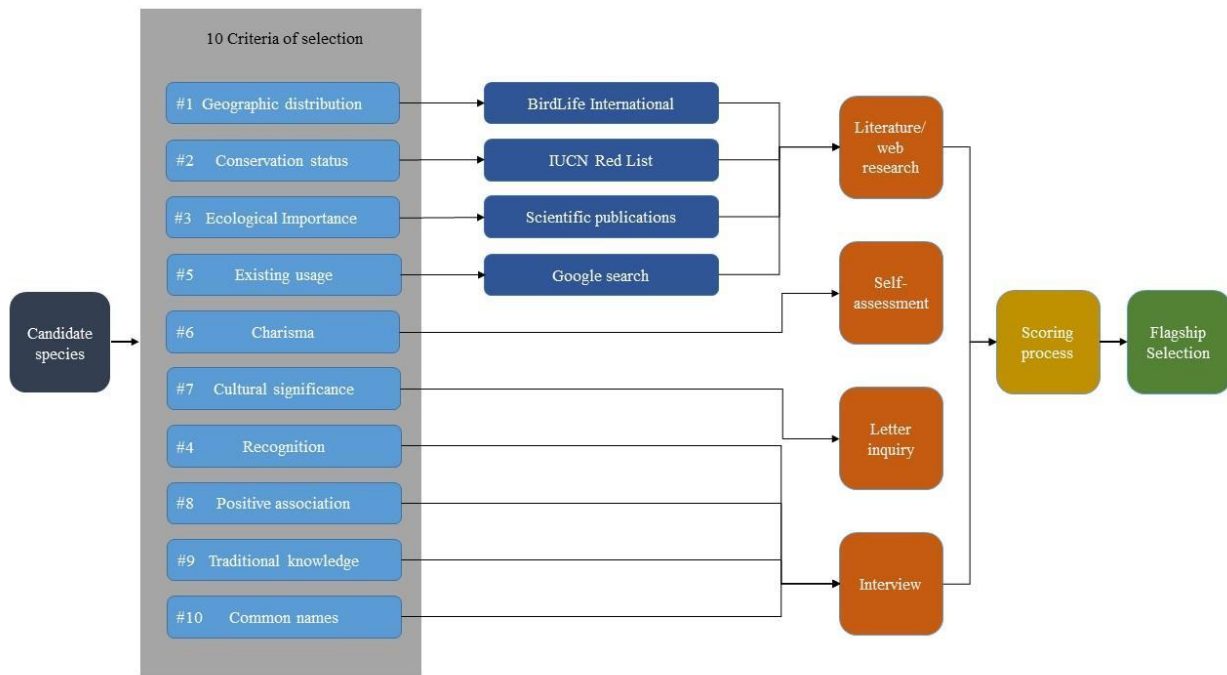
Figure 3. Steps for selecting flagship species based on criteria and the corresponding method used to measure each criterion.

Results

Literature and Web Research

According to the species distribution maps by BirdLife International, none of the candidate species was endemic to Iran. While the ruddy shelduck currently has a wide distribution throughout Iran, in approximately 70% of the country's total area, the Eurasian coot and common crane are found in less than 50% of the area. Therefore, the Eurasian coot and common crane received one score, and the ruddy shelduck received zero for criterion #1 (Geographic distribution).

For criterion #2 (Conservation status), all candidate species were classified as "Least Concern" according to IUCN. Therefore, each species received a zero score.

For #3 (Ecological importance), we found no studies treating the candidate species as an umbrella or keystone species. As a result, each species received a zero score.

For criterion #5 (Existing usage), the search results revealed that the ruddy shelduck and Eurasian coot had not been previously designated as flagship species elsewhere. In contrast, the common crane had been used as a flagship species for Meyghan Wetland in Iran (Ansari, 2015). Therefore, the ruddy shelduck and Eurasian coot scored 2, while the common crane scored 0 in this criterion.

Self-assessment

For criterion #6 (Charisma), the common crane has the largest body size among all, followed by ruddy shelduck and Eurasian coot in terms of plumage coloration; ruddy shelduck has four different

colors (orange-brown, white, black, and greenish gloss) in its plumage, common crane has four colors (black, white, red, and bluish-gray). Eurasian coot is only in two colors (black and white). Therefore, the common crane scored 1 for its large size and intermediate color variety, the ruddy shelduck received one score for the intermediate body size and high color variety, and the Eurasian coot scored zero due to its small size and lack of color variety.

Letter inquiry

For criterion #7 (cultural significance), a response from the Minister of Cultural Heritage, Tourism, and Handicrafts of Iran was received on May 9, 2022, two months after the inquiry. It declared that none of the candidate species was in the cultural heritage. Therefore, all candidate species received zero scores for this criterion.

Interview results

Of the 68 villagers participating in the interview, responses by 65 people (2.7% of the total population of Arjan Village, including 33 males and 32 females; mean age = 41 years [range = 18 - 76 years]) were included in the results. According to the village's traditional cultural practices, three younger villagers (aged under 15 years old) were not interviewed. For criterion #4 (Recognition), 38 participants (58%) claimed that they were familiar with the name of the Eurasian coot, with 22 (34%) of them correctly identifying it from the field guide. Similarly, 41 people (62%) claimed familiarity with the name of ruddy shelduck, with 30 (45%) of them correctly identifying it. Forty-seven people (71%) claimed to be familiar with the name of the common crane, with 30 (45%) of them correctly identifying it. Therefore, the ruddy shelduck and common crane received 2 points, while the Eurasian coot received a 0 score.

For criterion #8 (Positive associations), no participants reported negative associations with any candidate species. In addition, 21 (32%), 12 (18%), and 23 (35%) participants reported positive emotions towards common crane, Eurasian coot, and ruddy shelduck, respectively. Therefore, Ruddy Shelduck scored two due to the most positive associations received: common crane scored 1, and Eurasian scored 0. For criterion #9 (Traditional Knowledge), 28 participants (43%) identified one or more roosting/foraging sites for ruddy shelduck. Similarly, 27 participants (41%) identified common cranes' roosting/foraging sites. Only 11 participants (16%) identified the roosting/foraging sites for Eurasian coots. Consequently, the Ruddy Shelduck received two scores, the common crane received one score, and the Eurasian coot received 0 scores.

For criterion #10 (Common names), "Gholang" was for common crane, "Chalchalak" for Eurasian coot, and "Ghaze Ghermez" for ruddy shelduck. All the names above were without discernible connotations, as they serve as identifiers without positive or negative associations. Therefore, each

candidate species scored 2 (see table below). After summing up scores received from individual criteria, the Eurasian coot received five scores, the Ruddy Shelduck received 11 scores, and the common crane received 8 scores (Fig. 4).

Table 2. Results of Candidate Assessment across 10 Criteria

Criteria / Species	Eurasian coot (*Fulica atra*)	Ruddy shelduck (*Tadorna ferruginea*)	Common crane (*Grus grus*)
1. Geographical distribution	Not locally endemic	Not locally endemic	Not locally endemic
	Restricted distribution in Iran	Widely distributed in Iran	Restricted distribution in Iran
2. Conservation status	Least concern	Least concern	Least concern
3. Ecological role	Umbrella or keystone: ✘	Umbrella or keystone: ✘	Umbrella or keystone: ✘
4. Recognition	Complete recognition: 22 people (34%)	Complete recognition: 30 people (45%)	Complete recognition: 30 people (45%)
5. Existing usage	✘	✘	✓
6. Charisma	Number of colors: 2	Number of colors: 4	Number of colors: 4
	Body size: 36-42 cm	Body size: 58-70 cm	Body size: 96-115 cm
7. Cultural significance	Not significant	Not significant	Not significant
8. Positive associations	12 people (18%)	23 people (35%)	21 people (32 %)
9. Traditional knowledge	11 people (16%)	28 people (43%)	27 people (41%)
10. Common name	Chalchalak	Ghaze Ghermez	Gholang

	Eurasian Coot	Ruddy Shelduck	Common Crane
■ 10. Common names	2	2	2
■ 9. Traditional knowledge	0	2	1
■ 8. Positive associations	0	2	1
■ 7. Cultural significance	0	0	0
■ 6. Charisma	0	1	1
■ 5. Existing usage	2	2	0
■ 4. Recognition	0	2	2
■ 3. Ecological importance	0	0	0
■ 2. Conservation status	0	0	0
■ 1. Geographical distribution	1	0	1
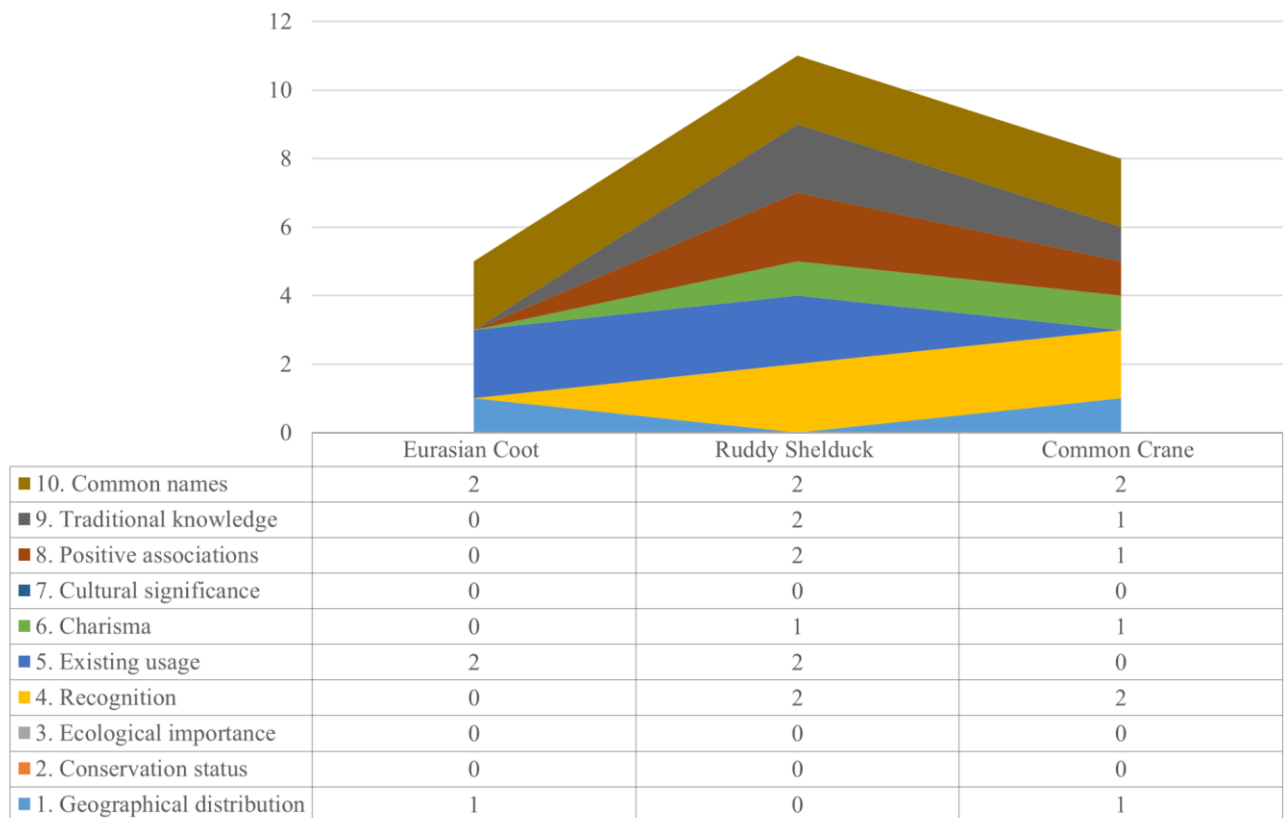
Figure 4. Comparison of scores for 3 candidates based on 10 criteria.

Discussion

This study reported a case study where different waterbird species were systematically evaluated to select a flagship species for AIW in Iran. Ruddy shelduck was chosen for its superior performance across the multiple selection criteria, particularly for its recognition by local communities, positive associations with local culture, and knowledge of the ecology of the species by the local people. The selection highlights the potential of ruddy shelduck to act as a future catalyst for local conservation efforts. The benefit of selecting the ruddy shelduck as the flagship species is multifaceted. Its high visibility (due to color variation) and familiarity by the local people are likely to enhance public engagement, understanding, and support for conservation initiatives. The species' broad distribution may also rally conservation efforts in its wider habitat.

The selection process, which incorporates local and cultural elements, also differs from selections that have received international attention. For instance, the giant panda in China (Yang et al., 2018) and the bald eagle in the U.S. (Cruz et al., 2019) were selected primarily based on their charisma and conservation status to attract global attention and conservation funding. By

involving local participation, we expect to reduce human-wildlife conflict in the study area. Moreover, we consider the selection process an educational tool to encourage environmentally responsible behaviors. Similar cases can be found in Lishui, China, where local bird species were selected as flagship species using a method that integrated ecological data as well as cultural weight (Wang et al., 2023); and in Pemba Island in Tanzania, where flying fox (*Pteropus voeltzkowi*) was selected (Bowen-Jones & Entwistle, 2002) for its roles in seed-dispersal and in leveraging community knowledge. During the study, a lack of scientific data limited our understanding of the species' ecological roles and population trends. Additionally, the criterion regarding cultural significance had a relatively weak impact on the scoring due to insufficient cultural studies at the AIW region. Longitudinal population monitoring and further understanding of the species' ecological and cultural values will provide a basis for effective management measures.

Government bodies and conservation organizations may endorse the ruddy shelduck and catalyze comprehensive conservation strategies at AIW. This could involve the implementation of stricter protection measures and augmented funding. To address the practical challenges of maintaining the vastness of AIW, there is a critical need to enhance the patrolling force. Increasing the number of rangers and improving their resources would significantly bolster the effectiveness of conservation measures, ensuring better management and protection against illegal activities and habitat destruction. Future conservation plans may also involve practical initiatives encompassing educational programs, the creation of localized symbols (e.g., sculptures and informational posters), promotions of ecotourism, and habitat restoration projects. All these efforts, centered around the flagship species, will benefit the ruddy shelduck, AIW's waterbird community and habitat, and bolster the overall health of the wetland ecosystem. These actions will foster a stronger connection between the local communities and their natural heritage, ensuring sustainable conservation impacts.

Conclusion

The selection of the ruddy shelduck as the flagship species for AIW is a milestone for regional conservation efforts. This strategic choice is expected to drive conservation actions in Iran and potentially in other regions with similar habitats and conservation challenges.

References

United Nations Educational, Scientific and Cultural Organization. (1976). Arjan-Man and the Biosphere Programme. Retrieved June 13, 2024, from https://www.unesco.org/en/mab/arjan

Ansari, A. (2015). Habitat suitability modeling for the common crane (Grus grus) in Meyghan Wetland, Arak. Ecobiology of Wetlands, 7(24), 57–69. Retrieved from https://sid.ir/paper/174895/fa

Barua, M., Tamuly, J., & Ahmed, R. A. (2010). Mutiny or clear sailing? Examining the role of the Asian elephant as a flagship species. Human Dimensions of Wildlife, 15(2). https://doi.org/10.1080/10871200903536176

Berger, J. (1997). Population Constraints Associated with Using Black Rhinos as an Umbrella Species for Desert Herbivores. Conservation Biology, 11(1). https://doi.org/10.1046/j.1523-1739.1997.95481.x

Berkes, F. (2007). Community-based conservation in a globalized world. Proceedings of the National Academy of Sciences of the United States of America, 104(39). https://doi.org/10.1073/pnas.0702098104

BirdLife International. (2024). BirdLife Data Zone. Retrieved January 30, 2024, from https://datazone.birdlife.org/

Borrini-Feyerabend, G. (1997). Beyond Fences: Seeking Social Sustainability in Conservation, Vol. 2 - A Resource Book. IUCN - The World Conservation Union, Gland, Switzerland.

Bowen-Jones, E., & Entwistle, A. (2002). We are identifying appropriate flagship species: The importance of culture and local contexts. Oryx, 36(2), 189-195. https://doi.org/10.1017/S0030605302000261

Cruz, J., Windels, S. K., Thogmartin, W. E., Crimmins, S. M., Grim, L. H., Larson, J. H., & Zuckerberg, B. (2019). The top-down effects of repatriating bald eagles hinder jointly recovering competitors. Journal of Animal Ecology, 88(7). https://doi.org/10.1111/1365-2656.12990

Czech, H. A., & Parsons, K. C. (2002). Agricultural wetlands and waterbirds: A review. Waterbirds, 25(SPECIAL PUBL.2).

World Weather Online. (2024). Dasht-E Arzhan Annual Weather Averages - Fars, IR. Retrieved June 13, 2024, from https://www.worldweatheronline.com/dasht-e-arzhan-weather-averages/fars/ir.aspx#google_vignette

Dietz, J. M., Dietz, L. A., & Nagagata, E. Y. (1994). The effective use of flagship species for conservation of biodiversity: the example of lion tamarins in Brazil. In Creative Conservation. https://doi.org/10.1007/978-94-011-0721-1_2

Dolatkhahi, M., Asri, Y., & Dolatkhahi, A. (2012). Floristic study of Arjan-Parishan protected area in Fars province. Taxonomy and Biosystematics, 3(9).

Ernoul, L., Wardell-Johnson, A., Mathevet, R., Sandoz, A., Boutron, O., Willm, L., Arnassant, S., & Béchet, A. (2021). Context in landscape planning: Improving conservation outcomes by identifying social values for a flagship species. Sustainability (Switzerland), 13(12). https://doi.org/10.3390/su13126827

Finlayson, C. M., & van der Valk, A. (1995). Classification and inventory of the world's wetlands. In A. G. van der Valk (Ed.), Advances in vegetation science (pp. 47-71). Springer.

Flagship Species - BirdLife South Africa. (2018). Retrieved June 13, 2024, from https://www.birdlife.org.za/what-we-do/species-conservation/what-we-do/flagship-species/

Frazier, J. (2005). Marine Turtles: The Role of Flagship Species in Interactions Between People and the Sea. Montana: The Magazine of Western History, 55(2), 14-25.

Ghoddousi, A., Kh. Hamidi, A., Ghadirian, T., Ashayeri, D., & Khorozyan, I. (2010). The status of the Endangered Persian leopard Panthera pardus saxicolor in Bamu National Park, Iran. Oryx, 44(4). https://doi.org/10.1017/S0030605310000827

Green, A. J., & Elmberg, J. (2014). Ecosystem services provided by waterbirds. Biological Reviews, 89(1). https://doi.org/10.1111/brv.12045

Heidarzadeh, N., Eghbal, M., Esmaeili, N., & Panaghi, K. (2023). Predicting the impact of climate change on the area of wetlands using remote sensing. https://doi.org/10.21203/rs.3.rs-3178370/v1

Heywood, V. H., & Watson, R. T. (1995). The Global Biodiversity Assessment. United Nations Environment Programme (UNEP), Cambridge University Press.

Home, R., Keller, C., Nagel, P., Bauer, N., & Hunziker, M. (2009). Selection criteria for flagship species by conservation organizations. Environmental Conservation, 36(2). https://doi.org/10.1017/S0376892909990051

Hosseini Tayefeh, F., Izadian, M., Ashoori, A., Jolaee, L., & Ebrahimi, E. (2021). Trends of waterbirds population changes in Fars province wetlands 1988-2018. Environmental Sciences, 19(1), 177–196. https://doi.org/10.52547/ENVS.33047

International Union for Conservation of Nature. (2024). IUCN Red List of Threatened Species. Retrieved January 30, 2024, from https://www.iucnredlist.org

Jepson, P., & Barua, M. (2015). A Theory of Flagship Species Action. Conservation and Society, 13(1). https://doi.org/10.4103/0972-4923.161228

Joolaee, L., Kankash, A. P., Derks, C., & Foekens, E. (2009). Mid-winter census of waterbirds in Fars Province, January 2009. In H. Amini & M. van Roomen (Eds.), Waterbirds in Iran, January 2009: Results of a mid-winter count in the provinces of Gilan, Mazanderan, Golestan, Fars, Khuzestan, Bushehr, Hormozgan & Sistan-Baluchistan (pp. 189-192). Department of Environment, Islamic Republic of Iran & Foundation Working Group International Waterbird and Wetland Research, The Netherlands. Retrieved from https://www.wiwo.org/iranreport2009.pdf

Kitowski, I., Jakubas, D., Wiącek, D., & Sujak, A. (2017). Concentrations of lead and other elements in the liver of the white-tailed eagle (Haliaeetus albicilla), a European flagship species, wintering in Eastern Poland. Ambio, 46(8). https://doi.org/10.1007/s13280-017-0929-3

Kleyheeg, E., van Dijk, J. G. B., Tsopoglou-Gkina, D., Woud, T. Y., Boonstra, D. K., Nolet, B. A., & Soons, M. B. (2017). Movement patterns of a keystone waterbird species are highly predictable from landscape configuration. Movement Ecology, 5(1). https://doi.org/10.1186/s40462-016-0092-7

Kushlan, J. A. (1993). Colonial waterbirds as bioindicators of environmental change. Colonial Waterbirds, 16(2), 223-251. https://doi.org/10.2307/1521444

Ramsar Convention Secretariat. (1997). Lake Parishan and Dasht-e-Arjan. Ramsar Sites Information Service. Retrieved June 13, 2024, from https://rsis.ramsar.org/ris/37

Maldonado, J. H., Moreno-Sánchez, R. del P., Espinoza, S., Bruner, A., Garzón, N., & Myers, J. (2018). Peace is much more than doves: The economic benefits of bird-based tourism as

a result of the peace treaty in Colombia. World Development, 106. https://doi.org/10.1016/j.worlddev.2018.01.015

Monavari, M. S., & Momen Bellah Fard, S. (2010). A GIS-based assessment tool for biodiversity conservation. International Journal of Environmental Research, 4(4), 649-660.

Normande, I. C., Costa, A. F., Coelho-Jr, C., dos Santos, J. U., & Ladle, R. J. (2023). Flagship Species: Manatees as Tools for Mangrove Conservation in Northeast Brazil. https://doi.org/10.1007/978-3-031-13486-9_13

O., T., & M., N. (2013). THE SURVEY OF SPICES DIVERSITY OF MIGRATORY WINTERING WATERFOWL AND WADERS IN ARJAN INTERNATIONAL WETLAND IN FARS PROVINCE (Vol. 6, Issue 1, pp. 29–40). JOURNAL OF ANIMAL BIOLOGY. https://sid.ir/paper/176792/en

Péron, G., Ferrand, Y., Leray, G., & Gimenez, O. (2013). Waterbird demography as indicator of wetland health: The French-wintering common snipe population. Biological Conservation, 164. https://doi.org/10.1016/j.biocon.2013.04.015

Preston, S. D., Liao, J. D., Toombs, T. P., Romero-Canyas, R., Speiser, J., & Seifert, C. M. (2021). A case study of a conservation flagship species: the monarch butterfly. Biodiversity and Conservation, 30(7). https://doi.org/10.1007/s10531-021-02183-x

Qian, J., Zhuang, H., Yang, W., Chen, Y., Chen, S., Qu, Y., Zhang, Y., Yang, Y., & Wang, Y. (2020). Selecting flagship species to solve a biodiversity conservation conundrum. Plant Diversity, 42(6). https://doi.org/10.1016/j.pld.2021.01.004

Roomen, H. A. M. v. (2009). Waterbirds in Iran 2009. WIWO Report 108. Wetlands International & Ornithological Society of the Middle East. Retrieved from https://www.wiwo.org/iranreport2009.pdf

Sadeghi, M. ; R. A. E. (2018). Investigation of factors affecting the drying of Arjan wetland. The 15th Conference of Geological Society of Iran.

Schlegel, J., Breuer, G., & Rupf, R. (2015). Local insects as flagship species to promote nature conservation? A survey among primary school children on their attitudes toward invertebrates. Anthrozoos, 28(2). https://doi.org/10.1080/08927936.2015.11435399

Schwoerer, T., & Dawson, N. G. (2022). Small sight - Big might: Economic impact of bird tourism shows opportunities for rural communities and biodiversity conservation. Plos One, 17(7), e0268594. https://doi.org/10.1371/journal.pone.0268594

Scott, D. A., & Smart, M. (Eds.). (1992). Wetlands of the Seistan Basin, South Caspian and Fars, Islamic Republic of Iran. Ramsar Convention Bureau.

Scovazzi, T. (2015). Intangible cultural heritage as defined in the 2003 UNESCO convention. In A. Bonet, M. Berenguer, F. Seguí, & L. Ghilardi (Eds.), Cultural Heritage and Value Creation: Towards New Pathways (pp. 69-80). Springer. https://doi.org/10.1007/978-3-319-08527-2_4

Sergio, F., Caro, T., Brown, D., Clucas, B., Hunter, J., Ketchum, J., McHugh, K., & Hiraldo, F. (2008). Top predators as conservation tools: ecological rationale, assumptions, and efficacy. Annual review of ecology, evolution, and systematics, 39(1), 1-19. https://doi.org/10.1146/annurev.ecolsys.39.110707.173545

Siler, C. D., Lira-Noriega, A., & Brown, R. M. (2014). Conservation genetics of Australasian sailfin lizards: Flagship species threatened by coastal development and insufficient protected area coverage. Biological Conservation, 169. https://doi.org/10.1016/j.biocon.2013.10.014

Smith, A. M., & Sutton, S. G. (2008). The role of a flagship species in the formation of conservation intentions. Human Dimensions of Wildlife, 13(2). https://doi.org/10.1080/10871200701883408

Statistical Centre of Iran (SCI). (2016). Iran Population and Housing Census 2016. Retrieved from https://irandataportal.syr.edu/census/census-2016

Svensson, L., Grant, P. J., Mullarney, K., & Zetterström, D. (2009). Collins Bird Guide (2nd ed.). HarperCollins Publishers.

Veríssimo, D., Fraser, I., Groombridge, J., Bristol, R., & MacMillan, D. C. (2009). Birds as tourism flagship species: A case study of tropical islands. Animal Conservation, 12(6), 549-558. https://doi.org/10.1111/j.1469-1795.2009.00282.x

Verissimo, D., MacMillan, D. C., & Smith, R. J. (2011). Toward a systematic approach for identifying conservation flagships. In Conservation Letters (Vol. 4, Issue 1). https://doi.org/10.1111/j.1755-263X.2010.00151.x

Veríssimo, D., Pongiluppi, T., Santos, M. C. M., Develey, P. F., Fraser, I., Smith, R. J., & Macmilan, D. C. (2014). Using a Systematic Approach to Select Flagship Species for Bird Conservation. Conservation Biology, 28(1). https://doi.org/10.1111/cobi.12142

Walpole, M. J., & Leader-Williams, N. (2002). Tourism and flagship species in conservation. In Biodiversity and Conservation (Vol. 11, Issue 3). https://doi.org/10.1023/A:1014864708777

Wang, Y., Shi, J., Wu, Y., Zhang, W., Yang, X., Lv, H., Xia, S., Zhao, S., Tian, J., Cui, P., & Xu, J. (2023). Selection of Flagship Species and Their Use as Umbrellas in Bird Conservation: A Case Study in Lishui, Zhejiang Province, China. Animals, 13(11). https://doi.org/10.3390/ani13111825

Western, D. (1987). Africa's elephants and rhinos: flagships in crisis. Trends in Ecology & Evolution, 2(11), 343-346. https://doi.org/10.1016/0169-5347(87)90112-1

Yang, Z., Gu, X., Nie, Y., Huang, F., Huang, Y., Dai, Q., Hu, Y., Yang, Y., Zhou, X., Zhang, H., Yang, X., & Wei, F. (2018). Reintroduction of the giant panda into the wild: A good start suggests a bright future. Biological Conservation, 217. https://doi.org/10.1016/j.biocon.2017.08.012