

## Black Storks (*Ciconia nigra*) wintering in Northern Israel

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**ABSTRACT** - *The Bet She'an and Hula Valleys in northern Israel are a very important migration bottleneck and wintering site for Black Storks. Not only 17000 Black Storks pass on autumn passage but also up to 1400 Black Storks wintered during the mid 1990s in the fishpond complexes of the northern Valleys. Most storks stayed in the eastern Bet She'an Valley. Most of the young birds that wintered in Israel were late migrants; a high proportion was marked at northern breeding grounds and tagged storks showed a high fidelity. Local wintering storks arrived earlier every autumn until they were 4 to 5 years old. By the middle of October most migrants had passed and most marked adults had arrived, while only 1 out of 11 wintering marked 1-st winter birds was present. The wintering population was composed of storks from all age groups; there were substantial yearly differences in the proportion of 1st and 2nd-winter birds. Almost no Black Storks stayed on the fishpond complexes during summer. Black Storks were mainly feeding in canals and on filled and drained ponds, where they looked for small living fish. Tilapia hybrids were the main prey. Young storks showed a preference for habitats where it was easy to catch fish. The type of fishponds, draining technique and yield had a significant effect on the number of wintering birds.*

### Introduction

The Bet She'an and the Hula Valley in northern Israel are the most important migration bottleneck and wintering site for Black Storks (*Ciconia nigra*). These two valleys are part of the Jordan Valley, which is the northern tip of the Rift Valley and the major migration route in the Middle East. The few permanent fresh water habitats like the Sea of Galilee, Hula nature reserve and Ma'agan Barukh are all situated in the northern part of Israel and are too deep for Black Storks. Most springs, pools and rivers in the Coastal Plain and Galilee are captured and polluted with sewage water, thus the storks rely on artificial reservoirs and fishpond areas.

The Bet She'an Valley is the main flyway of Black Storks on the eastern route with up to 17000 storks passing in autumn and at least 8000 in spring (this study). A large proportion of the migrants are stopping to feed and rest.

Black Storks from the European breeding popula-

tion are wintering in Africa south of the latitude 16°N till the equator (CRAMP & SIMMONS, 1977). Marked eastern Black Storks were recovered in Ethiopia (2) and Uganda (1) (ASH, 1981; CRAMP & SIMMONS, 1977) and tagged storks were followed from Nigeria and Chad to Ethiopia. In Saudi Arabia, 200 to 300 storks are probably wintering in wadi's with permanent water in winter. The maximum number counted during January was 51 storks in 1990 (SCHULZ, 1995). In this article we will discuss how the concentration of fishponds creates a unique situation for wintering Black Storks.

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## Methods

In 1994, an international colour-ringing project on Black Storks was started thanks to the co-operation of 12 countries and support by the Donana Field Station (Spain-CSIC). Black Storks from 8 of these countries follow the east-ern migration route and could be observed in Israel. The colour-rings were orange, with an inscription in black. The first inscription was a number that referred to the country of origin: Latvia (0), Poland (1), Austria (2), White Russia (3), Hungary (5), Czech Republic (6), Estonia (7) and Slovakia (8). The two other inscriptions were numbers or letters in a unique combination. All birds were colour-ringed at the tibia, except for Polish birds in 1996, which were ringed at the tarsus. The rings at the tarsus proved more difficult to read, because the storks are often standing in water. The additional metal ring was placed at the tibia or tarsus.

Thanks to the colour-ringing project that was started in 1994, the proportion of ringed birds in Black Stork groups increased from 2 out of 1000 in 1993 to 8 out of 1000 in 1996 (Table 1). The rings I could not identify were mainly metal rings; I failed to read only 4 of the colour-rings.

The colour-ringing program on Black Storks helped substantially to understand the migration pattern of the species. Before I started my observations there was only one Black Stork recovered in Israel, found in 1990 and ringed in the Czech Republic (RAVIV, 1995). From 1993 till 1997, I identified 123 different Black Storks in Israel. During the same period three additional findings of dead storks were reported to the Israel Bird Ringing Centre (IBRC).

As the fishponds are the main habitat for the Black Storks, I give some background on the size and structure of this habitat. The first fishponds were constructed in the 1940s. The maximal surface of ponds and reservoirs was reached in 1965 with 5095 ha (Fig. 1; SARIG, 1997). In the following years the fishpond area decreased and stabilized to 3000 ha in the period from 1983 to 1995. The number of fish farms decreased also from 96 farms in 1965 to 55 farms in 1995. The majority of the fishponds are privately run by kibbutzim. In contrast to the decrease in surface, the fish farm yield increased strongly from 0.1 ton per ha in 1946, to 5 tons per ha in the period from 1987 to 1995 (Fig. 1).

Table 1 - Number of observations of identified ringed Black Storks (1993-97). - Nombre d'observations de Cigognes noires baguées identifiées, de 1993 à 1997.

	Identified	Non-identified	Total Controlled	% Total
Aut 1993	12	8	9,733	0.2
Aut 1994	27	15	13,218	0.3
Spr 1995	43	9	13,360	0.4
Aut 1995	241	52	37,859	0.8
Spr 1996	20	16	5,767	0.6
Aut 1996	627	90	88,113	0.8
Aut 1997	211	34	35,607	0.7
Aut 1997	31	3	5,701	0.6

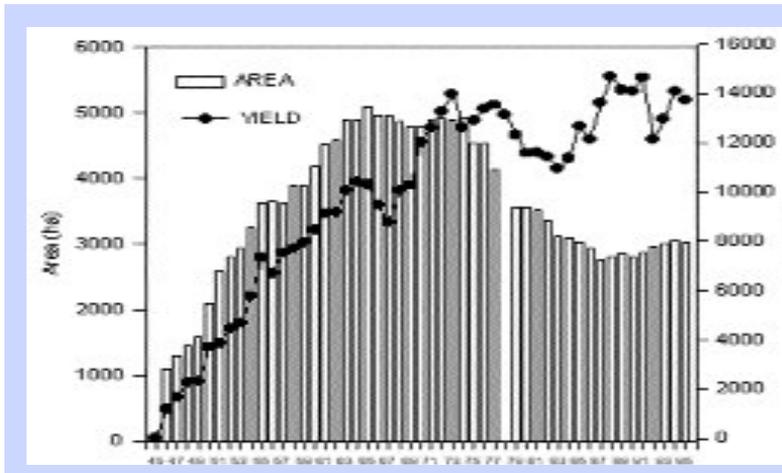


Fig 1 - Fishpond area in ha and yield in tons. - Superficie des étangs de pisciculture, en ha, et récolte annuelle, en tonnes.

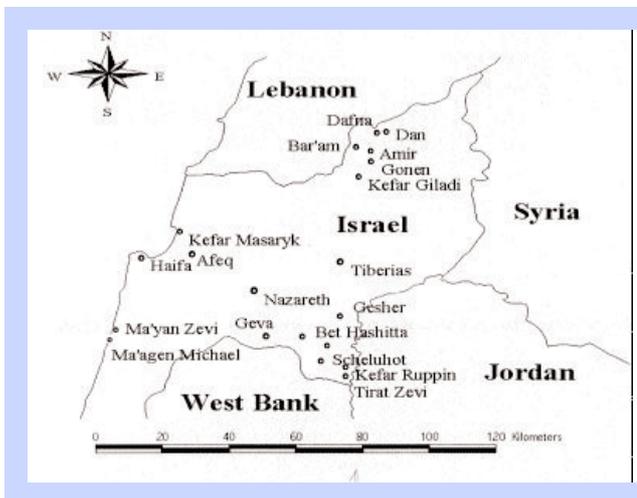


Fig 2 - Fishpond area in Israel. - Région des piscicultures en Israël.

The largest concentration of fishponds is found in the Bet She'an and Jezreel Valleys, between Tirat Zevi, Geshet and Geva (Fig. 2). Including the smaller ponds of the Jordan Valley they cover 1695 ha. They are situated east of Afula to the border with Jordan. Further ponds are situated in the Jordan Valley, from Bet She'an to the southern corner of the Sea of Galilee. The ponds of the Bet She'an, Jezreel and Jordan Valley were the main study area. In this work, we will refer to these three areas as Bet She'an Valley. The 580 ha of fishponds in the Coastal Plain are concentrated between Mount Carmel, Ma'agan Mikha'el and Nahal Hadera. Only the fishponds of Ma'agan Mikha'el and Ma'yan Zevi were

controlled. The third region is the Zevulun Valley, south of Acre (Akko) and west of Afula, with 320 ha of fishponds. In this area, the fishponds of En Hamifraz, Kefar Masaryk and Afeq were controlled. In Upper-Galilee, mainly the Hula Valley, there are 442 ha of fishponds and reservoirs. In the Hula Valley, we controlled fishponds in the central part of the valley near Gonen, Dafna, Dan, Kefar Geladi and the area of the lake north of the Hula Nature reserve and the canals.

Fish fry are produced by hatcheries in autumn and stocked in nursery ponds in April and May when they weigh 0.1 g. When the fish weigh 15

to 50 g they are transferred to grow-out ponds and reservoirs to remain there until they are 12 to 18 months old, then a Carp weighs 600 g and a Tilapia 250 g, which means they can be marketed. The fish are harvested by draining the pond and are taken to the factory or stored in small ponds. The ponds are drained through an opening with a filter with mazes small enough to keep the cultivated fish inside. The water is led to canals. The fish concentrate in the lowest corner of the pond, where the water remains the longest. The fish are kept in polyculture and are taken out with nets and selected on size and species on the spot. The small fish also concentrate in large quantities in the corner of the pond or get into the canals near the pond, escaping through the filtering system. The handling time of a small pond is only a few hours, during which time the pond is drained and all the fish is taken out. The pond is normally refilled shortly afterwards. It takes about 3 to 7 days to drain a grow-out pond completely, due to the processing of the fish. The draining of a reservoir can last 3 to 4 weeks. Recent techniques of taking all fish at once have drastically diminished the handling time of a pond. Not all the ponds can be drained at the same time because there would be too much fish on the market. Due to the large number of ponds in the Bet She'an Valley 10 or more ponds were drained at any day in autumn.

The cultivated fish species are : Common Carp *Cyprinus carpio*, Tilapia hybrids *Oreochromis niloticus* (female) x *O. aureus* (male), Mugilidae *Mugil cephalus* and *Liza ramada*, Silver Carp

*Hypothalmichthys malitrix*. In 1995, 13723 tons of fish grown on fishpond were marketed (SARIG 1997). Uncontrolled proliferation is seen as one of the biggest problems in Tilapia fish cultures. To prevent this proliferation, the fishermen try to grow only male Tilapias by crossbreeding. 90 to 100 % of the hybrids of the two Tilapia species *Oreochromis niloticus* x *O. aureus* are males (BEN TUVIA, 1981). This hybridisation method minimizes uncontrolled proliferation of the Tilapias, but substantial proliferation still exists (SHELTON *et al.*, 1978 in ASHKENAZI & YOM-TOV, 1996). The exact amount of this uncontrolled fry is not known but it was estimated in a grow-out pond in the Hula Valley to be 2 million fish, each weighing 5 g (ASHKENAZI & YOM-TOV, 1996). These small Tilapias are an extremely important food resource, especially for the Black Storks.

We studied the storks in the fishpond areas during autumn 1993 till 1997 and spring 1995 and 1996. Several times a day, ponds and fields in the Bet Shean Valley were checked for storks. The fishponds in the Coastal Plain and Zevulun Valley were checked once a month. The fishponds and canals of the Hula Valley (Upper-Galilee) were checked every fortnight. Since 1965 the Israel Nature & Parks Authority (INPA) organized yearly waterfowl counts in January (ZUARETZ, 1987; SHY, 1992 to 1996). Volunteers counted the numbers of birds present on fishponds and reservoirs. Unfortunately, not all fishponds areas and fields were covered during these surveys. We use these data to compare trends in wintering numbers with changes in the fish culture.

## Results and discussion

### Numbers and wintering areas

The fishpond areas in Israel have become the most important regular wintering area of Black Storks. Already early last century, Black Storks were observed during winter in Palestine (AHARONI, 1932). January counts, organised by the INPA since 1965, give a good picture of the

population increase from the 1970s (SHIRIHAI, 1996). The volunteers of the INPA counted only birds on ponds and not all the important areas were visited. This explains why the numbers of storks noted during January counts by INPA in 1993/94 were about 50 % lower than what I counted during total counts of all habitats.

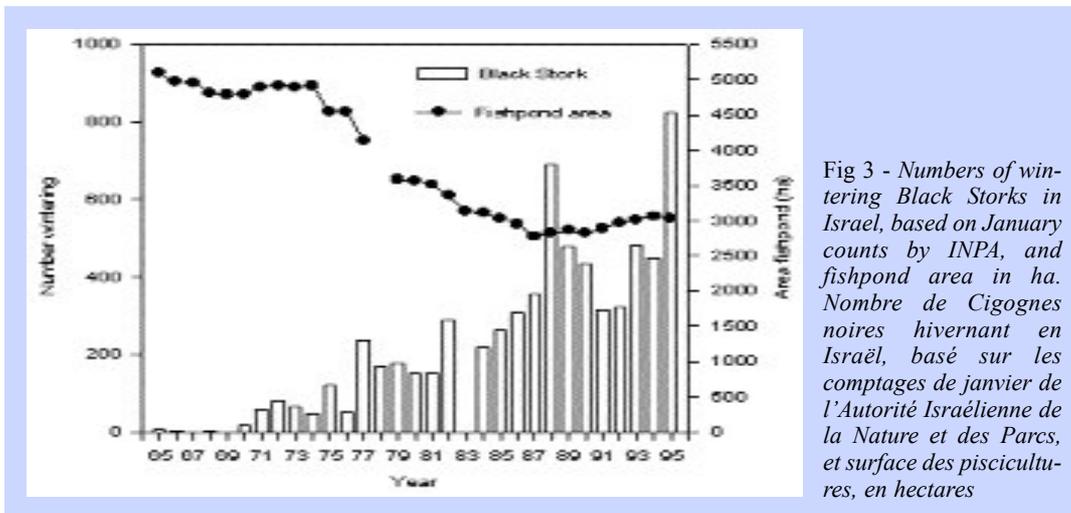


Table 2 - Numbers of wintering Black Storks in different regions in 1993-97. For 1993 and 1996 figures are based on November counts. - Nombre de Cigognes noires hivernant dans différentes régions en 1993-97. Pour 1993 et 1996, les chiffres sont basés sur les comptages de novembre.

	1993	1994	1995	1996	1997
Hula Valley	+7	86	219	184	71
Bet She'an Valley	°484	850	982	1,253	1,103
Zevulon Valley	?	20	93	1	136
Coastal Plain	?	0	0	1	0
<b>Total</b>	<b>+491</b>	<b>956</b>	<b>1,294</b>	<b>1,439</b>	<b>1,310</b>

° not including / non inclus : Gesher and Newe Ur.

In the second half of the 1960s, 1 to 6 storks were wintering, but not every year (Fig. 3). In the 1970s, the wintering population increased from a few tens to a maximum of 237 storks in 1977. The mean number in the 1980s was more than 300 storks, with a peak number of 691 individuals in 1989. In the 1990s, about 450 storks were counted in January, with a maximum of 823 in winter 1995/96 (INPA). Based on counts by INPA from 1970-94, Black Storks wintered yearly and in largest numbers in the Bet She'an Valley (72 %) and less in the Hula Valley (25 %). In the Coastal Plain (2 %) and Zevulon Valley (2 %), Black Storks wintered irregularly in small numbers.

During 1994-97, I observed that 76 to 89 % of the Black Storks wintered in the Bet She'an Valley. From the end of November onwards, Black Storks started leaving the Zevulon and Hula Valley and moved to the Bet She'an Valley or further south. In the former areas most ponds were drained and not refilled.

The large concentration of 1200 to 1400 Black Storks at fishponds in Israel is unique. In Egypt there are only 2 recent records of single storks during December and January (GOODMAN & MEININGER, 1989). Up to 100 birds were observed in January 1995 in Syria and up to 50

birds in January 1996 in Saudi Arabia (DELANY *et al.*, 1999). Groups of storks wintering elsewhere are found in central and southern Spain. At the marshes of the Guadalquivir River, storks feed on drainage canals of rice fields (MANEZ & GARRIDO, 1995). In Extremadura, 11 wintering places are known, where storks stay from November to March in flocks of up to 40 birds (FERRERO *et al.*, 1993). Another permanent winter quarter with up to 100 storks is located in the Gorno-Trakiiska Valley in Bulgaria (NANKINOV, 1993).

In Africa, Black Storks are known to winter alone or in small groups and are feeding at drying pools or small rivers (SCHRODER & BURMEISTER, 1974; CRAMP & SIMMONS, 1977; TRECA, 1995). This kind of habitat has probably not enough food available for more individuals. At good feeding sites in Mauritania flocks of 50 to 62 Black Storks were found (JADOUL, 2000).

### Origin and timing

Out of 123 identified marked Black Storks observed during the study period in Israel (Table 3), 15 were wintering in Israel. A majority of those wintering birds come from the northern part of the species breeding range, i.e. Estonia (3), Latvia (5) and eastern Poland (3), from where a high percentage of marked storks was wintering. Most marked storks breeding in South and Central Europe continued their migration. Three wintering storks were ringed in the Czech Republic and one in Hungary.

A Latvian and an Estonian stork wintering in 1996 had siblings, respectively one and two birds from the same family, migrating through in October and November.

In 1993-96, arrival dates for 11 1st-winter Black Storks wintering in Israel were noted. I observed migration of marked storks from the second half of August to the second half of November. None of the 31 1st-winter storks observed before

Table 3 - Numbers of marked Black Storks observed in Israel in 1993-97 and percentage of birds locally wintering. - Nombres de Cigognes noires marquées observées en Israël en 1993-97 et pourcentage d'oiseaux hivernant sur place.

Country of origin Pays d'origine	Number observed Nombre observé	Percentage wintering Pourcentage hivernants
Estonia	7	43 %
Latvia	27	19 %
Lithuania	2	0 %
Poland	15	20 %
White Russia	1	0 %
Germany	1	0 %
Slovakia	10	0 %
Czech Republic	38	8 %
Austria	2	0 %
Hungary	20	5 %

October were locally wintering. By the end of October, only 27 % of the wintering young Black Storks were present. Most wintering young storks arrived in the first half of November. In the second half of November, two arriving marked birds stayed during winter. Arrival date significantly affected the chance that a 1st-winter stork wintered in Israel (log regression,  $X^2=16.16$ ,  $P=0.0001$ ). The four marked wintering 2nd-winter Black Storks arrived before the end of October in Israel.

Most marked adult individuals were observed during several winters. During the first half of September, already 50 % of the wintering adults arrived in the wintering area. This is at the same time that the first significant numbers of migrants were passing. By the middle of October most migrants have passed and 7 out of 8 adult wintering birds were present. At the same time only 1 out of 11 wintering 1st-winter Black Storks was present. I could collect arrival dates of the same individuals for several years. All

storks gradually arrived earlier when they grew older. Two young storks could be followed from their first year and arrived gradually earlier up to 35 and 53 days in respectively their 4th and 5th year. After their 4th-winter the adult storks arrived almost every year in the same period, with at most a few days difference.

The marked storks started their spring migration from the beginning of February till the middle of March. All Black Storks left the area in summer, only very exceptionally were individuals observed during the summer months.

Marked wintering Black Storks showed a very high fidelity to their wintering area in Israel. In the period 1993-96, all seven identified wintering storks returned the next winter. The other six wintering marked storks fledged in 1996 (1st-winter). The 1st-winter storks that I observed in 1996 did not show such a high fidelity to Israel. On 19 November 1996, 7 colour-ringed Black Storks from Estonia (2), Latvia (3), Czech Republic (1) and Hungary (1) were present in the Bet She'an and Hula Valley and were potential wintering birds. In previous years, only very few marked birds left the area after the middle of November. One of them, O4R, was found dead in Eilat on 10 December 1996 (IBRC). The other 6 storks were not observed on migration in autumn 1997 and did not come back in winter.

## Age composition

During winter, Black Storks of all age groups were observed. The proportion of 1st-winter storks in the wintering population differed between 23 and 38 % and for 2nd-winter birds between 11 and 22 % (Table 4). The numbers for 1997 are very low for 2nd-winter as well as 1st-winter storks.

The wintering population in Israel is composed of 1st-winter, 2nd-winter and adult storks. Arrival time and thus the location of the nesting area is influencing whether a 1st-winter stork will winter in Israel or not. Marked Black Storks showed a high fidelity to their wintering area in Israel. There were no observations of marked birds that wintered for the first time in Israel as an adult bird. Until they were 4 to 5 year old, storks arrived earlier every winter.

Data from other parts of the wintering range support a similar fidelity to the wintering site. 'Krystina', a Czech tagged female stork returned for 3 winters to the same wintering site in Senegal (L. Peske, pers.com.). One individual ringed as nestling in Portugal in 1991, was observed wintering in Donana (Spain) for 3 winters (1991/92, 1992/93, 1994/95; GARCIA *et al.*, 1995).

Table 4 - Proportion of different age groups during the winter period. - Proportion des différents groupes d'âge durant la période hivernale.

Period	1st-winter	2nd-winter	Adult	Number controlled
08.11 - 20.12.1994	38 %	22 %	40 %	4,664
08.11 - 18.12.1995	28 %	16 %	56 %	12,400
08.11 - 19.11.1996	32 %	17 %	51 %	9,830
27.11 - 07.12.1997	23 %	11 %	66 %	5,701

Young Belgian tagged storks did not stay in the wintering place where they first arrived in West Africa. They continued to move hundreds of kilometres looking for a good wintering site (LIBOIS & JADOUL, 1996).

I observed that 504 and 7 1st-winters in 1997 had to leave Israel in December or January to go further south. This behaviour can be explained by competition with older birds that force the young birds to leave. In addition, young storks might not be able to forage successfully in natural rivers and filled ponds as adults do. If there are few drained ponds, young birds may be forced to leave.

## Behaviour

Migrating and wintering Black Storks were mainly roosting on hill-slopes along the Jordan River, on partly drained fishponds and more exceptional on trees, pylons or in fields. These sites were almost never disturbed and the same sites were used from year to year. Those roosts were in general only used by Black Storks. Only in Gesher, where some of the storks were roosting on pylons and trees, White Storks (*Ciconia ciconia*) joined the flocks.

I observed Black Storks feeding on filled and drained fishponds, small canals, the Jordan River and on dead fishes on refuse dumps. Their main food source was small living fish and therefore the Black Storks were mainly feeding on partially drained ponds. Black Storks always arrived before White Storks, as soon as the water level dropped, even if ponds were only drained by 70 or 80 % (Fig. 4). The highest number was present on a pond at the moment when it was drained and all live little fish were concentrated in the last small pool. This food supply lasted for maximum few days, because many fish died or were caught by other birds. Many hundreds of herons, mainly Little Egret (*Egretta garzetta*), Night Heron (*Nycticorax nycticorax*), Grey Heron (*Ardea cinerea*) and Great White Egret

(*Egretta alba*), together with hundreds of gulls were also feeding on small fish.

If food was available, Black Storks stayed on a pond until it was refilled or came back if the pond was being refilled. On some occasions I observed storks feeding on small dead fish lying on the edge of a drained fishpond.

## Age dependent choice of feeding sites

The variation in the proportion of 1st-winter Black Storks in flocks feeding in autumn in different habitats was affected by year (ANOVA :  $F_{4,9} = 8.83$ ,  $P < 0.05$ ) and type of habitat (Habitats : canal, drained pond, river, dead fish, filled pond; ANOVA :  $F_{5,9} = 20.86$ ,  $P < 0.01$ ) (Fig. 5).

There was a higher proportion of young birds in flocks feeding in canals. The water from drained ponds with many small fish is flowing in these canals and fish are very easy to catch. Compared to adult and 2nd-winters, less 1st-winters used drained and filled ponds. The lowest proportion was found on rivers, where fish were scarcer and feeding conditions were natural. In groups feeding on dead fish there was a high proportion of 1st-winters (Fig. 5).

A higher proportion of 1st-winter storks were feeding in canals and on dead fish. At drained and filled ponds there were more adults. There are at least two possible reasons for this age-dependent foraging behaviour. Adult birds are dominant and could chase young birds from good feeding places at drained ponds. When birds are feeding in ditches they are moving alone between the reeds and are less disturbed by other birds. Secondly, there could be a learning process on how to catch living fish in a shallow pond involved.

Competition between and within age groups during the regular migration period is probably not influencing whether a 1st-winter stork is

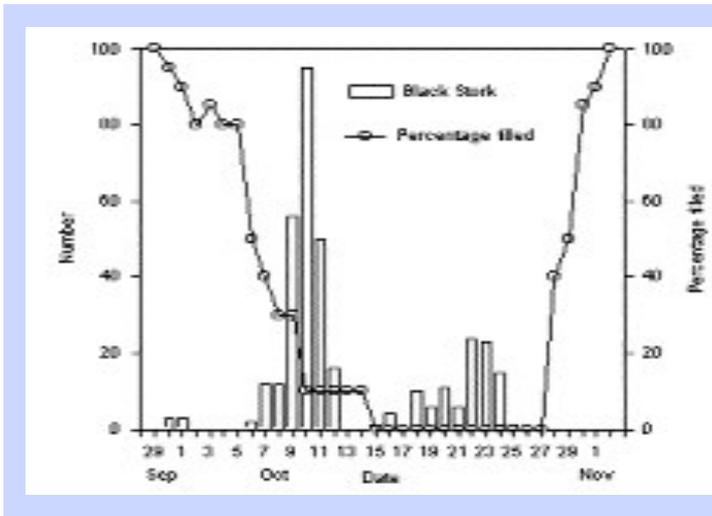


Fig 4 - Numbers of Black Storks present on a drained reservoir at Ma'oz Haim. - Nombre de Cigognes noires présentes sur un étang en assec à Ma'oz Haim et pourcentage de l'étang en assec (percentage filled).

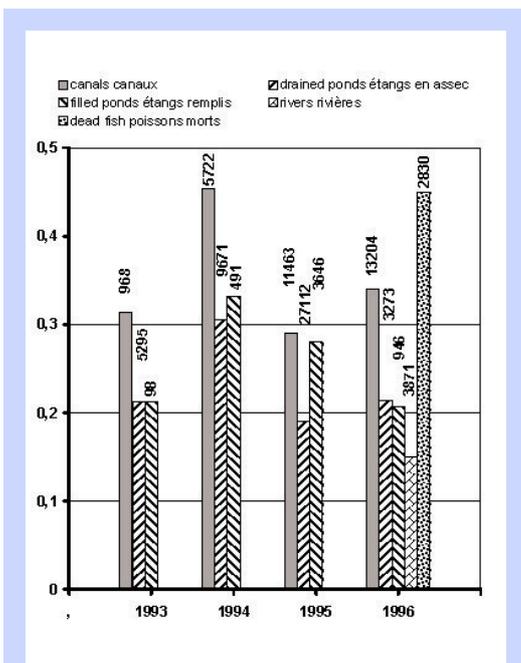


Fig 5 - Numbers of Black Storks present and proportion of 1st winters on a drained reservoir at Ma'oz Haim. - Nombre de Cigognes noires présentes et proportion de juvéniles sur un réservoir en assec à Ma'oz Haim.

wintering in Israel or not. The early storks are continuing, while the late arriving birds try to stay.

## Effects of fish farms on numbers of wintering Storks

Data on the numbers of Black Storks present during January counts by INPA were available from 1966 to 1995, except for 1984. I retrieved information on the Tilapia yield for 1975 and 1982-94. The numbers of wintering storks in January were compared with the Tilapia production in the previous year.

The numbers of wintering Black Storks were positively correlated with yield (tons/ha) in all fishponds ( $df = 27$ ,  $r^2 = 0.33$ ,  $P < 0.01$ ) and was positively correlated with the number of tons of Tilapia grown on fishponds ( $df = 13$ ,  $r^2 = 0.37$ ,  $P < 0.05$ ).

In Tirat Zevi in 1996/1997 and Ma'ale Gilboa in 1997, all fish were taken out of the pond in a very short time. None of the small fish were left in the pond. The ponds in this area were intensively visited by Black Storks in 1995, when 68 % of all birds of the Bet She'an Valley were at these ponds (Table 5). In the same period in 1996 and 1997, only a smaller proportion of Black Storks was feeding here (31 and 29 %).

Table 5 - Black Storks on fishponds of Tirat Zevi, En Hanaziv and Ma'ale Gilboa between 1 September and 11 October. - Nombre de Cigognes noires sur les piscicultures de Tirat Zevi, En Hanaziv et Ma'ale Gilboa entre le 1er septembre et le 11 octobre.

Year	Number on ponds	Average per visit	Number in study area	Proportion
1995	15,045	198	22,238	68 %
1996	14,342	158	45,923	31 %
1997	10,255	122	35,264	29 %

The number of 5500 Great White Egrets in November and December 1997, was 20 % lower than in 1996. This species is feeding on the same

prey and at the same places than Black Storks, but they are sometimes feeding on mice in alfalfa fields.

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*Harmorrious cohabitation between fish farming and piscivorores birds in Israel.  
 Cohabitation harmonieuse entre pisciculture et piscivores en Israel. Photo G. Jadoul.*

## L'hivernage de la Cigogne noire (*Ciconia nigra*) dans le nord d'Israël

[Résumé](#)

La vallée du Jourdain, située au nord de la vallée du Rift, est la principale route de migration de la Cigogne noire au Moyen-Orient. Les vallées de Bet She'an et d'Hula, dans le nord de l'Israël, en font partie avec, pour la vallée de Bet She'an, plus de 17.000 cigognes de passage en automne et au moins 8.000 au printemps. La construction d'étangs de pisciculture et l'établissement de fermes piscicoles y commencèrent dans les années 1940 (Fig. 1). Après un maximum de 5.095 ha atteint en 1965, la superficie de ces étangs s'est stabilisée à 3.000 ha en 1995. Parallèlement, le nombre de fermes piscicoles est passé d'un maximum de 96 exploitations en 1965 à 55 trente ans plus tard.

Dans une région où les habitats aquatiques permanents sont rares et soit trop profonds pour la Cigogne noire, soit trop pollués, ces étangs sont une aubaine pour l'espèce. La plupart des migrants s'y arrêtent pour se nourrir et se reposer. En outre, cette région est devenue la plus importante zone d'hivernage de l'espèce.

Déjà au début du siècle, des Cigognes noires étaient observées durant l'hiver en Palestine. Depuis 1965, l'Autorité de la Nature et des Parcs d'Israël (INPA) organise un recensement annuel en janvier, au cours duquel seule une partie des étangs est visitée (Fig. 3). Au début de ces recensements, dans la seconde moitié des années 1960, on y comptait 1 à 6 cigognes, mais pas chaque année. Dans les années 1970, la population hivernante a augmenté jusqu'à un maximum de 237 ex. en 1977. L'effectif moyen des années 1980 est de plus de 300 cigognes, avec un maximum de 691 individus en 1989. Dans les années 1990, environ 450 cigognes sont recensées en janvier, avec un maximum de 823 lors de l'hiver 1995-1996. Selon les données de l'INPA de 1970 à 1994, les Cigognes noires hivernent annuellement et en grand nombre dans la vallée de Bet

She'an (72%), et dans une moindre mesure dans la vallée d'Hula (25%), les 3% restants se rapportant à la plaine côtière et à la vallée de Zebulon. (Tableau 2).

J'ai étudié la Cigogne noire dans ces différentes régions au cours des automnes de 1993 à 1997 et des printemps 1995 et 1996. Les étangs et les champs de la vallée de Bet She'an ont été visités plusieurs fois par jour, ceux de la plaine côtière et de la vallée de Zebulon une fois par mois, tandis que les étangs de pisciculture et les canaux de la vallée d'Hula en Haute-Galilée ont été contrôlés tous les quinze jours.

Avec une population hivernante comprise entre 1.200 et 1.400 individus - la différence avec les données des recensements INPA s'explique par une plus grande couverture de la région - cette zone est unique au monde. Pour comparaison, de bons sites de nourrissage en Mauritanie accueillent des groupes de 50 à 62 oiseaux; une centaine d'individus ont été observés en Syrie en janvier 1995, et une cinquantaine en Arabie saoudite en janvier 1996. En Estrémadure (Espagne), 11 sites d'hivernage sont connus; ils accueillent les cigognes de novembre à mars en groupes pouvant atteindre 40 ex; elles se nourrissent dans les canaux de drainage des rizières. Un autre quartier d'hivernage permanent, abritant jusqu'à une centaine de cigognes, est situé dans la vallée de Gorno-Trakiiska, en Bulgarie. En Afrique, par contre, les Cigognes noires sont connues pour hiverner seules ou en petits groupes dans les petites rivières et les mares en cours d'assèchement; ces milieux ne sont probablement pas suffisamment riches en nourriture pour accueillir davantage d'oiseaux.

En Israël, de 1994 à 1997, les cigognes commencent à quitter, à partir de la fin novembre, les vallées de Zebulon et d'Hula pour se rendre plus

au sud dans la vallée de Bet She'an où, suivant mes comptages, hivernent de 76 à 89% de cette population. Ces déplacements s'expliquent par la vidange et le non-remplissage de la plupart des étangs. La migration pré-nuptiale, quant à elle, se déroule de début février à la mi-mars; l'estivage est exceptionnel.

Cette étude a été facilitée par le programme international de marquage par bagues de couleur mis sur pied dans 12 pays d'Europe. Les Cigognes noires de 8 de ces pays (Lettonie, Pologne, Autriche, Russie, Hongrie, République tchèque, Estonie et Slovaquie) empruntent la voie orientale et peuvent être observées en Israël, où 123 individus différents ont ainsi pu être identifiés de 1993 à 1997. Sur ces 123 oiseaux, 15 y ont hiverné (Tableau 3).

## Résultats

### Age des oiseaux

La population hivernante d'Israël se compose d'oiseaux de premier hiver (entre 23 et 28 %), de 2ème hiver (entre 11 et 22 %) et d'adultes (Tableau 4). Les adultes sont fidèles au site d'hivernage; avant leur 4ème hivernage, ils arrivent de plus en plus tôt à mesure que les années s'écoulent; à la mi-octobre, 7 des 8 adultes bagués hivernant en Israël y sont présents. Les oiseaux de premier hiver arrivent entre le 15 août et le 15 novembre mais 27 % seulement avant le 1er novembre. Plus ils arrivent tard, plus ils ont des chances d'hiverner, et ceux qui arrivent après la mi-novembre restent. Aucune des 31 cigognes juvéniles observées avant octobre n'a hiverné sur place. Par rapport aux adultes, les jeunes hivernants (6 ex. bagués) sont plus erratiques. Les 4 oiseaux de 2ème hiver hivernants bagués sont arrivés avant la fin octobre.

### Comportement

Les sites de repos se situent sur les pentes des collines le long du Jourdain, sur les étangs partiellement vidangés, plus exceptionnellement sur les arbres, les pylônes et dans les champs; ces

endroits où les oiseaux sont rarement dérangés sont réutilisés d'année en année.

Elles se nourrissent de petits poissons, surtout des tilapias, pêchés dans les étangs, pleins ou vidangés, ainsi que dans les canaux d'évacuation des étangs et le long du Jourdain. Elles fréquentent aussi les décharges, où elles consomment des poissons morts. Les lieux de pêche privilégiés sont les étangs en assec, où les Cigognes noires arrivent très rapidement (Fig. 4).

### Choix des sites de pêche en fonction de l'âge

La proportion des jeunes dans les groupes varie en fonction du lieu de nourrissage. Elle est très élevée dans les petits canaux, où la pêche est aisée, et dans les décharges. La proportion d'adultes est plus grande dans les étangs vidangés tandis que les jeunes pêchant dans les rivières sont rares (Fig. 5).

### Influence de la récolte des poissons sur le nombre d'hivernants

En comparant le nombre d'hivernants en janvier avec la production totale dans les étangs de pisciculture au cours de l'année précédente et avec la production de tilapias, on relève une corrélation positive. Cela signifie que l'importance de l'hivernage est tributaire de la quantité de nourriture disponible. En 1996 et 1997 à Tirat Zevi, et en 1997 à Ma'ale Gilboa, la récolte des poissons s'est effectuée sur un temps très court et avec peu de résidus en petits poissons. Alors qu'en 1995, 68% de la population de Bet She'an se trouvaient sur ces étangs, ce pourcentage est tombé respectivement à 31 et 29% en 1996 et 1997 (Tableau 5).