Invasive Alien Species in Al-Dalmaj Protected Area, Iraq: Conservation and Wildlife Management Approach

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Abstract

An invasive species can be any kind of living organism that is not originally native to an area or ecosystem. These species can harm the environment, the economy, or even human health, the matter that necessitates their studying and monitoring. The current study has focused only on the alien invasive species and excluded the invasive species of native origin. The alien invasive species have been studies for more than a decade in Dalmaj area as part of the Iraqi Organization for Conservation of Nature (IOCN)’s long-term environmental studies in this protected area that includes wide spectrum of habitats and is rich in biodiversity. Only the invasive species have been tackled in this survey, and the alien species that are of native origin have not been included in this study. Nineteen invasive species have been observed in the study area that belong to different flora and fauna taxa. These groups included three plant species (16% of the total invasive species), twelve fish species (63%), three bird species (16%), and one mammal species (5%). The status of these species in the study area was described. By shading light on this group of organisms and provide basic information on their population size, this would establish for long-term monitoring of these taxa and would help in the management of these species and assessing their effect in the different habitats of Al-Dalmaj protected area.

Keywords: Alien and invasive species, Dalmaj, Iraq, IOCN.

1. An introduction to Dalmaj area and its biodiversity

The current study was carried out in Dalmaj wetlands and the surrounding terrestrial habitats. Dalmaj area is well known area of its biological diversity and the wide range of habitats that’s located in the Middle Euphrates region, central Iraq, approx. 170km south of Baghdad (Salim, et al., 2020). It is obvious that the vast area that includes wide range terrestrial and aquatic habitats has provided good shelter and food resources to quite large numbers of different taxa in one area (Abed et al., 2014). Dalmaj wetlands area is fed by the Main Outfall Drain via main feeding canal in addition to some other smaller feeding canals from the eastern side of the MOD (Abed, 2014).
The diversity in the habitats types in Dalmaj area has attracted considerable number of different taxa including alien species that have established concentrated breeding grounds for their increasing generations within the suitable habitats in Dalmaj and the surrounding areas like some flora and fauna species; however, their current status in Dalmaj area might not make them eligible to be considered as invasive as these species are still considered as alien species only. The alien species have been excluded from the current study.

The International Union for Conservation of Nature (IUCN) has clearly defined the invasive alien species as: “An alien species is a species introduced outside its natural past or present distribution; if this species becomes problematic, it is termed an invasive alien species” (GISD, 2018). The CBD (Convection on Biological Diversity) had indicated to the direct driver of biodiversity loss as that this group of species as “Alien species that become invasive are considered to be main direct drivers of biodiversity loss across the globe” (CBD, 2018).

While the Non-native species secretariat defines this group as: “Those species that their introducing and expansion leads to threats to the ecosystems, habitats, and the species with serious environmental and economic threats”, where only a small percentage of living organisms move into new environments would become invasive and affect food, plants, animals, human health and economic development (Laikre, et al., 2010 and Haloob, 2015). Nevertheless, invasive species might cause serious threats in case they adapt to the new circumstances especially when their original traits enable these species to succeed in competition and adaptation to new environments and thus have a destructive effect on the indigenous flora and fauna species causing their extinction, subsequently, affecting natural and cultured ecosystems (Khoury, & Al-Shamlieh, 2006; and Blackburn et al. 2004). As for floral invasive alien species, it might became obvious that they have a distressing impacts on native biota according to many research efforts that tackled this subject where these species causing decline or even extinctions of native species, and negatively affecting ecosystems (Thomas, et al., 2016).

It seems that the phenomenon of the spread of invasive alien species is one of the most dangerous phenomena witnessed by the world in general, and the environmental outlook for the Arab region, in its 2010 report, indicated an increase in invasive species in a number of Arab countries and stated that 551 species were included in the lists of invasive species spread in Arab countries (Khoury et al., 2012; and Al-Ali et al., 2020). During a survey conducted by (Ibrahim M. Abd, et al., 2009) 25 marine fish species (present 61% from fish community) has been noticed in southern Iraq marshlands , while Coad’s filed guide (Coad et al. 2010) mentioned 10 exotic fish species in Iraqi inland water.
2. Methodologies

The study area consists of Dalmaj wetlands (shown in figure 1 above), the wetlands margins and the occasionally-flooded parts, the terrestrial and desert areas, water canals, in addition to the farms. Dalmaj area is located at the ‘Middle Euphrates’ region, central Iraq, shared by Qadisiyah and Wassit Governorates, 45km to the northeast of Diwaniya city. Dalmaj is an area that’s rich in habitats diversity. It includes wetlands of different types such as the open-lake waters, marshes of dense reedbeds, submerged aquatic plants habitats, sallow and seasonal marshes, large mudflats areas, in addition to the draining and irrigation canals. In addition, the current study in Dalmaj area has covered wide spectrum of terrestrial habitats such as the open fields, shrublands, grasslands, desert and semi-desert areas. This wide spectrum of aquatic and terrestrial habitats and plants has created shelter and food resources to the fauna species.

Field surveys were conducted by different members of the Iraqi Organization for Conservation of Nature (IOCN) in Dalmaj wetlands, the Main Outfall Drain (MOD), and the surrounding habitats. These surveys have been conducted over more than one decade 2010-2020 the matter that allowed the opportunity to the team members to survey the area in different conditions covering in depth the entire life circle of many flora and fauna species through all of the four seasons. Both parts, the flora and fauna have been targeted by the team in order to shade more light on the invasive species in the study area using the direct methodologies in collecting the data on these different taxa during the surveys.

The current study has covered only on the alien/exotic invasive species and has excluded the invasive species of native origin; i.e. the Iraqi species whose their population or geographical range got in increase recently for a reason or another have not been included in this study. The
species have been recorded based on the direct observation by the team members, however, in some occasions the trusted, frequent reporting by the locals, fishermen, and hunters were taken into consideration especially regarding the description of the status of the species in the study area. Based on the accumulated collected data, the status of each species in the study area was described as in-depth as possible.

3. Results and Discussion

The continuous, intensive surveys that targeted the study area in Dalmaj and the surrounding habitats in different seasons over ten years (2010-2020) has provided quite wide range of opportunities for the team members to collect more data and to find more details on the invasive species and their habitats within the study area. The long period of surveys has provided the team more experience on where and when to find the invasive flora and fauna species within the study area.

The list provided below shows the status of the alien invasive species found in Dalmaj area and the surrounding habitats, including the Main Outfall Drain canal. This list demonstrates the status of each alien invasive species with basic description of their population in Dalmaj area.

3. 1. Flora

Azolla filiculoides Lam.

A small floating aquatic fern belongs to Salviniaeeae Martinov, it grows on the surface of canals, marshlands, lakes, and slow-moving streams. The plants are small, 1.5 - 2.5 cm long with minute leaves, 1-2 mm long, green, become reddish in direct sunlight (Hashemloian and Azimi, 2009). This invasive plant recorded for the first time in Iraq in 2016 in two different locations: Kalar (about 120 km S. Sulaimanya) and near Hartha (25 km north Basra) (Al-Mayah et al, 2016), now it spreads out in different wetlands in Iraq including middle and northern parts of Dalmaj wetlands. Being the only feeder for Dalmaj waterbody, the Main Outfall Drain (MOD) should be considered as the carrier canal of this floating species. The species forms dense surface mats that compete with other water plants, also affects the ecosystem by preventing light penetration in open-water areas, and causes oxygen deficiency as well affect PH and nitrogen compounds; it could reduce phytoplankton and other aquatic species (Abou et al, 2012).

The required action regarding this invasive species is to continue monitoring its occurrence and expansion in different locations in Dalmaj wetlands, and studying the factors of its expected expansion in these areas.
**Hydrilla verticillata (L.f.) Royle**

Diococious or monoecious herbs, submerged, leaves in whorls of 3-8, linear or narrowly strap-shaped, belong to Hydrocharitaceae Juss. family (Shu, 2010), native to tropical Asia, it has specialized physiological, growth, and reproductive features that have allowed it to become a dominant species in a wide range of freshwater environments (Langeland 1996). The first mentioned record for this species in Iraq in southern marshes during 2006 and 2007 (Al-Abbawy and Al-Mayah, 2010).

The required action regarding this invasive species is to continue monitoring its occurrence and expansion in different locations in Dalmaj wetlands, and studying the factors of its expected expansion in these areas.

**Prosopis juliflora (Sw.) DC.**

Thorny shrubs to small tree, generally 3-8 m high (Townsend and Guest, 1974), belongs to Fabaceae Lindl. family, native to Central and South America (Ghazanfar, 1996). This species affects the native plant species by reducing the number of associated species, species evenness, richness, and density, and also impact the water resources, and their strong thorns cause wounds to livestock and human beings (Wakie et al, 2016; El-Keblawy & Al-Rawai, 2007). It has been introduced to Iraq in the middle of the last century to control erosion, sand dunes, and desertification control; now it is invading a number of locations within Iraq wherever it was planted including Dalmaj area.

3. **Fish**

**Carassius gibelio (Bloch,1782)**

This species appeared on the Basrah fish market when an increase in the Tigris River discharge reduced the salinity of the Shatt al-Arab river (Coad, 1996). The combination of spines in both the dorsal and anal fins and the absence of barbels is unique to this species. The first records of the species C. gibelio were given as *C. auratus* by Baran and Ongan (1988) and *C. auratus gibelio* by Ozulug (1999) from Lake Gala and Byukekmece Dam Lake, respectively,

Common in Dalmaj wetlands and the adjacent parts of the Main Outfall Drain as well.

**Ctenopharyngodon idella (Valenciennes in Cuvier & Valenciennes, 1844)**

Grass carp was introduced to Khuzestan Province, Iran in the 1970 to control vegetation in irrigation ditches and to Iraq fish farms (Shireman and Smith, 1983; Ali et al., 1988). Large numbers of fingerlings are produced by hatcheries in Iraq for restocking in irrigation and drainage ditches (White,1988). This species is identified by the eyes being lower side of the
head, the anal fin is far back on the body close to the caudal fin, and pharyngeal teeth have large, parallel grooves on the grinding surface.

Uncommon species in Dalmaj wetlands, yet rather common in the adjacent parts of the Main Outfall Drain.

*Cyprinus carpio* (Linnaeus, 1758)

The common carp is fish-farmed and widely transplanted the Tigris-Euphrates basin, Pond culture of carp was started in Iraq in 1955 and lakes, reservoirs and irrigation channels were subsequently stocked with fingerlings (Ahmed and Taher, 1988). This species rapidly became established in Iraq. This species is easily identified by the long dorsal fin, the spine in both the dorsal and anal fins, and the two pairs of barbels.

Very common species in both waterbodies: Dalmaj wetlands and the adjacent parts of the Main Outfall Drain.

*Hemiculter leucisculus* (Basilewsky, 1855)

The native range of this species is from Maritime Russia south through China to Korea and Viet Nam, This species is introduced to Iran, probably by accident along with commercial shipments of Chinese major carps from central Asia. It recorded in the Hawizah marsh (Coad and Hussain, 2007), and in Iraqi southern marshes (Al-Faisal, 2008).This species specified by the sharp keel, extending from the anus to the throat below the pectoral fin on the mid-ventral surface is distinctive, especially when combined with the dorsal fin spine and the three clear rows of pharyngeal teeth.

Common species in Dalmaj wetlands and the adjacent parts of the Main Outfall Drain.

*Hypophthalmichthys molitrix* (Valenciennes in Cuvier & Valenciennes, 1844)

The silver carp, one of the major Chinese carps, was introduced to reservoirs and marshes throughout Iran water including in Khuzestan cities and in Zaribar lake, Kordestan by release from private and governmental fish farms, and is used in a variety of fish ponds in Iraq (Ali et al., 1988). The abdomen of this species has a compressed keel extending from the breast to the anus, the eyes are positioned low such that they are visible from the head, and scales are minute. The similar bighead (*H. nobilis*) can be recognized by the long pectoral fins which extend past the origin of the pelvic fins, a shorter keel (pelvic fins to anus), and gill raker structure.

Occurs in Dalmaj and the adjacent parts of the Main Outfall Drain in few numbers.
**Hypophthalmichthys nobilis** (Richardson, 1844)

The Bighead, one of the Chinese carps group, is recorded from fish farms and reservoirs in Khuzestan, Iran, this species has been advocated for introduction to Syrian fresh water reservoirs (Coad, 1996). It is used in fish ponds in Iraq. It is one of the valuable commercial species for fish farm, feeding mainly on phytoplankton when adult.

Occur in Dalmaj and the adjacent parts of the Main Outfall Drain in few numbers.

**Oreochromis aureus** (Steindacher, 1864)

The Blue tilapia is captured of a specimen from the Khabour river in Syria, presumably an escape from a fish ponds in the basin of Euphrates river tributary (Coad, 1996). It also recorded in Iraq by Mutlak and Al-Faisal (2009) at the last part of the main outfall drain in Basrah city. Blue tilapia has 18-26 gill rakers on the lower part of their first gill arch. They have 15 dorsal spines and 3 anal spines. The caudal fin has a broad pink to bright red distal margin. Breeding males have intense bright metallic blue on their head, a vermilion coloration on the edge on their dorsal fin and an intense pink coloration on the margin of their caudal fin.

Very common species in Dalmaj wetlands and the adjacent part of the Main Outfall Drain canal.

**Tilapia zillii** (Gervais, 1848)

The Redbelly tilapias is established in the Syrian Euphrates, and recorded at Al Musayyib city on the Euphrates river in Iraq (Al-Sa'adi, 2007; Al-Sa'adi et al., 2012), and recorded at the last part of the main outfall drain in Basrah city (Mutlak and Al-Faisal, 2009). Coloration of *T. zillii* is top dark olive body and light olive to yellow-brown on the sides, often with an iridescent blue sheen. Lips are bright green and the chest is pinkish, six to seven dark vertical bars cross two horizontal stripes on the body and caudal peduncle. Redbelly tilapia has 8-11 gill rakers on the lower part of their its gill arch. They have 15-16 dorsal spines and 3 anal spines. Tilapias are among the most resistant fishes known against to diseases and relatively bad environmental conditions such as high stocking density of fish, lower water quality, organically pollutant water, and low dissolved oxygen level of the water.

**Oreochromis niloticus** (Linnaeus, 1758)

Nile Tilapia is closely related to, and often confused with, Blue Tilapia (*O. aureus*). It was recoded at tropical and subtropical Africa, Middle East. Widely distributed in Nile and Niger river basins and in lakes Tanganyika, Albert, Edward, and George, as well as in many smaller drainages and lakes in western and eastern Africa (Graça, Pavanelli, 2007). also in Middle East in Yarmok River, Israel (Trewavas, 1983).
**Heteropneustes fossilis (Bloch, 1794)**

This catfish has been introduced to Tigris river basin in southern Iraq (Zakaria, 1964). It was widely distributed in all the rivers and marshes of southern Mesopotamia. This species was introduced to Iraq for eat the snail *Bulinus truncates vector* for the human parasite causing schistosomiasis. It has 4 pairs of hard barbels, short and spineless dorsal fin, absence of an adipose fin, and the long anal fin are distinctive. The head is small and very flattened and tapers both dorsally and ventrally to a terminal mouth.

Common species in both waterbodies: Dalmaj wetlands and the adjacent part of the Main Outfall Drain canal.

**3. 3. Birds - Class Aves**

**Black-shouldered Kite *Elanus caeruleus***

This small raptor is considered one of the key alien species that have been invaded many countries out of their original distribution (Abed and Salim, 2018). Black-shouldered kite was recorded for the first time for Iraq by Salim where some observations (including breeding records) were gained from various districts in Iraq including the northern parts of Iraq (Salim, 2008). Further studies that targeted its breeding ecology and biology have shed more light on the recent expansion of this species in Iraq (Abed and Salim, 2018). Now this species is still expanding in different locations in Iraq where they established new breeding grounds (Salim, 2012).

Black-shouldered Kite was observed in Dalmaj at mid-2000s for the first time, and few more observations were made that highlighted to its breeding in Dalmaj where a pair and four juvenile individuals were found at the western parts of Dalmaj.

**Laughing (or Palm) Dove *Spilopelia senegalensis***

This species has expanded noticeably during the last decades in the regiona and in Iraq as well. The first record of this species was in the extreme south (Fao, 2013), then, more observations were made (including breeding) over various locations in Iraq to be one of the common Iraqi bird species that can be found almost everywhere (Salim, 2012).

In Dalmaj, Laughing Dove is a resident breeder that can be found either mixed with the Collard Dove *Streptopelia decaocto* or on its own in different parts in Dalmaj mostly within the southern, western, and northwestern parts of the area. This species getting the benefit of the presence of the alien invasive species *Prosopis juliflora* thorny shrubs as barricaded shelter and breeding locations in Dalmaj.
Namaqua (or Long-tailed) Dove *Oena capensis*

This species has expanded its occurrence and breeding range recently in the Middle East originated from Africa (Shirihai & Geller, 1989). This expansion might be due to the expanding of the green areas and farms within Arabia that provided suitable shelter and food source and has facilitated it movement northward. This species has been recorded for the first time in Iraq by Salim where a specimen was collected from date-palm orchards to the west of Western Hammar marshes (Salim, 2008). Salim 2012 has expected more expansion of this species northward within Iraq, and it was true where more individuals and breeding pairs were found in different locations in Iraq (IOCN, unpublished internal reports). This species has been first found in Dalmaj at early last decade where the early individuals have been found in different periods in the year including breeding season; then, this species has established its own breeding grounds in the southern and southeastern parts of Dalmaj. Like the previous species, this species getting the benefit of the presence of the alien invasive species *Prosopis juliflora* thorny shrubs as barricaded shelter and breeding locations in Dalmaj.

3. 4. Mammals

*Rattus norvegicus* Brown Rat

This invasive species is native to China and Mongolia that has expanded its distribution widely on the global level to be of ‘worldwide distribution’ with various populations structure of global distribution (Orgain, & Schein, 1953). The development of the agricultural activities and expansion might contributed to create new habitats for this species living in close association with human (Puckett et.al., 2016). Brown Rat can be found in the terrestrial areas mostly close to the human settlements (Mohammed, 2014; and IOCN, unpublished internal report). Despite that very few observations made on mammals in the study area, it seems that this species’ status in Dalmaj is stable, however, this status might be subject of change in case more human settlements got established in the area due to the planned development in Dalmaj area.

Due to being the study area rich with biological diversity especially the habitats diversity, this might provide suitable foundation to receive alien species where some of them might develop their status and take in increasing and expansion to be considered as invasive alien species in the area (Salim et al., 2020). In addition, the various water canals surrounding and within the study area might be considered as the main channel that brought the aquatic flora and fauna species to Dalmaj. The agricultural activities can be added as an added factor that might increase the population of these species in the study area; however, *Prosopis juliflora* has been brought and planted for different reason as a mechanical treatment for preventing the expanding of the sand dunes in Dalmaj area. Despite that this plant species has contributed in creating new habitat (especially as barricaded shelter) for different species especially
mammals and breeding birds, but still it is considered as alien invasive species that was not existed historically in Dalmaj area.

Some of 10 fish exotic species have been recorded in Dalmaj lake, most of them are invasive and has significant impacts on native species via a competition on feeding and spawning areas. Serious change was observed by recent study indicated that the increasing noticeable presence of the alien fish species has contributed in creating serious shift in fish composition and diversity of the native fish diversity and distribution when comparing their current status with the historical observation (Abdullah et.al., 2020).

The figure below (Fig. 2) shows the numbers of the invasive alien species in Dalmaj study area where the fish fauna seems to be the highest in species numbers where ten fish species were observed in the waterbody of Dalmaj (both parts: the marshes and the lake), and the water canals around and within Dalmaj area.

![Bar chart showing invasive species numbers in Dalmaj PA](chart.png)

**Fig. 2: The alien invasive taxa that have been recorded in Dalmaj PA along with their species numbers.**

The invasive alien species that have been observed in Dalmaj were found in various habitats and in different numbers and populations. The figure below (Fig. 3) shows the percentage of the occurrence among the different invasive alien species in Dalmaj area.
4. **Summary and Recommendations**

The current paper represents the first attempt on the national level to study the occurrence of the alien invasive flora and fauna species in Dalmaj protected area and the surrounding areas. Being based on ten-years field observations, we consider this study as one of the reliable studies especially for the applied dimensions. Dalmaj management Plan should take the results of the current work into consideration when planning and applying the implementation plans in Dalmaj protected area.

Despite the fact that intensive presence-absence field studies on the species in Dalmaj protected area, with more concentration on avifauna, we recommend to focus on the flora and other gaps in the knowledge in Dalmaj area.

Based on Dalmaj areas’ specialties and unique features, a priority list is to be developed to arrange the studies according to their importance and urgency. Such a list should be agreed and endorsed by the related stakeholders.

Special attention is to be addressed to the alien and invasive taxa in Dalmaj, and whenever possible, detailed action plan is to be prepared and implemented regarding the alien and invasive species in Dalmaj protected area.

Continuing the field surveys and monitoring programme, giving more focus on the alien and the invasive species in Dalmaj, and considering any observed alien species as priority for study and monitoring/mapping their expansion carefully.
Encouraging the new students and the project proposals to target the alien and invasive species in Dalmaj, and consider this issue as one of the priorities of the Dalmaj Research Centre (DRC).

5. Acknowledgement

The authors would like to thank the Iraqi Organization for Conservation of Nature (IOCN) for providing the logistical facilities to conduct the surveys and making their data and photos available to support preparing this paper. We’d also like to thank the Iraqi Ministry of Health and Environment, represented by Dr. Jassim Al-Falahi, the Ministry’s Deputy; and Mrs. Raghad Abdulsada, head of Al-Qadissiya Environment Directorate, for their assistance regarding Dalmaj protected area. We also would like to thank the Arab Regional Centre for World Heritage (ARC-WH) for the continuous support on studying the natural heritage in the Arab Region.

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