Waterfowl wintering, resting and breeding areas of the south-west Caspian lowlands

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Introduction

The South Caspian region of Iran has received considerable ornithological attention as compared with other sections of the country. Misonne (1953), Schüz (1959), Passburg (1959), Nielsen and Speyer (1967), Nielsen (1969), and Feeny *et al.* (1968), to name only a few of the more recent investigators, have all added to the knowledge of this area. Most of these workers, however, were only able to devote relatively short periods of time to the region and therefore concentrated on migrational aspects. Others described local movements, occurrence and abundance. Emphasis was almost always on the passerines.

This paper describes the results of an intensive study of the waterfowl and wetlands in the south-west Caspian lowlands. Investigation of the area was instigated through the interest of the Iran Game and Fish Department. The entire South Caspian region was recognised as an important wintering ground for Palaearctic waterfowl which provided an abundant supply of food for a well-established wildfowling industry (Savage 1963). However, little information was available on the kinds and abundance of species, the number, size, and type of habitats, effects of hunting, as well as many other aspects that would affect the status of the population as a whole. The Department was primarily interested in the factors affecting management of the waterfowl, but were also concerned with the overall ecology of the region.

The author of this paper, while employed as an advisor to the Iran Game and Fish Department and later as the Chief of the Migratory Waterfowl Unit, Division of Research and Development in the Department, collected data on an irregular time basis for the area from January 1967 to April 1970. Most observations were carried out during the winter months, but in December 1968 a month-by-month survey was initiated at the Pahlavi lagoon and marsh situated in the centre of the region. Visits were made over two or three day periods at approximately the same time each month until April 1970.

A total of 332 observations was made on over 100 areas throughout the south-west Caspian lowlands. Some areas were only visited once or twice to locate, study and evaluate them. Others, which were usually larger and determined to be more important, were visited several times to see how the situation changed from month to month. Due to the number of areas and observations the information in this paper is necessarily summarised.

The area of study consists of the south-west Caspian lowlands extending from the border in the north with the U.S.S.R. at Astara, south and east to an arbitrary point near the present town of Rudsar where the plain narrows between the Alborz Mountains and the Caspian Sea (Figure 1). The arbitrary demarcation was due in the north to political boundaries and in the south-east to physical limits of extensive wetland habitat other than the shore of the Caspian itself.

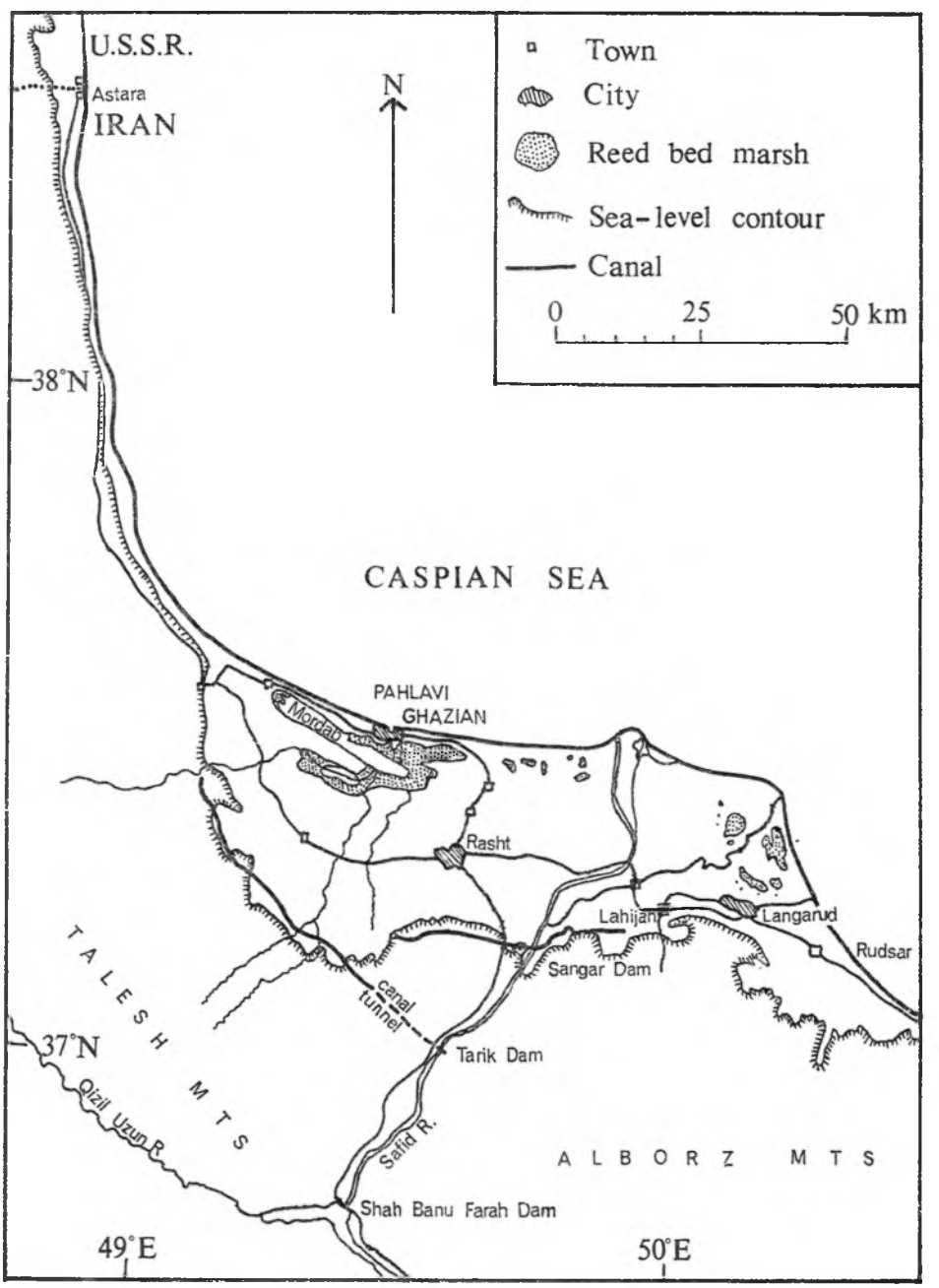

Figure 1. The south-west Caspian lowlands.

AREA AND STRUCTURE

Physical geography, geology and geomorphology

1 Caspian Sea

The Alborz Mountains (the western portion is known as the Talesh section) extend eastward from the border with the U.S.S.R. in the north-west, in a shallow arc (maximum width of 130 km. and an average of under 95 km.) along the southern end of the Caspian Sea for over 1,000 km. Included in this chain, and lying approximately in the centre, is the volcanic cone of Mount Demavand (5,774 metres) which is higher than any peak to the west of it in Asia or Europe. Because of its restricted width, the system is extremely steep, especially the northern slopes. These rise directly from the below sea level coastal plain of the Caspian.

Water runoff has furrowed these slopes with deeply-cut valleys and deposited the debris in the forelands in great alluvial fans and wide deltas. However, drainage to the South Caspian is by no means restricted to the northern slopes of the Talesh and Alborz Mountains.

The outwash and deposition of sediments from erosion of the northern uplands, accompanied by a lowering of the level of the Caspian, has succeeded in creating a narrow coastal plain some 650 kilometres in overall length but varying in width from 30 kilometres to less than two.

According to Zenkevitch (1963) the lowering of the Caspian is characteristic of the whole Quaternary Period. Savage (1958) indicates that since the area is in a great earthquake region, following any movement of the earth's crust there must be some settlement in the great depth of unconsolidated gravels which are known to underlie the Caspian. He also suggests that the climate is getting warmer in that part of Asia, and evaporation is therefore increasing.

Other investigators, including Zenkevitch (1963), report that changes in the level of the Caspian are the results of the fluctuations in the amounts of fresh water received from the rivers and from rainfall minus evaporation. Zenkevitch points out that over the last century (1830-1946) the level of the Caspian has averaged 25.45 metres below ocean level but that there has been considerable year to year as well as seasonal variation. The highest level was recorded in 1896 but since then the level has continued to drop. By 1929 it had decreased by 42 cm., and in the next 17 years fell rather uniformly another 187 cm. (there was an exception in 1942 when a minor rise was experienced, but this was followed by a greater fall in 1944). Zenkevitch further reports that the conformity between fluctuations of the Caspian Sea level and those of the inflow of the Volga River which supplies about 75.6% of the total water supply of all the rivers, is so close that direct influence has been established. He states that the great drop in the Caspian level from 1930 to 1943 was caused by the considerable decrease of river inflow, particularly the Volga, but that this has now been stabilised.

Almost all the reports since then indicate the contrary; that the Caspian continues to fall. However, the same reports give values for the level of the sea which lead to a great deal of confusion. For example, Vladykov (1964) states that the level of the Caspian in 1955 was about 28 metres below the level of the Atlantic Ocean (in effect, a further drop from 1946). Savage (1958) reports this level for 1956-57. Fisher (1968a), on the other hand, writes: 'The Caspian Sea at present is some 85 feet (25.91 m.) below mean sea level, and is slowly shrinking in size, with an average annual fall in level of about 8 inches (20.32 cm.)'. If all the readings were correct it would mean a drop from 1946 to 1957, and then a two metre rise from 1957 to 1968! It is doubtful that such is the case.

It is known, however, that the Caspian shows great seasonal fluctuation with highest levels occurring during the first half of summer, after floods, the lowest levels at the beginning of winter. There are no real tides, but sporadic *seiche* movements are produced as a result of sustained wind action. Definite currents exist; mainly from west to east, as regards the southern end. The sea has no outlet but is less saline than open oceans. The salt content is only about one-third of the average major ocean (12-13%) and one-fifth to one-fourth of that prevailing in the Mediterranean and Red Sea (Zenkevitch 1957).

2 The south-west lowlands

The present coastline of the south Caspian, produced as it is by shrinkage of the water surface, appears generally straight or only slightly curved and without any prominent headlands or cliffs. It is characterised by a sequence of sand beaches, dunes, spits and bars, bordered by a series of low-lying brackish and freshwater lagoons and marshes. A slightly higher and generally drier terrace zone fronts a piedmont zone marking the

beginning of the Alborz and Talesh foothills.

The south-west Caspian lowlands consist essentially of the delta of the Safid River which has built out a plain north and north-east into the Caspian and, hence, extended the width of the coastal plain to about 30 kilometres. The Safid River is the second largest in Iran and has a catchment basin of over 54,000 square kilometres and a natural flood discharge of 3,400 to 4,200 cubic metres per second which dwindles to a minimum flow of 19.6 cubic metres per second (Oberlander 1968). With such intermittent flow the Safid, and to a certain extent most of the Caspian rivers, divided into several distributary channels which frequently shifted and changed course. Many small lagoons, marshes and inundated areas were created along the seaward side of the plain and some were closed off by developing sand spits; hence, the name Mord-ab (dead water).

3 The Pahlavi Mordab

A large lagoon (now known as the Pahlavi Mordab) developed on the western flank of the Safid delta. Its exact origin is not known, but obviously underwent fluctuations in size and salinity, and may even have been inundated as a direct result of the changes in level of the Caspian. Presently, it is composed of a shallow, 26 km. long and 2 to 3.5 km. wide strip of water surrounded by reed beds and aquatic vegetation, which extend its eastern limits another 7 km., and lies in a north-west—south-east plane very close to the Caspian (Figure 2). Adjacent to this lagoon to the south and probably once a part of the lagoon is the extensive reed-bed marsh called Siahkesheem (12 km. long by 4.5 km. wide).

Several small perennial streams emanating in the nearby Talesh Mountains feed into this large lagoon-marsh complex, chief of which are the Bohambar, Chakoor and Siahdarveshan. Other shorter streams from runoff and irrigation from the Safid River also terminate in this area. The entire marsh and lagoon complex drain into the deep-water harbour of Bandar Pahlavi from several short channels at the north-east end of the lagoon.

4 Other mordabs

There are a few other open-water mordabs in the south-west Caspian lowlands worthy of note. Bandar Farahnaz (formerly Hassan Keyadeh) is a 3.75 km. long by 1.5 km. wide, shallow, freshwater lagoon 1.5 km. east of the present mouth of the main channel of the Safid River. It has formed relatively recently in the delta area and is separated from the Caspian by a sand spit that varies from 60 to 250 metres wide. An extensive reed marsh of 140 hectares covers the western end.

The open, but reed-rimmed, freshwater Shal Kol Mordab (also called Sheikh Ali Kol and Amirkelayeh) is situated on the eastern end of the Safid River delta about two kilometres from the Caspian. It lies in a north-south plane and is 4.5 km. long and 1,700 metres wide at the north end narrowing to about 700 metres in the south. Diverging northwesterly from the south end and lying nearly parallel to Shal Kol is the Hassan Aliadeh reed marsh (4 km. by 1 km.). These areas drain from the north-west end of Shal Kol into a channel of the Safid River that flows northward 1.5 km. away. Whether this channel created the mordabs originally is hard to say for it now appears they are entirely spring-fed. Shal Kol is extremely clear with depths of up to six metres and rich growths of underwater vegetation.

Several other mordabs are present in the lowlands. They vary in size from about 35 hectares up to nearly 900, and most of them occur on the east edge of the Safid delta in the vicinity of Shal Kol. They are nearly all full of aquatic and emergent vegetation and many are being reclaimed for agricultural use.

A complete list of mordabs, Abbandans and other wetlands in the area, 65 in all, with their size, location, status and present use, has been deposited with the Iranian Game and Fish Department, and with the headquarters of the International Waterfowl Research Bureau.

Climate

Although Iran has not had any long-term climatic observations, the Iranian Meteorological Department has been keeping records since World War II and has published an annual meteorological yearbook from 1956. From these synoptic and climatological data and Ganji (1968), the following account has been compiled.

1 Winter

During the winter months a high pressure system builds up over the interior of Asia due to the cooling of this vast continent. It is highest over Siberia but decreases outward. Portions of it extend over the north Caspian region into Europe, as well as over the interior of

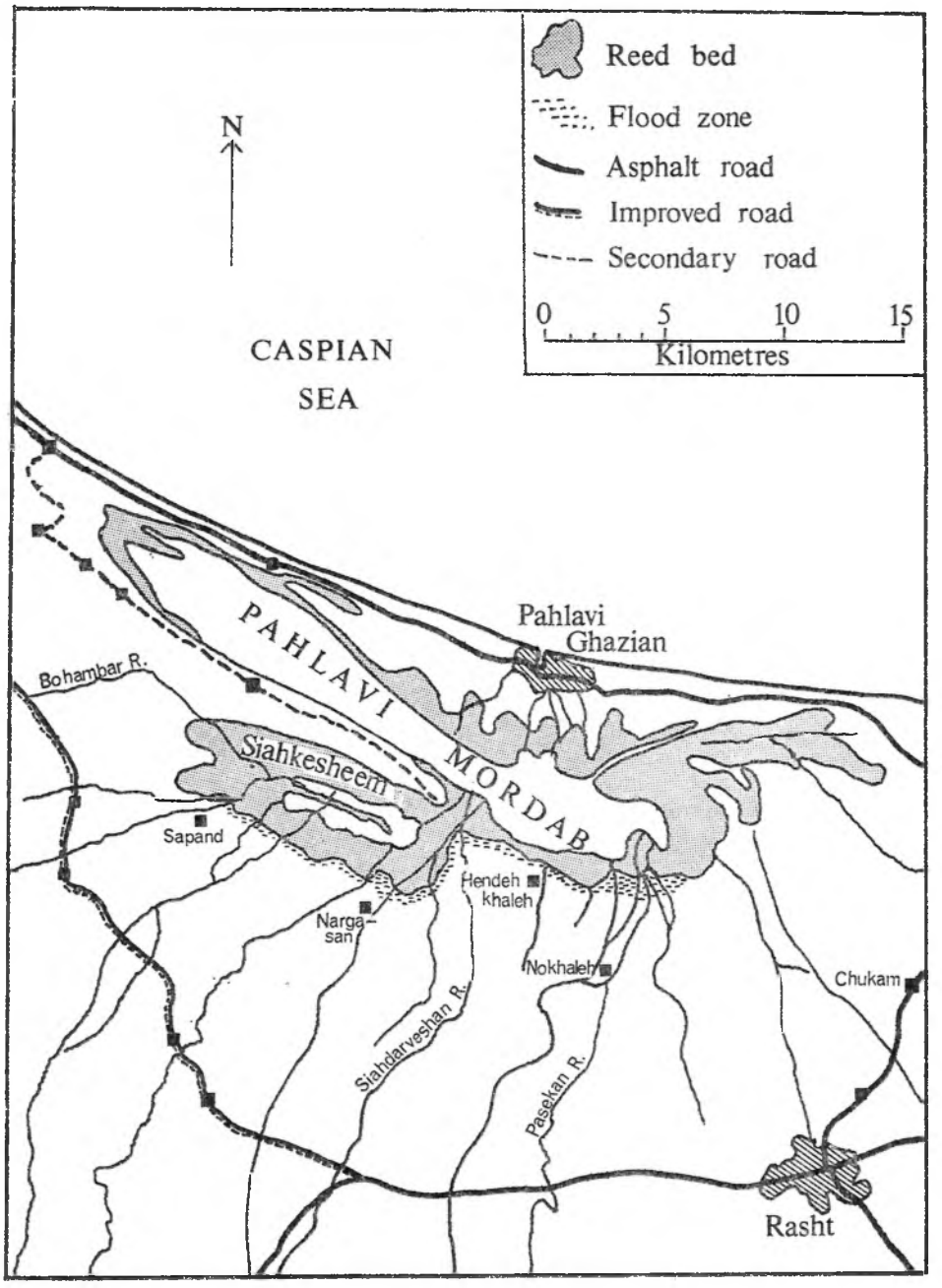

Figure 2. Pahlavi Mordab and Siahkesheem Marsh.

Iran. However, there is a relatively low centre over the warm waters of the Caspian itself bringing counter-clockwise winds from the north and west. Ganji (1968) states that the pressure field for northern Iran in winter (January) is 1,020 to 1,018 millibars mean sea level pressure and declines in intensity southward. Depressions formed over the Mediterranean bring almost all of the rain that occurs over the region during this time. Although winter is generally the rainy season for the rest of the country and the Caspian area receives the most precipitation, it is actually less than 25% of its annual total. Falls of 40-80 mm. of precipitation per day are frequent along the Caspian with up to 100 mm. per day in the south-west lowlands. Precipitation decreases from west to east.

2 Spring and summer

In spring and summer the interior of the country warms up rapidly, but cooler air over the Caspian causes a relatively high pressure field over the northern part of the country. The Mediterranean depressions retreat rapidly and as the temperature rises, a great deal of instability is created causing convectional rain and thunderstorms to arise in the north and west. Rainfall in the spring falls to 10% of its annual total along the Caspian, but the region still remains the wettest part of the country.

The summer months bring local winds primarily orographic in origin which are extremely variable and greatly influenced by topography over the Alborz and Talesh Mountains. Narrow valleys provide channels between the pressure system of the interior and that of the Caspian producing strong winds; a good example of which occurs in the Safid River valley at Manjil. Upward flows in the day and downward flows at night are common. Land and sea breezes are prevalent over the coastal area and bring in moisture from the large surface area of the Caspian. The steep, high Talesh and Alborz Mountains lie at right angles to these air movements and greatly facilitate condensation. Precipitation is heavy with almost daily rains, and the south-west lowlands again receive the greatest amount.

3 Autumn

After the autumnal equinox the Mediterranean depressions begin to re-establish themselves over the Middle East. The high pressure over Asia begins to form and the Caspian region draws in north-easterly and easterly winds that pick up a good deal of moisture as they move across the Caspian. Cyclonic activity is considerable all across the north Caspian coming in from the west. Local land and sea breezes continue. The combination of all these processes brings tremendous rain and shower activity. The south-west Caspian receives 50% of its annual rainfall during this time.

At all times the main annual precipitation is much higher along the Caspian with the south-west averaging 1,950 mm. roughly five times the average for the country as a whole. Relative humidity averages 80-85% yearly with highest readings during spring and autumn.

Temperature distribution is highly influenced by latitude and elevation. The Caspian zone is characterised by a low annual range of temperatures with relatively high values in winter and lower ones in summer. Low temperatures occur in February (mean around 6°C.) and the highs in August (maximum near 25°C.), due to the retarding influence of the sea. Minimum temperatures occur in January throughout the rest of the country with maxima in July.

Sub-zero readings are occasionally recorded but snow is relatively rare along the Caspian plain due to the warming effects of the sea. However, storms in January/February 1969 dumped up to a metre of snow on the lowlands including those in the south-west.

Soils and vegetation

1 Alluvial soils

The bulk of the soils in the south-west lowlands are fine-textured alluvials and continually or intermittently wet hydromorphic soils. They range from silt loam to silty-clay loam, clay loam and even clay in the surface (Dewan and Famouri 1961). The Safid River delta is composed mainly of these soils which are usually medium to heavy textured, calcareous, and good to fairly well drained.

2 Hydromorphic soils

The hydromorphic soils are a variety of low-humic, humic gley, and half bog, pseudo-gley, and gley; generally formed from sediments in the Caspian and converted into land with the recession of the sea (Dewan and Famouri 1961). These soils contain the remains of mussel shells which are broken down to chalk. Gradual lowering of the ground water and removal of the salts makes these soils very fertile. They are, however, very poorly drained.

3 Other soils

Other soils, of the piedmont and foothill zone, are the podzols, lithosols, and the brown forest types.

4 Vegetation

Zohary (1963) indicates that the south Caspian, due to its particular local climate, was one of the few refugia during the glacials of the Pleistocene to retain part of the temperate mesic flora of Europe which was virtually exterminated from the northern parts of its range. The lowland vegetation falls into several associations according to local conditions.

Sand Dune Vegetation—along most of the present south Caspian shore extends a line of dunes from 10 to 20 metres high and at various distances from the water's edge, but no more than 600 metres. A loose group of communities of coarse plants, including grasses, bushes and scrub, are confined to the non-mobile sands of the spray zone. According to Zohary (1963) the most characteristic species are: *Agriophyllum latifolium, Crepis foetida, Convolvulus persicus, Tournefortia arguzia, Daucus littoralis, Salsola kali.*

Swamp Vegetation—the rich hydrophytic flora is widespread all over the Caspian lowlands in the mordabs, small marshes, and virtually every impoundment of still or slow moving water. However, widescale drainage, filling, and agricultural practices have reduced this group's range.

The underwater aquatics are comprised of a long series of characteristic plants such as *Nuphar luteum, Nymphaea alba, Lemna* sp., *Limnanthemum nymphoides, L. indicum, Potamogeton crispus, P. pectinatus, P. nodosus, Myriophyllum spicatum, Ceratophyllum demersum, Salvinia natans.*

The emergent vegetation is represented by a series of plant communities dominated by: *Phragmites communis, Arundo donax, Erianthus ravennae, Saccharum spontaneum* var. *aegyptiacum, Cyperus longus, C. laevigatus, C. globosus, C. fuscus, Carex* sp., *Heleocharis palustris, H. pauciflora, Juncus lampocarpus, J. bufonius, J. conglomeratus, Alisma plantago-aquatica, Butomus umbellatus, Sparganium erectum, Iris pseudocorus, Typha australis, T. minima.*

The Hyrcanian Forest—this vegetation is similar to a tropical forest in its vigorous growth, tall trees and several storied structure. The liana, the fast regenerative abilities, and the number of species of trees and shrubs it contains (Bobek (1968) cites about 50 and 60 respectively), add to this effect. Individual communities are difficult to delineate owing to the effect Man has had on the ecological boundaries and species makeup through excessive cutting and unrational use of certain species. This has caused a large-scale altitudinal shifting. Clearing of the lowlands, particularly during the last 50 years, has left only small patches of the former forest, and agricultural and cultivated zones now predominate.

RESULTS AND CONCLUSIONS

Wintering

Habitat and food conditions of the south-west Caspian lowlands for waterfowl are near ideal and the region serves as one of the most important wintering areas in Iran for Palaearctic waterfowl, particularly dabbling species.

The area of land at or below sea level is about 3,800 sq. km. and a good portion of this is under rice cultivation. Although rice is planted in April and assiduously harvested by October, the paddies are full of stubble and seeds throughout the winter months. The abundance of precipitation in the autumn and winter turns the paddies into one large feeding table. In addition there are over 200 sq. km. of inland marshes, ab-bandans and mordabs which provide places to rest and hide. They are also filled with rich amounts of aquatic vegetation providing additional food. The great expanse of the Caspian, with its 250 km. of shoreline, serves as a resting area during the day for many species which fly inland at night to feed. Diving species may winter here throughout the season.

1 The Pahlavi Mordab

The most important area in the region is the Pahlavi Mordab and its adjacent reed beds and flood zones covering a contiguous area of nearly 15,000 hectares or three-quarters of the inland habitat of the region. The Mordab itself comprises nearly 11,000 hectares with about 7,000 hectares of open water, 3,300 hectares of *Phragmites communis* and emergent vegetation, and the rest flood plain. The adjacent Siahkesheem Marsh covers over 3,600 hectares, most of it *Phragmites* and emergent vegetation (2,400 hectares) with 900 hectares of open water and about 350 hectares of flood plain.

Maximum precipitation occurs in the autumn and as this is also the end of the growing season, runoff is allowed to flow unimpeded. The Pahlavi Mordab receives its greatest quantities of water at this

season and most of the southern sides are flooded, with water level rises of one metre or more not uncommon. This great mass of water seems to be slowed and dissipated by the reeds and there is rarely any flooding along the north side or at the drainage channels to the Caspian.

Precipitation in the winter is not as intense as in the autumn and water levels in the Mordab are much lower. Flood zones on the south side may be covered with 50 cm. of water down to practically none. This creates ideal conditions for dabbling ducks such as Mallard *Anas platyrhynchos*, Pintail *Anas acuta*, Teal *Anas crecca*, Shoveler *Anas clypeata*, Wigeon *Anas penelope* and Gadwall *Anas strepera*, as well as the Greylag Goose *Anser anser* and the White-fronted Goose *Anser albifrons* and the Mute Swan *Cygnus olor*, Whooper Swan *Cygnus cygnus* and Bewick's Swan *Cygnus columbianus bewickii*. The White Pelican *Pelecanus onocrotalus*, Dalmatian Pelican *Pelecanus crispus* and even the Greater Flamingo *Phoenicopterus ruber* occasionally use the area, but not in large numbers.

Disturbance is minimal even with a relatively high human population close by because the local inhabitants rigorously protect these areas which they have turned into ab-bandans, to trap ducks (see Savage 1963). The protection as well as the improvement by diking, reed cutting, and grazing enhances the value of the ab-bandans to waterfowl.

The three most important areas, in order of numbers wintering, are situated between the towns of Nokhaleh-Hendehkhaleh (90 hectares called Selkeh), Hendehkhaleh-Nargasan (100 hectares called Nargasan), and Nargasan-Sapand (60 hectares called Esfand) (see Figure 2). The entire southern flood plain is estimated at a little over 1,000 hectares. Concentrations of waterfowl occur at the previously mentioned locations throughout the winter because of the protection afforded them. Other parts of the flood zone are utilized but not to any great extent.

It is important to mention that the flood zones are tied in very closely with the adjacent low, emergent marsh vegetation and there is a lot of movement of waterfowl back and forth. Generally, these emergent zones are narrow and give way to tall, thick *Phragmites* which seem to serve merely as escape cover. If the approximately 5,000 hectares of reeds covering the entire area was one solid block, it would be virtually lost as waterfowl habitat. Fortunately it is spread out and the larger blocks are all interlaced with canals, streams and openings. The reeds are utilized by the local people for building materials, mats, etc., and thus many are cut each year. Duck hunters clear series of channels through the large reed blocks creating openings which attract waterfowl. These activities have definitely improved the reed bed areas for waterfowl.

The large, open, shallow-water area of the Mordab proper has lost much of its former importance for waterfowl mainly from almost constant disturbance even though it is potentially a good area for diving species. Pochard *Aythya ferina* and Tufted Duck *Aythya fuligula* still occur in fairly large numbers and float in large rafts near the west central portion.

Coots *Fulica atra* still use the area in large numbers and often occur near the reeds at the west end. However, waterfowl hunters, using firearms, keep all the birds moving. It is illegal to hunt from a motor boat but hunters working in pairs can get around this measure by using one man in the boat to keep the birds moving while the other sits in a blind surrounded by decoys. The disturbance effect of this method by a hundred hunters with no bag limits can be considerable. This water area is also the traditional route to the market at Bandar Pahlavi and boat activity transporting goods to and from the small villages and towns surrounding the Mordab is quite considerable. Many birds fly out to the Caspian during the day.

2 *Ab-bandans and smaller mordabs*

The remaining inland ab-bandans, marshes, mordabs, and small reservoirs make up an important part of the winter wetland complex. The degree of protection afforded these areas or their remoteness seem to be the most deciding factors in their welfare. Many areas of relatively small size such as Amir Abad Ab-bandan just west of the Pahlavi Mordab, get tremendous numbers of waterfowl. Others, many times larger but lacking protection, have but a fraction of the population, or even none at all. Many birds probably return to the same areas year after year but there is also considerable local movement in the whole population. Ducks ringed at ab-bandans near the Pahlavi Mordab have been recovered a few days later in areas 20-30 km. west and south. Movement may be random or from stress. Nevertheless, the numbers of sanctuaries and proximity to each other are undoubtedly important factors in the quality of the region as a whole. Waterfowl rest in these areas and forage out in

the surrounding rice paddies in the evenings and early mornings.

3 Caspian Sea

The Caspian is a key element in the suitability of the adjacent land area for waterfowl. As noted previously, its surface salinity is only 12-13% and according to Vladykov (1964) the salts consist mainly of carbonates and sulphates which approaches the situation in fresh water. Because of this, many freshwater fish can survive in the Caspian and in its rivers. Although not as rich faunistically or floristically as other large seas, the Caspian, nevertheless, provides abundant food for many species of waterfowl. It also serves as a haven of rest. Ducks such as the Tufted Duck and Pochard in good numbers as well as a few Goldeneye *Bucephala clangula* can be seen riding the waves in long lines 100 to 300 metres offshore all winter. Concentrations are often seen at the mouths of rivers.

Surface-feeding species, such as Mallard, Shoveler and Teal can often be seen in the Caspian opposite the Pahlavi Mordab. Except for severe storms, birds on the Caspian are fairly safe from disturbance and danger. Unfortunately, there has never been any attempt to fly over the Caspian to see how far from shore waterfowl occur, mainly because of the proximity of the U.S.S.R. border and the political implications.

Passage movement

There is little doubt that the south-west Caspian lowlands serve as an important resting area for bird migrants travelling to and from their more northern breeding grounds and their more southern wintering grounds. However, there is sometimes a problem in sorting out the status of waterfowl in the region since it is also a vast wintering ground and early arrivals or late departures of overwintering birds may be mistaken for migrants. Some species such as the Garganey *Anas querquedula* are obviously passing through since they do not winter there. Others, like the Pochard, which do winter in the region, probably also have numbers moving through.

1 Ringing results

A ringing programme was established by the Iran Game and Fish Department in early 1966 to follow duck movements as well as to learn something about the origins of the waterfowl visiting Iran. By 1970, 1,279 individuals of 14 species of ducks and coot had been ringed in the south-west Caspian lowlands, with 42 recoveries of eight species (Cornwallis and Ferguson 1971). Of these recoveries, 26 were in Iran within 100 km. of the place of ringing and most of them (17 Mallard, 3 Teal, 1 Ferruginous Duck *Aythya nyroca* and 1 Coot) during the same winter. However, four of these (2 Mallard, 1 Teal and 1 Tufted Duck) were recovered the following winter.

The remaining sixteen birds (9 Mallard, 1 Teal, 1 Pintail, 1 Garganey, 1 Pochard, 2 Tufted Duck and 1 Coot), were all recovered in the U.S.S.R. Most of the birds were captured within nine months on their nesting grounds during the late spring or early autumn. Three Mallard were recovered the second year after ringing. The recovery localities lie in an ellipse aligned in a north-east direction from the south-west Caspian wintering grounds and the moulting grounds in the Volga Delta and extend into North and West Siberia between the Urals and the Upper Ob River.

2 West Siberian-Caspian-Nile population

The above information is included since it lends support to Isakov and Shevareva's (1968) postulate that the large geographical population of ducks and geese which they call the 'West Siberian-Caspian-Nile' group winters near the shores of the Caspian Sea, in western Turkey, in the countries of the eastern Mediterranean, in the Nile Delta, as well as the valley of the Euphrates, on the Persian Gulf, in Ethiopia and in the Sudan. This population, which they contend emanates from breeding grounds within the drainage systems of the Pechora, Kama and Vyatka rivers to the west of the Urals and in the north and west of West Siberia along the Lower Ob, North Sos'va, Tavda, Ishim and Tobol rivers, migrates principally along the valleys of the Lower Ob, the Irtysh and the Tobol through which they emerge over the Urals, the Emba River and the Volga delta. Here, Isakov and Shevareva say a number of flyways join together with a section of birds moving west towards the Balkans and the Mediterranean while the majority proceeds southerly along the west shore of the Caspian to Azerbaijan and Iran. They go on to state that a considerable number of these birds continue still further to the valley of the Euphrates and the Persian Gulf. From there they may pass to the Upper Nile, Ethiopia and the Sudan.

3 Effects of weather

Weather, of course, has quite an effect on migration, both on arrival and departure times as well as on the routes taken. Using Isakov and Shevareva's (1968) contention of the route of waterfowl coming to the south-west Caspian, if fair weather and good conditions are prevalent on the Volga delta during migration, it is conceivable that many birds might linger there longer than normal, thus delaying flights to Iran. Mild winters in the north Caspian region could entice many birds from journeying further south.

The autumn and winter of 1969-70 may have been a good example of this. Unfortunately, official weather records are not yet available for Europe, the U.S.S.R. and the Middle East for this period and hence it is only possible to speculate. Unofficially, northern Iran experienced a mild winter. The general consensus of hunters and farmers in the south-west Caspian lowlands on the arrival of waterfowl in the region is that Garganey usually arrive first in late August to late September. Occasionally Pintail, Shoveler and Teal arrive at nearly the same time. Mallard are said to arrive from mid-October to mid-November, geese in mid-November and the bulk of the ducks are in by mid-December.

A visit to the Pahlavi Mordab area in the second week of September 1969 indicated that, at least for waders and raptors, autumn migration was well under way. However, the Caspian was void of waterfowl as were the open waters of the Pahlavi Mordab, Bandar Farahnaz, and Shal Kol. The only place waterfowl were seen in numbers was the Safid River, especially at the Sangar Dam reservoir, 42 km. south of the Safid mouth, where 200 Garganey and 12 Shoveler rested.

The following month from the 13th to the 15th, the wader-raptor migration appeared to be tapering off, but waterfowl had not made an appearance except for a few thousand ducks on Selkeh (mostly Pintail, with a few Mallard and Shoveler).

The next visit to the area in the first week in November found 15,000 ducks of 10 species and 30,000 Coot on the Pahlavi Mordab area. About 100 geese (11 Greylag and 90 White-fronted) were also observed. Only a few birds were seen on the Caspian with about 500 ducks on Bandar Farahnaz and none on Shal Kol. There was no activity in any of the smaller ab-bandans and queries to the local inhabitants revealed that there had not been any.

Checking the same localities during the second week of December (11th-14th) resulted in counts of a little over 29,000 ducks of 11 species and 6,300 Coot on the Pahlavi area. The numbers of Coot, Pochard and Tufted Duck had dropped off drastically from the previous month suggesting that many birds were passing through. The Caspian Sea, Bandar Farahnaz and Shal Kol showed an increase in both numbers and species. Waterfowl were present in most of the smaller ab-bandans and hunting methods throughout the area were well under way indicating that wintering birds had established themselves. However, gun hunters on the Pahlavi Mordab were all complaining that there were not many birds this year.

This fact seemed to be borne out by mid-winter counts in January and February 1970 which totalled only 86,000 ducks in the Pahlavi Mordab area; and counts were fairly complete. Mid-winter counts for the two previous years which were only 50-80% complete turned up 144,000 and 101,000 ducks respectively for the area. Naturally, there are probably other reasons for these differences and it will be interesting to see what develops in the coming years.

4 Spring migration

The south-west Caspian is a staging or resting area in the spring for returning migrants. The local inhabitants say that the wintering population of waterfowl normally leaves the region in late March and early April with the geese departing a bit earlier in mid-March. Counts in late March (14th and 25th) 1969 indicated that at least for that year, this theory was correct. With 12 cm. of snow on the ground, the open water of the Pahlavi Mordab held only 600 ducks of four species (Pochard, Tufted Duck, Mallard and Shoveler, in order of abundance) and 3,100 Coot. The small ab-bandans around the area were essentially empty of waterfowl, but about 350 ducks (Mallard, Tufted Duck, Teal and Goldeneye) were seen in the Caspian area opposite the Mordab. In addition, the flooded abandoned airfield area east of Ghazian-Pahlavi had about 500 ducks (Pintail, Teal and Shoveler). Five flamingos and six Mute Swans were seen, at different times, flying low over the Mordab toward the Caspian. Ten Whooper Swans were seen on the west end of the Mordab and 28 more were observed feeding on a flooded zone at the east end of the Mordab.

One month later (26th April-1st May) observations along the Caspian from Bandar Pahlavi to Astara revealed no

waterfowl. On 27th April, 1 Ruddy Shelduck *Tadorna ferruginea* at Selkeh, 6 Mute Swans (2 immature) at Nargasan, 5 Mute Swans with 100 ducks and 2 Coot on the Pahlavi Mordab, were recorded.

The 1970 spring, which followed a mild winter with low numbers of waterfowl, saw the birds leaving perhaps earlier than usual. Counts from 3rd-9th March indicated a few thousand ducks present on the Pahlavi Mordab (Mallard, Teal, Pochard, Tufted Duck and 3 Ferruginous Duck). However, a report from Selkeh on 23rd April listed a concentration of over 700 Pintail, 500 Pochard, 350 Teal, 150 Wigeon and over 100 Shoveler. These were, no doubt, migrants from further south.

One further set of records from 1967 has some bearing here. On 29th April and 5th May visits to Selkeh revealed no waterfowl, but on 8th May at Bandar Farahnaz, the Safid River mouth and the adjacent Caspian, a total of over 400 ducks (135 Shoveler, 100 Garganey, 90 Mallard, 40 Wigeon, 20 Gadwall, 15 Tufted Duck, 9 Pintail and 8 Pochard) with a pair of Mute Swans were noted. Most of the birds were on the Bandar Farahnaz Mordab.

5 Routes of migration

The route taken by migrants when they leave the south-west Caspian to travel further south seems to follow the Safid River upstream across the Alborz Mountains on to the inner plateau. Here there probably is a divergence of birds with some moving south-eastward along the east-facing slopes of the Zagros Mountains to the salt lakes and marshes of south-west Iran around Shiraz. Another route probably turns south-west across the low Northern Zagros and follows the west-facing slopes southward to Iraq and the Persian Gulf.

Whether waterfowl returning to their northern breeding grounds in the spring follow the same routes as in the autumn is not known. Many more continuous month-by-month observations plus recovery data from ringed birds will be necessary before any conclusions can be drawn.

Breeding and nesting

The only waterfowl found to be nesting in the south-west Caspian lowlands were Mallard, Teal and Coot. Activity seems to be restricted to the heavily vegetated portions of the Pahlavi Mordab and adjacent Siahkesheem Marsh.

1 Food and habitat conditions

Physical conditions appear to be satisfactory for supporting nesting of fairly large numbers of waterfowl. It is estimated that there are over 300 kilometres of major emergent-to-open water and emergent-to-land edge, plus probably three times that amount created by openings.

Khavari-Nejad (1968) lists 37 species of plants in the Pahlavi Mordab (14 emergents, 14 floating-leaf aquatics, and 9 submerged aquatics) (Table I). Unfortunately, he makes no estimate of quantity of any of the species. From personal observation, however, the most dominant emergent, by far, is *Phragmites communis* which has little cover and no food value to waterfowl. This means that the bulk of the 5,000 hectares of reed bed is relatively unused.

Nevertheless, openings, and especially shallow water areas around the Siahkesheem Marsh and along the north and at the east end of the Mordab proper, show a zonation of plants which include fair to excellent cover and food species. Floating leaf and submerged aquatics are the species that provide the bulk of the food in the marsh areas. The open water in the centre of Siahkesheem is particularly rich in submerged aquatics such as *Potamogeton* sp., *Elodea* sp., and *Ceratophyllum* sp. *Lemna* sp. and *Spirodella* sp. cover the water in protected areas. Profuse growths of filamentous algae appear in the shallows and stagnant areas.

Vegetation growth, as mentioned earlier, is fast-growing and lush due to the favourable climate. Some areas would soon become a solid mass of plants were it not for the activities of Man. Still, some species such as *Trapa natans* are overwhelming in their capacity to reproduce. Fully one-third of the open water area of the Pahlavi Mordab at the east end (about 2,000 hectares) is completely covered with leaves of this plant by July every year. Although edible by waterfowl, it is not utilized as much as it could be because the area of growth coincides with the area of most intense boat activity.

Aquatic animal life in the Mordab area is abundant also. The late spring and early summer waters contain a wealth of invertebrate and insect fauna. Tadpoles of frogs and toads abound as do small molluscs and millions of tiny fish fingerlings in very shallow water cling to vegetation. Walczak and Ralonde (1971) report at least 11 species of resident, 8 migratory, and 1 semi-migratory fish in the Mordab. They mention that all the migratory species come into the area in the spring with *Silurus glanis* generally migrating in

Table I. Plant species in the Pahlavi Mordab (from Khavari-Nejad 1968).

Plant species	*Value to waterfowl* food	cover
Emergents:		
Phragmites communis		++
Sparganium sp.	++	
Typha latifolia		+++
Echinochloa crus-galli	+++	+++
Glyceria luitans	?	?
Scirpus palustris	++++	++++
Cyperus sp.	++++	++++
Sium angustifolium	?	?
Nasturtium amphibium	?	?
Sagitteria sagittaefolia	++	
Alisma plantigo-aquatica	?	?
Butomus umbellatus	?	?
Equisetum sp.	+	
Nelumbium caspicum	?	?
Floating-leaf aquatics:		
Utricularia vulgaris	++	
Salvinia natans	?	
Hydrocharis morsus-ranae	?	
Hydrocotyle vulgaris	?	
Lemna minor	+++	
Lemna trisulca	+++	
Lemna polyrhiza	+++	
Trapa natans	++	
Lymnanthemum nymphoides	++	
Polygonum lapathifolium	++++	
Polygonum amphibium	++++	
Polygonum natans	++++	
Spirodella polyrhiza	+++	
Riccia sp.	?	
Submerged aquatics:		
Myriophyllum verticillatum	+	
Myriophyllum spicatum	+	
Ceratophyllum submercum	+	
Ceratophyllum demersum	+	
Hydrilla verticillata	?	
Potamogeton pectinatus	++++	
Potamogeton crispus	++++	
Elodea nutallii	+	
Ranunculus divaricatus	+	

Value ratings: + = slight; ++ = fair; +++ = good; ++++ = excellent; ? = unknown.

the spring to coincide with the hatching of the young cyprinids.

One of the more obvious of invertebrate organisms inhabiting the Mordab area and virtually all standing and slow-moving waters including rice paddies and the smaller streams are the leeches. There seem to be two species present: a large blood-sucking leech, tentatively identified as *Hirudo medicinalis*, which preys on fish, turtles, waterfowl and mammals including Man, and is extremely widespread on the south-west Caspian lowlands; the other species is probably *Glossosiphonia* sp., a smaller member of flat leeches and less abundant, which inhabits the vegetation of standing waters and calm rivers and feeds on the blood of molluscs and small invertebrates.

The larger leech, which is still used for medicinal purposes in the U.S.S.R., is a pest to the rice farmers of Northern Iran who call it 'zagi' and know it well. The leeches become active as soon as the water warms sufficiently in the spring and persist into November. Their abundance and habits may be detrimental to young waterfowl by weakening them, although there is no evidence to support this theory.

2 *Predation*

Potential predators of waterfowl inhabiting the area include avian, terrestrial and

aquatic. Of these, the Jackal *Canis aureus* poses the biggest threat to nesting and juvenile waterfowl. Jackals range all over the lowlands, especially along the sea coast, marshes, and villages where they search for carrion. They have been observed at all times of the year and do not hesitate to venture into shallow water.

Of the avian predators, the most common during the breeding and nesting period is the Marsh Harrier *Circus aeruginosus* and although it may take a few young birds and eggs, it is doubtful that it is a limiting factor. Black Kites *Milvus nigrans* and White-tailed Eagles *Haliaeetus albicilla* frequent the area but generally confine themselves to the sea coast where there is always an abundance of dead fish and carrion.

3 Disturbance

Most of the flood zones on the south side of the Pahlavi Mordab and Siahkesheem Marsh dry up during the summer months. Domestic livestock, mostly water buffaloes and horses but some cattle also, are allowed to graze this area as soon as green shoots appear (about early April). These animals have adapted themselves to the aquatic environment and will forage into water one metre or more deep in search of the marsh plants. There is little danger of overgrazing and the effect of cropping the vegetation is probably beneficial in setting back succession. It is doubtful that they are detrimental to nesting waterfowl.

Boat activity continues but generally stays on the open waterways and seldom ventures into the surrounding vegetation.

4 Breeding data

All conditions would seem to point to a favourable waterfowl breeding and nesting habitat. However, courtship and breeding behaviour was observed only once even though there was obviously much more: on 28th April 1967 at Gulegha on the north side of the Pahlavi Mordab. Three pairs of Garganey were sitting together in open water with the males dropping their heads to the water and bobbing and swimming in front of the females. All would suddenly leap into the air and, flapping their wings, turn in a clockwise semi-circular path back into the water. This was repeated several times. Then all circled the area in the air and finally disappeared into the nearby *Phragmites* reeds, picking up a fourth pair along the way.

Reports from local inhabitants indicated that Mallard, Teal, Shoveler and Ferruginous Duck nested at the east end of the Pahlavi Mordab and some in Siahkesheem. Coot were reputed to nest in hundreds near Selkeh. Investigation in late April and early May 1969 revealed the presence of Coot, Mallard, Teal and Garganey but none in large numbers and no indication of nesting.

Visits from 8th-10th July 1969 found 15 Coot nests in the reeds near the Nargasan River (south side of Siahkesheem) and one Coot with three recently hatched young. Several adult Coot were seen nearby but no more young. Pygmy Cormorants *Phalacrocorax pygmeus* were nesting in the reeds in the same vicinity and six nests were found, all containing 3-5 eggs. The lateness of these suggests they may have been second nests.

Farther west along the south side of Siahkesheem near the village of Sapand a female Teal was seen sitting on a nest in the marsh vegetation alongside an earthen dike. Six adult Mallard were observed over the centre of Siahkesheem one evening.

On the evening of 4th August 1967, 17 Teal in eclipse plumage with a pair of Garganey were feeding at the edge of Siahkesheem near the mouth of the Siahdarveshan River. Later, 40 unidentified ducks were seen flying east in two groups over the Caspian opposite the Mordab.

Despite the fact that so few waterfowl nest in the region several other species of water birds do. Sightings in the summer of 1969 confirm that the following water birds nest in the marsh vegetation of the Pahlavi Mordab and Siahkesheem: Great Crested Grebe *Podiceps cristatus*, Squacco Heron *Ardeola ralloides*, Cattle Egret *Bubulcus ibis*, Great Egret *Egretta alba*, Little Egret *E. garzetta*, Grey Heron *Ardea cinerea*, Water Rail *Rallus aquaticus* and Purple Gallinule *Porphyrio porphyrio*.

Anthropogenic effects

1 Historic

The first real effect Man had on the region was probably during the Mongol invasion of the thirteenth century. The following account is from Savage (1958) who reported that before the tenth century the level of the Caspian Sea was only about 10 metres below sea level. The Mongols diverted the ancient River Oxus (now called Amu-Dar'ya) which used to flow into the south-east corner of the Caspian at Krasnovodsk and the Turkmensk Inlets in the U.S.S.R. For a short period the sea fell rapidly until it reached

an equilibrium at about 33 metres below sea level. Later, during their second invasion of the region, the Mongols diverted the River Oxus back to its old channel to drown a city built over its previous course. The water level in the Caspian rose to a little above its former level where it remained for about another two centuries when the Oxus was once again diverted to the Aral Sea. There it has been used for irrigation and other purposes ever since. How much of the South Caspian lowlands were inundated and altered by these events is not known.

The lowlands were still sparsely settled and according to DePlanhol (1968) only by individuals and detribalised peoples forced into the area from south of the Alborz. Fisher (1968b) speaks of early populations leading patriarchal lives, with pastoralism a principal element, preying on travellers for extractions and conducting local trade as an important supplement. These predatory and often turbulent actions of the inhabitants led Shah Abbas in 1593 to order a general massacre of the people in the south-west Caspian region. Ultimately, the Qajar rulers south of the Alborz in the capital city of Tehran brought in numbers of people from other regions in the eighteenth century. Significant colonisation took place soon after.

2 *Population*

The south-west Caspian lowlands are part of the administrative province of Gilan (named in 1937) with the city of Rasht as the political capital and communications centre. Rasht lies about 20 kilometres from the Caspian Sea on the Safid River delta and dates from the end of the thirteenth century (DePlanhol 1968).

With the construction of all-weather roads, Rasht has developed considerably and is now the largest town of the Caspian provinces. Besides its function as the regional agricultural market and capital, it handles a large portion of the trans-Caspian trade through the port of Pahlavi. A 1966 census (Anon. 1970) established the population of Rasht as 143,557.

Gilan is one of the most densely peopled areas of Iran with an average of 47.9 persons per sq. km. (1966 census) and nearly half of the population are under 20 years of age. Oberlander (1968) states that the south Caspian plain: "supports the greatest concentrations of humanity between the Black Sea and the Indus Valley".

This great influx of people shows no sign of diminishing; rather as more and more areas are cleared of forest, there are increased opportunities for settlement. The soils under the Mordabs are particularly fertile so wetlands are being drained and reclaimed. In many places cultivation now extends over the entire zone between the sea and the Talesh foothills.

3 *Water*

The Safid River is now controlled by the 106 metre high Shahbanu Farah Dam, 60 kilometres south of Rasht and completed in 1963 for flood control, irrigation and electric power. This has essentially eliminated any further building out of the Safid delta, but it has created a large reservoir that varies in size from 3,000 to 5,600 hectares. The reservoir is silting up very rapidly which may render it practically useless in 20 years or so.

Two smaller water control structures on the Safid, the Tarik Pasikhan Dam and the Shakharaz (Sangar) Dam, between the large dam and the Caspian were completed in the late 1960's for irrigation purposes. A system of canals from these two smaller dams will eventually provide sufficient water to most of the south-west Caspian plain to eliminate the need for the private ab-bandans, the small reservoir-like impoundments constructed all over the lowlands for irrigation.

Rice is the major crop grown in the area and requires a great deal of water during its growing season. Thus, as land was cleared and planted, the small streams from the mountains were diverted into the paddies and small earthen reservoirs were constructed to provide an adequate supply of water through the summer. Some of the smaller mordabs were improved for similar purposes. These reservoirs or ab-bandans are fairly shallow and vary in size from a few hectares to several hundred. The favourable climatic conditions encouraged abundant growth of hydrophytic flora in the ab-bandans and the owners quickly found that these areas attracted large numbers of waterfowl in the winter months. For centuries through his clearing practices Man has destroyed a great deal of wetland habitat. Unknowingly, he produced suitable habitat with his ab-bandans.

It probably did not take the Gilan farmer long to realise that he had a ready supply of meat from late autumn to early spring if he kept his ab-bandans filled with water and protected. Thereafter a series of waterfowl catching methods evolved (see Scott (1939) and Savage

(1963) for discussion of the more important methods). The role of these ab-bandans in wetland conservation is stressed by Savage (1963) and Firouz (1968).

The future demand for more land and the availability of irrigation water from the larger dams will probably preclude the need for ab-bandans. Thus, the farmers will require added incentive to retain these structures merely for waterfowl during a short period of the year.

4 Pahlavi Mordab

Several large projects in Gilan in the past few years have greatly affected the Pahlavi Mordab area and threaten its well-being. New roads are being pushed into many areas formerly served only by foot trail or by boat, particularly on the south side of the Mordab. Other roads are being asphalted. An airport has been constructed north of Rasht. The harbour facilities at Bandar Pahlavi are being expanded. An industrial site is planned for the south side of the Mordab. These projects have opened up new areas and increased the flow of people which makes more of a demand for available land.

A section of the 1,100 km., 101-106 cm. Iran-U.S.S.R. gas line runs about 6 kilometres south of the Mordab and Siahkesheem area. Farther west it turns toward the sea coast and follows it up into the U.S.S.R. at Astara. Although the pipe is underground, a 30-50 m. wide right-of-way has been cleared on the ground surface which cuts across marsh-land and agricultural areas alike.

A 2 km. long 20 m. wide drainage canal, from the north-west end of the Mordab (8 kilometres east of Bandar Pahlavi) into the Caspian, is presently under construction. Its purpose is to reclaim some 5,000 hectares of reed marsh for agriculture. What effect drainage of this area will have on the rest of the Mordab ecosystem is not known.

The forests of Iran were nationalised in January 1963 to protect them against indiscriminate burning for charcoal. In October 1967 the Ministry of Natural Resources was created and took over the administration of the forests from the Ministry of Agriculture. As part of their overall management of the northern forests a law was passed to allow cutting of all timber below 100 metres elevation so that the land could be converted to agriculture. This will essentially wipe out the remaining forests of the south-west Caspian lowlands.

5 Hunting

It has been mentioned previously that the Gilan farmers use their irrigation ab-bandans to catch waterfowl during the winter months. Savage (1963) estimated that nearly a million ducks were harvested in Gilan in this manner in 1959, while Firouz (1968) indicated that the number had dropped to about 20% of this by 1967. The reasons for the decline are many. The amount of suitable habitat has obviously been decreasing. The Iran Game and Fish Department, which had its beginnings in 1956, required all duck hunters to obtain a licence and ab-bandan owners were forced to purchase permits for their areas, the price being dependent on the size, quality, and number of birds taken. Some ab-bandan owners felt the permit price was too high and simply ceased activities.

Gun hunters in Gilan accounted for 82,500 ducks in 1959, according to Savage (1963), while the number taken by them in 1967 was down to about 15,000 (Firouz 1968). Game and Fish Department records indicate that the number of bird licences sold in Gilan (about 90% are for waterfowl) dropped by nearly half from 4,673 to 2,991 in the period 1966 to 1969. Evidently, many hunters are not finding it profitable to purchase licences. Still, the effect of gun hunters on the disturbance of waterfowl, mostly on the Pahlavi Mordab, is considerable.

The netting methods are silent and rely on protection of the areas to attract waterfowl. The most efficient method is carried out at night and disturbance is minimal. Few birds are maimed or lost and the birds rarely connect Man with the operation. On the other hand, shooting is not only more noisy, but losses from crippling and the ingestion of lead shot are a real threat.

In February 1969 two Whooper Swans which were unable to fly, were captured on the south side of the Pahlavi Mordab. They later died and examination of the gut revealed the presence of a considerable amount of lead shot in both gizzards. In November of the same year at Selkeh, 3 Coot and 1 Great Egret were found dead. All had been shot, but had evidently managed to fly off before dying.

Gun hunters, pursuing their quarry in boats or from blinds, keep the birds constantly moving with little chance for rest, hence, many birds fly out to the Caspian during daylight hours.

6 Protection

The importance of the south-west Caspian lowlands for waterfowl seems to be

determined by the number, proximity, and diverseness of the habitats. Some ab-bandans are as small as two hectares but are located close to other areas and attract hundreds of waterfowl. A good 40 hectare ab-bandan lies near Astara but there are no other wetland areas nearby except for the Caspian, and waterfowl are subject to gun hunting, so few birds utilise the area. The same goes for a similar area 70 kilometres farther south. The first area of any importance lies a few kilometres west of the Pahlavi Mordab and from that point south and east for about 120 kilometres stretches a network of good to excellent waterfowl habitat. The size of this complex, however, has been decreasing steadily over the years and is at a critical point now. Further diminution of the complex, especially the Pahlavi Mordab area, coupled with increased disturbance, will spell doom to the entire region as an important wintering ground for waterfowl.

The ages-old protection of waterfowl by the protection of ab-bandans has already been briefly mentioned. However, as this system is gradually fading out, the Iran Game and Fish Department has taken steps to set aside the more important areas as Protected Regions (described by Firouz *et al.* 1970). Most of the Siahkesheem Marsh, totalling 3,515 hectares, was declared a Protected Region in August 1967. About 85 hectares of important flood zone and adjacent marsh vegetation at Selkeh became a Protected Region in September 1970. The 519 hectare Shal Kol Mordab and the 40 hectare Jocandan Ab-bandan 85 kilometres north-west of Bandar Pahlavi are being considered for such status. Hunting and fishing, grazing and reed cutting are controlled on these areas and can be immediately banned if the necessity arises.

Systematic list

The following list of waterfowl includes only those species seen during the study period. Some species observed in previous years by other investigators may have been overlooked, but it can be assumed they were vagrants and not very important in the overall picture.

Greater Flamingo *Phoenicopterus ruber*

A passage migrant in small numbers both in the spring and autumn. Two Flamingos ringed in July at Tengiz Lake near Tselinograd, U.S.S.R., were recovered in Iran: one near Lake Rezaiyeh in north-west Iran six months later in December of the same year, the other at Gorgan Bay in the south-east Caspian during March of the following spring (Cornwallis and Ferguson 1971). On 12th November 1966, 56 Flamingos were observed flying west over the South Central Caspian near Chalus, Iran. A dead Flamingo was recovered at the mouth of the Shalmon River near Langarud, Gilan, in late December 1968. One was seen at Bandar Farahnaz at the mouth of the Safid River in early February 1970. During the hard winter of 1968-69, 124 were recorded from Selkeh and Nargasan in early February 1969. Twelve were seen in the same locality early the following month. Fifteen Flamingos rested in the same locality for four days in mid-October 1969. Wintering populations are known from Lake Rezaiyeh and Gorgan Bay and it can be theorised that they are of the same Russian origin. Movement may be along the South Caspian shore to Pahlavi, then over the Talesh Mountains to Rezaiyeh, perhaps via the Safid and Qizil Uzun Rivers.

Mute Swan *Cygnus olor*

Mainly a vagrant in winter although a few are observed every year. In late January 1969 during a blinding snowstorm, eight were seen flying south along the Caspian at Astara. Early the following month, four were recorded on Shal Kol and 13 on the south side of Siahkesheem. Six were seen on the north side of Siahkesheem late in March of the same year and again in the same place at the end of April. Five more were on the south side of Siahkesheem at the end of April.

The only other record is for a pair on Bandar Farahnaz in early May 1967.

Bewick's Swan *Cygnus columbianus bewickii*

An irregular winter visitor generally occurring with Whooper Swans and geese on the flood zones south of Siahkesheem and Pahlavi Mordab. Records include 20 in late December 1968, 843 in early February 1969, 16 in early January 1970 and 20 in early February 1970.

Whooper Swan *Cygnus cygnus*

A regular winter visitor to the region in small numbers, normally occurring with the geese on the flood zones south of Pahlavi Mordab and Siahkesheem. They have also been recorded from Sangar Dam on the Safid River, Shal Kol, Bandar Farahnaz, the north side of Siahkesheem,

in the Pahlavi Mordab, and on the Caspian opposite the Mordab. Arrival time appears to be in mid to late December with departure in February. However, they have been recorded in late March (1969). The average number of wintering birds is about 50, although 1,361 were recorded in early February 1969.

White-fronted Goose *Anser albifrons*

Similar to the Greylag as a regular winter visitor in the flood zones and rice paddies south of the Pahlavi Mordab and Siahkesheem but in smaller numbers. The highest number recorded was 800 in November 1969 and some of these may have been passage migrants. Arrives and departs about the same as the Greylag.

Greylag Goose *Anser anser*

Winters regularly on the south side of Pahlavi Mordab and Siahkesheem in numbers from 1,000 to 2,000. They usually arrive in late November to early December with a few seen in early November and depart from mid-February to March. Occasionally they appear on the Pahlavi Mordab and Farahnaz in small numbers. In the harsh winter of 1968-69, 4,500 were recorded for the south side of Siahkesheem.

Ruddy Shelduck *Tadorna ferruginea*

Only two records and both from Selkeh: one was seen in late April 1969 and the other in early February 1970. The April bird was alone while the February one occurred with thousands of geese, swans and ducks. This species is known to winter in the Lake Rezaiyeh area and also farther south in the interior of Iran.

Common Shelduck *Tadorna tadorna*

Another winter vagrant with only three records: one bird at Bandar Farahnaz in mid-January 1968, two at Selkeh in mid-December 1969, and three flying near the Caspian opposite the Pahlavi Mordab in early January 1970.

Marbled Teal *Marmaronetta angustirostris*

Little information on this species which is a passage migrant in small numbers. Recorded from Shal Kol in November 1969. Probably occurs with Garganey and may go unnoticed.

Pintail *Anas acuta*

A common but not widespread species with major concentrations at Selkeh where mid-winter surveys count 11,000 to 40,000 birds. Arrivals and departures are about the same as Mallard and Teal. Occurs in Ab-bandans and on the Caspian in small numbers; Bandar Farahnaz and Pahlavi Mordab in somewhat larger flocks.

May be a passage migrant. Nine were recorded at Bandar Farahnaz in early May 1967, two were seen there in mid-September 1969, 1,000 were observed at Selkeh in mid-October 1969, and 730 were seen there in late April 1970.

It is taken by hunters in fair numbers.

Teal *Anas crecca*

Winters in the region in populations counted as high as 46,500. The Teal is probably second to the Mallard in numbers taken by hunters annually in the region. It too frequents the ab-abandans but occurs most abundantly in large concentrations in the flood zones south of Pahlavi Mordab and Siahkesheem. Flocks of 19,000 to 25,000 have been counted annually at Selkeh in mid-winters 1967-68 to 1969-70. It occurs throughout the Safid delta lowlands but is rarely seen on the Caspian or at Shal Kol. Arrivals and departures are about the same as for Mallard.

Some birds of this species probably use the region as a resting place during migration further south. In late September 1968, 550 were seen in the Pahlavi Mordab, 800 in mid-October 1969 at Selkeh and 350 at Selkeh in late April 1970. In mid-March 1969, 64 were seen in the Safid River below the Shahbanu Farah Dam.

Breeding of this species was confirmed in Siahkesheem in the summer of 1969, but total numbers are, no doubt, quite small.

Mallard *Anas platyrhynchos*

One of the most common and widespread species wintering in the south-west Caspian lowlands, the Mallard seems to prefer the ab-bandans, reed bed peripheries, and flood zones and is rarely recorded in large numbers on the open water of the Pahlavi Mordab. However, it often uses the Caspian surface for a resting place during the day. This species is the mainstay of the wildfowling industry in the region, occurring in flocks of thousands. Wintering populations of 30,000 have been counted and it is estimated that numbers may go as high as 50,000.

Evidence suggests that there are few passage migrants through the region. Some birds are seen before November

but the bulk of the population does not arrive until December and then most are gone by March. Ringing returns indicate the population originates in West Siberia and North Kazakhstan, U.S.S.R.

A few birds have been seen in mid-summer in Siahkesheem and it is suspected that some breed in the region but not significantly.

Gadwall *Anas strepera*

A regular, but not common, winter visitor. Small numbers mix with large flocks of other dabbling ducks and it may often go unnoticed. An exception occurred in January 1970 when two flocks of 1,000 birds each were recorded from Selkeh and Nargasan. They were in company with large concentrations of other ducks.

Probably arrives and departs with Mallard and Teal, but 230 were seen at Selkeh with some other ducks in late April 1970 indicating that some birds may be passage migrants.

A small number are taken by waterfowl hunters each year.

Wigeon *Anas penelope*

Winters commonly in the region, particularly in large concentrations in Nargasan and at Selkeh where 14,000 were recorded in December 1968. Occurs throughout the Safid delta lowlands in small numbers and can often be found sitting on the Caspian.

Arrivals and departures coincide with Mallard and Teal. There may be some passage migrants as 41 were seen on Bandar Farahnaz in early May 1967 and 140 were observed at Selkeh in late April 1970.

A small number are taken by waterfowl hunters.

Garganey *Anas querquedula*

A regular early autumn and late spring passage migrant moving through the region in early September and October and back again in late April/early May. They have been recorded from Esfand where about 250 of them stayed about 25 days in late September and early October 1969, Bandar Farahnaz, Shal Kol, Gulegha, and Sangar Dam where about 200 were recorded in mid-September 1969.

Breeding by a few birds probably occurs, although no confirmed nests or young have been found. Three pairs were observed in courtship behaviour at Gulegha in late April 1967 and a pair were recorded at the north side of Siahkesheem in early August 1969.

Shoveler *Anas clypeata*

A regular winter visitor in fair numbers with habits much like the Mallard. Occurs in most ab-bandans in the Safid delta region with the largest concentrations at Selkeh and Nargasan (1,500 in Selkeh, early February 1970).

May also be a passage migrant as 135 were observed at Bandar Farahnaz in early May 1967, 12 were seen at the Sangar Dam in mid-September 1969, about 40 at Siahkesheem in mid-October 1969, and 117 at Selkeh in late April 1970.

Taken in small numbers by hunters.

Red-crested Pochard *Netta rufina*

A regular winter visitor in small numbers and not very widespread. Recorded at Abbas Abad Ab-bandan near Astara, the Pahlavi Mordab, Bandar Farahnaz, and Shal Kol. By far the largest concentration occurred in early February 1969 at Shal Kol when 2,300 were recorded. At the same time 1,275 were observed in Siahkesheem.

Rarely taken by hunters.

Pochard *Aythya ferina*

Vies with the Tufted Duck as the most common winter diving duck with mid-winter counts of 8,000 to 12,000 in the region. It is widespread and common in large concentrations on the Pahlavi Mordab from December through February. It also occurs on Shal Kol and the Caspian; occasionally some of the smaller ab-bandans.

Probably a passage migrant. Eleven were recorded near Bandar Farahnaz in early May 1967 and 500 at Selkeh in late April 1970. Large concentrations of 2,200 and 2,400 were seen at Selkeh and Nargasan in early November 1969 but disappeared by early the following month.

Taken in good numbers by hunters.

Ferruginous Duck *Aythya nyroca*

Seemingly an irregular winter visitor in small numbers. In the mid-winter census of 1966-67, 450 were counted, with 10 seen the following year, and none the next. The census of 1969-70 picked up nearly 100. They occur in the Pahlavi Mordab, Gulegha, Selkeh, Nargasan, Shal Kol and a few ab-bandans.

There may be irregular passage migrants also as 5 were seen at the north side of Siahkesheem in mid-October 1969,

and nearly 70 at Selkeh and Nargasan early the next month, with 210 at Shal Kol in late November.

Rarely taken by hunters.

Tufted Duck *Aythya fuligula*

A regular and widespread winter visitor and the most common diving duck in the Caspian. Occurs in large numbers at Bandar Farahnaz and with the Pochard on the Pahlavi Mordab. Also shows up regularly at Shal Kol and ab-bandans throughout the region. It seems to be a winter resident only, arriving in November and leaving in February to March.

Taken in good numbers by hunters.

Scaup *Aythya marila*

A winter visitor in very small numbers, this species has only been recorded once in four years at Gulegha in early January 1970. It is probably often overlooked or counted in with Tufted Duck at sea. They are occasionally picked up by hunters from Shal Kol and the Pahlavi Mordab.

Goldeneye *Bucephala clangula*

Regularly winters in small numbers all along the Caspian and ventures inland to suitable waters nearby. Recorded from Abbas Abad at Astara, Pahlavi Mordab (100 in early February 1970), Bandar Farahnaz, and Shal Kol.

Rarely taken by hunters.

Smew *Mergus albellus*

Winters in the south Caspian in small numbers and appears in the south-west region only in January and February when it generally confines itself to the sea. Occasionally comes in to the Pahlavi Mordab and 100 were recorded there in early February 1970.

Red-breasted Merganser *Mergus serrator*

Two were recorded at Bandar Farahnaz in early January and again in early February 1970. These were probably vagrants from farther east where large numbers are regularly observed in the winter.

Coot *Fulica atra*

A regular winter resident occupying virtually every wetland habitat throughout the region except the Safid River. Large numbers generally arrive in late September and early November and do not leave before March. They are common on the Pahlavi Mordab (12,000 recorded in early December 1969) and often are the only waterfowl present there when large numbers of hunters are active. Concentrations seem to move about and are not confined to one place for long but 21,000 were counted at Esfand in late December 1969.

This species provides the bulk of the birds taken by the gun hunters in the Pahlavi Mordab. There may be much movement by this species into and out of the region during the winter. One Coot ringed at Shal Kol in November was recovered a few days later near Lenkoran, 300 kilometres north in the U.S.S.R. Another ringed at the same time and place was recovered a little over a month later 300 kilometres east.

A few birds stay all year round and nest, confirmed by a report of 10 Coot, one of which had three young at Nargasan in early August 1969. Others of this species may nest throughout the region in small numbers.

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Summary

The waterfowl and wetlands of the south-west Caspian lowlands were intensively surveyed over a period of three years from January 1967 through April 1970. Factors affecting management of the waterfowl and the overall ecology of the region are discussed. It is concluded that a number of species use the area as a refuelling ground during passage migration and a few remain to nest in small numbers. The importance of the region as a wintering ground is dependent on the number, proximity to others, and degree of protection afforded the individual wetland habitats, and the entire area is severely threatened by man-caused disturbance and development projects.

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