# A TIME CAPSULE - AVIAN DIET COMPOSITION STUDIES FROM NORTH DOBRUDJA (ROMANIA), ESPECIALLY FROM THE DANUBE DELTA FROM THE LAST DECADES OF THE 20TH CENTURY

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**Abstract.** Avian diet composition studies are based on material collected from the Danube Delta (Romania) and adjacent areas, from the second half of the 20th century. In the socialist era, the ruling political regime regarded the avifauna as an exploitable natural resource, which either has to be converted into monetary income, or those species that were posing a threat to fish production in fisheries had to be ruthlessly decimated or even extirpated. Most culled birds were not subjected to scientific study. We succeeded to sample only a small fraction of the killed birds, and to publish the results of the studies. After the political changes in 1989, as nature conservation gained impetus in the Eastern Block, the publication of results based on invasive sampling generated unfavourable reactions in the society. Even so, we believe the publication of the findings based on the saved data is very useful. This study provides the results of the quantitative and qualitative examination of 247 individuals belonging to 9 bird species. We did not compare our findings to other data, but believe this work gives insight into an era long gone.

**Keywords:** Danube Delta, diet composition, date saving.

**Rezumat. O capsulă a timpului - cercetări privind compoziția hranei păsărilor din Dobrogea de Nord (România), Delta Dunării, în ultimele decade ale secolului XX.** Materialul bromatologic studiat provine din Delta Dunării (România) și zonele adiacente, din a doua parte a secolului trecut. În sistemul social de atunci, ornitofauna a fost considerată doar o resursă naturală care se cerea a fi convertită pecuniar, iar unele specii, care puteau să producă un pericol producției piscicole, să fie strict decimate sau extirpate. Majoritatea păsărilor ucise nu a fost supusă studierii. Numai de la o mică parte a păsărilor combătute s-a putut preleva probe bromatologice și, după prelucrarea acestora, de a le publica rezultatele. După schimbarea regimului social din 1989, publicarea datelor prelevate prin metode agresive a provocat reacții nefavorabile ale societății. Considerăm totuși utilă publicarea datelor obținute din probele salvate. Studiul de față conține rezultatele analizelor a 247 de ex. de păsări din 9 specii. Datele nu au fost comparate cu alte studii asemănătoare, dar le considerăm o retrospectivă a unei ere apuse.

**Cuvinte-cheie:** Delta Dunării, date bromatologice, recuperare.

## INTRODUCTION

The most critical era for the avifauna of the Danube Delta was the period between 1945-1989. Based on the ideological approach set by the Soviet Union, the political regime in Romania supported the principle that nature has to be ruled by mankind, and all of its resources had to be exploited without considering any other societal interest. Consequently, several bird species inhabiting the Danube Delta became public enemies, and these species had to be decimated by any means in order to mitigate and prevent the damage they posed to fish production in fisheries. The Ministry of Food of that era co-ordinated the extirpation of the target species for decades, and its results were summarised by several publications: "…*in the period between 1950-1989 approximately 6 million birds were killed by shooting, destroying their nests, cutting the legs of the nestlings in the breeding colonies, and by the indiscriminate destruction of the bird nests through the ignition of uncut reed stands*" (DRAGOMIR & STARAȘ, 1992). The title of a research project, which sounds unbelievable today, officially declared by the Ministry of Food tells a lot about the zeitgeist of the era: *"The widespread sales of the meat of waterfowl (prepared as exhibition mounts and live waterfowl) and species sold with difficulties (Coot and Glossy Ibis) as tinned food and partially processed produce"*. The title page of the final report is attached below (Fig. 1).

The report mentions 750 000 cans of tinned food, 2000 live specimens, and the mounted birds are only listed as a sum, while the project of producing biltong from waterfowl was given up.

In theory, even a much less radical project and the reported annihilation of bird populations should have been based on preliminary studies focusing on the interactions among different piscivorous birds and fisheries. And yet only two large official studies were conducted, that were heavily influenced by the official preconceptions. One of them, based on the autopsy of 1925 birds thought of preying on fish and shot in fisheries, only dealt with the specimens of the Eurasian carp (*Cyprinus carpio*) and disregarded any other food components (PĂSCULESCU et al., 1962). The other, based on 873 samples, only dealt with fish in the diet, but at least this study published all the identified fish species from the stomach contents (ANDONE et al., 1969). We mention a smaller study as an example of a better approach that dealt with 17 bird species considered as piscivorous or partly piscivorous. This study tried to analyse all the components of the diet and was based on 193 stomach content samples (MUNTEANU et al., 1996). Another work started in the 1950s was based on museum specimens and also tried to describe the whole food spectrum of the studied bird species, but it did not deal only with the avifauna of the Danube Delta, as additional samples coming from other areas were also analysed (PETRESCU, 1999).

Our research group performed a both quantitative and qualitative analysis of approximately 3800 samples of bird stomach contents collected in the Danube Delta and adjacent areas. Our results were published in several papers in the socialist times, their list and the papers dealing with avian diet composition in the North Dobrudja region were also published (KISS, 2023).

In Romania, after the political changes (1989), both the legal system and our approach to research changed profoundly, and hence the earlier legal and ethical research methods based on invasive sampling methods sacrificing bird specimens are not supported by the society and the scientific community anymore. But we believe that, decades after these changes, the time capsule of research activities carried out in the socialist times should be reopened, and all the available additional data should be available for the scientific community. Hence, the sacrificed birds and invested research effort could be utilised to a certain extent. We should add that, besides the stomach contents of birds, their ectoparasites were also collected and preserved, and these were later published in a dozen publications, 162roundd 200 ectoparasites new for Romania were reported (https://www.researchgate.net/profile/J-Kiss).

From the 21st century we are not aware of any similar studies utilizing samples from shot birds in Romania, only a single paper on the food composition of the Great Cormorant was partly based on the stomach content analyses of shot birds (CUZIC, 2004). An interesting Algerian study utilised the carcasses of birds confiscated from poachers for diet composition research (FETHI, 2012).

Only a small fraction of the data presented here were formerly used for other publications (KISS et al. 1978, 1980), or the data were referenced in other works at higher taxonomic groups only (KISS et al. 1997; PLATTEEUW et al. 2004). To a certain degree, the composition of molluscs in the diet wwas elaborated in earlier publications (KISS et al 1983, 1986, 1995). The sole exception is the paper on the Pygmy Cormorant (KISS & RÉKÁSI, 2001), from which the diet composition part is used here for comparison with other species.

## MATERIAL AND METHODS

Our samples originate from the period 1971-1985 from north Dobrudja, mainly from the Romanian part of the Danube Delta and adjacent areas. Sampling activities and the examination of samples were not supported by any official government grant. A large part of the samples came from three officially licensed taxidermy workshops operating in Tulcea that were integrated within the following institutes: the former Danube Delta Museum, the Forestry Authority and the Scientific Research Institute. The first two taxidermy shops produced large number of mounted bird specimens of attractive species that could be sold through tourist agencies. These sale activities often disregarded the hunting regulations concerning the sold bird species. The third taxidermy shop was mainly involved with assembling a scientific collection from the avifauna of the region. Unfortunately, this collection containing several thousand mounted specimens was liquidated, and even its inventory perished, hence the scientific study of its material is impossible.

Some of the samples originate from bird species that could be legally hunted in that time period. In an unpredictable manner, stomach content samples were contributed by the game wardens of fisheries that we could accompany on their patrols. The viscera of some rare birds were offered for study by hunters, whom we personally knew.

Those food items that were easily recognisable in the stomach content were identified in the field, and sometimes morphometric data were also taken. The remaining components were dried and later analysed, and the species were identified by using taxonomic keys and reference collections. Due to their more decomposed state some items could only be classified into higher taxonomic categories.

In order to save the time capsule properties of the data, we intentionally did not use the present taxonomic nomenclature and systematic notions, instead we used the nomenclature valid at the time of sampling. The present study elaborates the stomach content material of 247 individuals belonging to nine bird species living in wetlands.

Where we had the precise collection data, we provided the month of collection and listed the sampling sites. Due to their high number and uncertainty, we cannot show the sampling points on a map.

In the tables, diet components are listed in descending order according their absolute proportion. When the proportion of two species was equal, higher item numbers were listed first, and if they were impossible to rank, we indicated them with an "X" sign. When both the proportion and item number of a given prey item was equal, we listed them in alphabetic order.

As in our earlier bromatological diet composition studies, the number for plant material refer to individual grains. If the sample contained other plant remains (leaves, stems, roots), it was indicated in the table. In the case of invertebrates, numbers always refer to imagoes, other developmental forms (larvae and pupae) are separately listed. The items in larval stage were also separately given for amphibians. In the case of food items of animal origin, the taxonomic order was applied. Gastroliths and sand found in the stomach of birds were not entered into the tables. Our findings and the drawn conclusions are solely based on our samples, and we intentionally only provide the raw findings and omit comparisons with other publications and we do not risk to state unfounded partial conclusions.

As the sampling was often spontaneous and irregular, the circumstances under which samples were collected and the exact time and location of the sampling are uncertain. As the collection of similar data is impossible, the data provides unique information, and the lack of exact collection data should be accepted.

The results presented hereunder can be divided into two groups. The first group of the results tries to compare the extent of piscivores among different bird species based on the frequency of fish component in the diet. Due to the low sample sizes these results should be taken as hints on diet composition. According to the frequency of the fish component and other food items, we proposed four categories (the fifth category contains the empty stomachs). The extent of piscivores is given as percentage, the number of stomach contents containing fish is given compared to the total number of samples of the given species. We believe this method is feasible to assess the piscivores among birds. Unfortunately, there were no similar studies available in the socialist era that could save a lot of birds from persecution.

The second part deals with other birds occurring in wetlands that could be legally hunted during the time period of sampling. Their diet in Romania is not thoroughly studied.

## RESULTS AND DISCUSSIONS

Hereunder we present our results listed by bird species in a comparative table, providing the presence of different fish species in their diet, and also presenting the food spectrum of other waterbirds.

**A. The specialised piscivores, partial piscivores, and occasional piscivores (Tables 1-7).**

Table 1. Trophic components identified in the gastrointestinal contents of *Phalacrocorax carbo* collected in the Danube Delta, Murighiol fishponds during the period July-August 1974.

| Crt. No. | Trophic component<br>B. Components of animal origin | Frequ. | No. of spec. | Remarks |
|---|---|---|---|---|
| | 1. Invertebrates | | | |
| 1 | Mollusca ssp. fragments | 1 | x | Maybe through its prey |
| 2 | Fragments of chitin | 1 | x | Maybe through its prey |
| | 2.Vertebrates<br>2.1. Pisces | | | |
| 3 | *Carassius carassius* | 6 | 6 | 140 mm, 60 g |
| 4 | *Cyprinus carpio* | 4 | 6 | 400 g |
| 5 | *Acerina cernua* | 1 | 1 | 104 mm, 22 g |
| 6 | *Alburnus* sp. | 1 | 1 | 86 mm, 12 g |
| 7 | *Ctenopharyngodon idella* | 1 | 1 | 175 mm, 74 g |
| 8 | *Cyprinidae* sp. | 1 | 1 | 15 g |
| 9 | *Hypopthalmychtis mollitrix* | 1 | 1 | 105 mm, 200 g |
| 10 | *Stizostedion lucioperca* | 1 | 1 | 180 mm, 80 g |
| 11 | *Perca fluviatilis* | 1 | 1 | 113 mm, 31 g |
| 12 | *Silurus glanis* | 1 | 1 | 174 mm, 29 g |
| 13 | Pisces ssp. | 1 | 1 | 15 g |

Distribution of evidence over time: July-August 1974.

Distribution by area: Murighiol, fishponds.

Table 2. Trophic components identified in the gastrointestinal contents of *Phalacrocorax pygmaeus*, collected in the Danube Delta, Murighiol fishponds during the period 10.09.1973-24.08.1978 (n=71).

| Crt. No | Trophic component | Frequ. | No. of spec. | % frequ./No. | Remarks |
|---|---|---|---|---|---|
| | **A. Components of vegetal origin** | | | | |
| 1 | *Polygonum lapathifolium* seeds | 1 | 6 | 1,4 | |
| 2 | Gramineae sp. fragments | 1 | x | 1,4 | |
| 3 | Plants indet. fragments | 1 | x | 1,4 | |
| 4 | *Phragmytes* sp. fragments | 1 | x | 1,4 | |
| | **B. Components of animal origin**<br>1. Invertebrates | | | | |
| 5 | Odonata ssp. | 3 | 3 | 4,2 | |
| 6 | *Dytiscus* sp. larvae | 2 | 4 | 2,8 | |

| | | | | | |
|---|---|---|---|---|---|
| 7 | *Dytiscus marginalis* | 1 | 9 | 1,4 | |
| 8 | *Adonis variegata* | 1 | 5 | 1,4 | |
| 9 | *Naucoris cimicoides* | 1 | 5 | 1,4 | |
| 10 | *Aeschna affinis larvae* | 1 | 3 | 1,4 | |
| 11 | *Sigara lateralis* | 1 | 2 | 1,4 | |
| 12 | *Adelia decempunctata* | 1 | 1 | 1,4 | |
| 13 | *Dytiscus* sp. | 1 | 1 | 1,4 | |
| 14 | Chitin fragments | 1 | x | 1,4 | |
| | 2. Vertebrates<br>2.1. Pisces | | | | |
| 15 | *Cyprinus carpio* | 28 | 50 | 39.4 | To 111 mm, 39 g |
| 16 | *Carassius auratus gibelio* | 14 | 43 | 19,7 | To 5 g |
| 17 | Pisces ssp. | 6 | 9+x | 8.4 | To 30 mm |
| 18 | *Alburnus alburnus* | 5 | 8 | 7 | |
| 19 | *Cobitis taenia* | 2 | 12 | 2.8 | To 50 mm, 11 g |
| 20 | *Ctenopharyngodon idella* | 2 | 2 | 2.8 | To 141 mm, 12 g |
| 21 | *Misgurnus fossilis* | 2 | 2 | 2.8 | To 40 mm |
| 22 | *Perca fluviatilis* | 1 | 2 | 2.8 | |
| 23 | *Gasterosteus aculeatus* | 1 | 2 | 1,4 | |
| 24 | *Neogobius kessleri* | 1 | 2 | 1,4 | |
| 25 | *Vimba vimba* | 1 | 1 | 1,4 | To 68 mm, 5 g |
| 26 | *Abramis* sp. | 1 | 1 | 1,4 | To 60 mm, 2 g |
| 27 | *Acerina cernua* | 1 | 1 | 1,4 | |
| 28 | *Alburnus* sp. | 1 | 1 | 1,4 | |
| 29 | *Leuciscus* sp. | 1 | 1 | 1,4 | |
| 30 | *Pseudorasbora parva* | 1 | 1 | 1,4 | To 24 g |
| 31 | *Sander lucioperca* | 1 | 1 | 1,4 | |
| 32 | *Silurus glanis* | 1 | 1 | 1,4 | |
| | 2.2. Amphibia | | | | |
| 33 | *Rana* sp .larvae | 12 | 25 | 17 | |
| 34 | *Rana* sp. | 1 | 1 | 1,4 | 25 g |

Distribution of evidence over time: 15.11.1973-03.09.1983.
Distribution by area: Murighiol - 25, Sarinasuf - 25, Sălcioara - 15, Maliuc - 4, Grindul Lupilor - 2.

Table 3. Trophic components identified in the gastrointestinal contents of *Nycticorax nycyticorax*, collected in the Delta during the period 27.07.1974-17.07.1985 (n=32).

| **Crt. No.** | | **Mar.- Aug.** | | **Sept. – Feb.** | | **Total** | | |
|---|---|---|---|---|---|---|---|---|
| | **Trophic components** | **Feb.** | **% Frequ./No.** | **No. samples** | **% Frequ./No.** | **Frequ.** | **% No/Frequ.** | **No. ex.** |
| | **A. Components of vegetal origin** | | | | | | | |
| 1 | *Poygonum aviculare* | | | 1 | 5 | 1 | 3.12 | 5 |
| 2 | Green vegetable fragments | | | 1 | x | 1 | 3.12 | x |
| | **B. Components of animal origin** | | | | | | | |
| | 1, Invertebrates | | | | | | | |
| 3 | *Naucoris cimicoides* | 2 | 6 | 2 | 4 | 4 | 12.5 | 10 |
| 4 | *Dytiscus marginalis* larvae | 1 | 1 | 1 | 2 | 2 | 6.64 | 3 |
| 5 | *Astacus fluviatilis* | 2 | 2 | | | 2 | 6.64 | 2 |
| 6 | *Hydrous piceus* | 2 | 2 | | | 2 | 6.64 | 2 |
| 7 | *Anax imperato*r larvae | | | 1 | 4 | 1 | 3.12 | 4 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8 | *Carabus* sp. | 1 | 2 | | | 1 | 3.12 | 2 |
| 9 | *Gryllotalpa gryllotalpa* | 1 | 2 | | | 1 | 3.12 | 2 |
| 10 | *Odonata* sp. Larvae | | | 1 | 2 | 1 | 3.12 | 2 |
| 11 | *Acilius sulcatus* | | | 1 | 1 | 1 | 3.12 | 1 |
| 12 | *Odonata* sp. | 1 | 1 | | | 1 | 3.12 | 1 |
| | B. Vertebrates<br>1. Pisces | | | | | | | |
| 13 | *Carassius carassius* | 7 | 69 | 3 | 6 | 10 | 31.25 | 75 |
| 14 | Pisces sp. | 2 | 2 | 1 | 1 | 3 | 9.37 | 3 |
| 15 | *Lepomis gibbosus* | 1 | 27 | | | 1 | 3.12 | 27 |
| 16 | *Abramis brama* | 1 | 1 | | | 1 | 3.12 | 1 |
| 17 | *Pseudorasbora parva* | | | 1 | 11 | 1 | 3.12 | 1 |
| | 2. Amphibia | | | | | | | |
| 18 | *Rana* sp. | 2 | 2 | | | 2 | 6.64 | 2 |
| 19 | *Rana* sp. Larvae | 1 | 4 | | | 1 | 3.12 | 4 |
| | 3. Mammalia | | | | | | | |
| 20 | *Microtus* sp. | 1 | 1 | | | 1 | 3.12 | 1 |

Distribution of evidence over time: Oct.-10, Jan.-8, May-7, Febr.-2, Aug.-2, Mar.-1, Apr.-1, Sep.-1.

Distribution by area: Sarinasuf – 11, Chilia Veche – 8, Mila 35 – 4, Murighiol – 2, Sălcioara – 2, Tulcea – 2, Crișan – 1, Dunavățul de Sus – 1, Jurilovca – 1.

Table 4. Trophic components identified in the gastrointestinal contents of *Ardeola ralloides*, collected in the Danube Delta during the period 17.08.1972-21.08.1982 (n=18).

| Crt. No | Trophic component | Frequ. | No. spec. | % No/Frequ. | Remarks |
|---|---|---|---|---|---|
| | **A. Components of vegetable origin** | | | | |
| 1 | *Polygonum lapathifolium* | 3 | 33 | 16.7 | Accidental |
| 2 | *Polygonum aviculare* | 2 | 7 | 11.1 | Accidental |
| 3 | *Umbelliferrae* sp. | 2 | 5 | 11.1 | Accidental |
| 4 | *Echinocloa crus-galli* | 1 | 2 | 5.5 | Accidental |
| | **B. Components of animal origin**<br>1. Invertebrates | | | | |
| 5 | *Naucoris cimicoides* | 4 | 11 | 22.2 | |
| 6 | *Carabus* sp. | 4 | 7 | 22.2 | |
| 7 | *Odonata* sp. | 4 | 5 | 22.2 | |
| 8 | *Grillotalpa grillotalpa* | 3 | 11 | 16.7 | |
| 9 | *Hydrous* sp. | 2 | 8 | 11.1 | |
| 10 | *Otiorrhynchus* sp. | 2 | 6 | 11.1 | |
| 11 | *Coccinella septempunctata* | 2 | 5 | 11.1 | |
| 12 | *Calliptamus barbarus* | 1 | 3 | 5.5 | |
| 13 | *Amara* sp. | 1 | 2 | 5.5 | |
| 14 | *Calliptamus* sp. | 1 | 2 | 5.5 | |
| 15 | Ephemeroptera sp. larvae | 1 | 2 | 5.5 | |
| 16 | *Geotrupes* sp. | 1 | 2 | 5.5 | |
| 17 | *Harpalus* sp. | 1 | 2 | 5.5 | |
| 18 | *Scymnus bipunctatus* | 1 | 2 | 5.5 | |
| 19 | *Acrida hungarica* | 1 | 1 | 5.5 | |
| 20 | *Cocinella quiquepunctata* | 1 | 1 | 5.5 | |
| 21 | *Chorthippus paralellus* | 1 | 1 | 5.5 | |
| 22 | *Coleoptera* sp. | 1 | 1 | 5.5 | |

| | | | | | |
|---|---|---|---|---|---|
| 23 | *Chrisomella* sp. | 1 | 1 | 5.5 | |
| 24 | *Dytiscus* sp. | 1 | 1 | 5.5 | |
| 25 | *Harpalus affinis* | 1 | 1 | 5.5 | |
| 26 | Hirundinaceae sp. | 1 | 1 | 5.5 | |
| 27 | *Hydrous spiceus* | 1 | 1 | 5.5 | |
| 28 | *Hyphydurus ovatus* | 1 | 1 | 5.5 | |
| 29 | *Notonecta glauca* | 1 | 1 | 5.5 | |
| | 2. Vertebrates<br>1. Pisces | | | | |
| 30 | *Cyprinus carpio* | 4 | 6 | 22.2 | To 12 g |
| 31 | *Carassius gibelio* | 2 | 3 | 11.1 | |
| 32 | Pisces sp. | 2 | 2 | 11.1 | |
| 33 | *Pseudorasbora parva* | 1 | 4 | 5.5 | |
| 34 | *Alburnus alburnus* | 1 | 2 | 5.5 | To 76 mm, 6 g |
| 35 | *Abramis brama* | 1 | 2 | 5.5 | To 73 mm, 6 g |
| | 2. Amphibia | | | | |
| 36 | *Rana* sp. | 3 | 7 | 5.5 | To 35 mm |
| 37 | *Rana* sp. larvae | 2 | 4 | 5.5 | |
| 38 | *Bombina bombina* | 1 | 1 | 5.5 | |
| 39 | *Rana esculenta* | 1 | 1 | 5.5 | |
| | 3. Mammalia | | | | |
| 40 | *Mus* sp. | 1 | 1 | 5.5 | |

Distribution of evidence over time: Aug.-18, Sept.-7, Nov.-1

Distribution by area: Sarinasuf - 6, Tulcea - 5, Crișan - 2, Mila 23 - 2, Dunavățul de Sus - 1, Maliuc - 1, Sălcioara - 1.

Table 5. Trophic components identified in the gastrointestinal contents of *Ardea purpurea* collected in the Danube Delta during the period 10.09.1973-24.08.1978 (n=26).

| Crt. No. | Trophic component | Frequ. | No. spec. | % No/Fequ. | Remarks |
|---|---|---|---|---|---|
| | **A. Components of vegetable origin** | | | | |
| 1 | *Echinocloa crus-galli* seeds | 3 | 9 | 11.5 | Detritus |
| 2 | *Polygonum lapathifolium* seeds | 1 | 1 | 3.8 | Detritus |
| 3 | Gramineae sp. green fragments | 1 | 1 | 3.8 | Detritus |
| | **B. Components of animal origin**<br>1. Invertebrates | | | | |
| 4 | Odonata sp. | 9 | 28 | 34.6 | |
| 5 | *Naucoris cimicoides* | 6 | 17 | 23 | |
| 6 | *Dytiscus marginalis* | 6 | 9 | 23 | |
| 7 | *Otiorrhynchus* sp. | 3 | 11 | 23 | |
| 8 | *Dytiscus* sp. | 3 | 8 | 23 | |
| 9 | *Harpalus* sp. | 2 | 9 | 7.6 | |
| 10 | *Agonum ruficorne* | 2 | 4 | 7.6 | |
| 11 | *Hydrous piceus* | 2 | 4 | 7.6 | |
| 12 | *Physa acuta* | 2 | 3 | 7.6 | |
| 13 | *Cybister lateromarginalis* larva | 1 | 2 | 3.8 | |
| 14 | *Adonia variegata* | 11 | 2 | 3.8 | |
| 15 | Crustacea sp. | 1 | 2 | 3.8 | |

| | | | | | |
|---|---|---|---|---|---|
| 16 | *Hydrobius* sp. | 1 | 2 | 3.8 | |
| 17 | Odonata sp. larvae | 1 | 2 | 3.8 | |
| 18 | Pulmonata sp. | 1 | 2 | 3.8 | |
| 19 | *Subcoccinella vigintiquatropunctata* | 1 | 2 | 3.8 | |
| 20 | *Amara aenea* | 1 | 2 | 3.8 | |
| 21 | *Anax imperator* | 1 | 2 | 3.8 | To 40 mm, 2 g |
| 22 | *Anax* sp. larva | 1 | 2 | 3.8 | |
| 23 | *Coccinella septempunctata* | 1 | 2 | 3.8 | |
| 24 | *Crocothemis erythraea* | 1 | 2 | 3.8 | |
| 25 | *Coleoptera* sp. larva | 1 | 2 | 3.8 | |
| 26 | *Leptinotarsa decemlineata* | 1 | 2 | 3.8 | |
| 27 | *Libellula* sp. | 1 | 2 | 3.8 | |
| 28 | Orthoptera sp. | 1 | 2 | 3.8 | |
| 29 | *Scimmus bipunctatus* | 1 | 2 | 3.8 | |
| | *2*. Vertebrates<br>2.1. Pisces | | | | |
| 30 | *Cyprinus carpio* | 7 | 10 | 26.9 | |
| 31 | Pisces sp. | 3 | 4 | 11.5 | |
| 32 | *Carassius gibelio* | 1 | 1 | 3.8 | To 73 mm |
| 33 | *Ctenopharyngodon idella* | 1 | 1 | 3.8 | To 120 mm |
| 34 | Cyprinidae sp. | 1 | 1 | 3.8 | |
| 35 | *Hypopthalmictis molitrix* | 1 | 1 | 3.8 | To 80 mm |
| 36 | *Scardinius erythrophtalmus* | 1 | 1 | 3.8 | |
| 37 | *Lucioperca lucioperca* | 1 | 1 | 3.8 | To 150 mm |
| | 2.2. Amphibia | | | | |
| 38 | *Rana* sp. | 14 | 39+ x | 53.8 | To 45 mm, 26 g |
| 39 | *Rana* sp. larvae | 7 | 26 | 26.9 | |
| 40 | *Hyla arborea* | 1 | 1 | 3.8 | To 30 mm, 7 g |
| 41 | *Rana ridibunda* | 1 | 1 | 3.8 | To 95 mm, 70 g |
| | 2.3. Mammalia | | | | |
| 42 | *Microtus arvalis* | 2 | 2 | 7.6 | |
| 43 | *Mus* sp. | 1 | 1 | 3.8 | |
| 44 | Rodentia sp. | 1 | 1 | 3.8 | |

Distribution of evidence over time: Aug.-18 , Sept.-7, Nov. –1.
Distribution by area: Murighiol - 20, Sarinasuf - 4, Periteașca – 2.

Table 6. Trophic components identified in the gastrointestinal contents of *Plegadis falcinellus* collected in the Danube Delta during the period 04.08.1973-25.08.1982 (n=32).

| **Crt. No.** | **Frequ.** | **No. spec.** | **% Frequ./No.** | **Remarks** | |
|---|---|---|---|---|---|
| | **A. Components of vegetable origin** | | | | |
| 1 | *Hordeum vulgare* | 3 | 56 | 9.3 | As food? |
| 2 | *Sparganium erectum* | 2 | 2 | | Accidental |
| 3 | *Echinocloa cris-galli* | 1 | 6 | 3.1 | Accidental |
| 4 | *Convolvulus arvensis* | 1 | 4 | 3.1 | Accidental |
| 5 | *Bolboschoenus maritimus* | 1 | 1 | 3.1 | Accidental |
| 6 | Algae sp. | 1 | x | 3.1 | Accidental |
| 7 | Gramineaceae sp. fragments | 1 | x | 3.1 | Accidental |

| | | | | | |
|---|---|---|---|---|---|
| 8 | Plant fragments | 1 | x | 3.1 | Accidental |
| | **B. Components of animal origin** | | | | |
| | 1. Invertebrates | | | | |
| 9 | *Naucoris cimicoides* | 8 | 46 | 25.0 | |
| 10 | *Litoglyphys naticoides* | 5 | 10 + x | 15.6 | |
| 11 | Mollusca sp. | 6 | x | 18.7 | |
| 12 | *Stratiomys* sp.larvae | 4 | 83 | 12.5 | |
| 13 | Odonata sp. | 4 | 16 | 12.5 | |
| 14 | Carabus sp. | 4 | 8 | 12.5 | |
| 15 | *Harpalus* sp. | 3 | 13 | 9.3 | |
| 16 | Tabanidae sp. larvae | 3 | 11 | 9.3 | |
| 17 | *Dytiscus* sp. larvae | 3 | 9 | 9.3 | |
| 18 | *Hydous piceus* | 3 | 5 | 9.3 | |
| 19 | *Cybister lateromarginalis* | 2 | 25 | 6.2 | |
| 20 | *Bythinia tentaculata* | 2 | 8 | 6.2 | |
| 21 | *Aeschna affinis* | 2 | 6 | 6.2 | |
| 22 | Odonata sp. larvae | 2 | 5 | 6.2 | |
| 23 | Lamellibranchiata sp. | 2 | x | 6.2 | |
| 24 | *Helophorus aquaticus* | 1 | 4 | 3.1 | |
| 25 | *Curculio* sp. | 1 | 3 | 3.1 | |
| 26 | Elateridae sp. Larve | 1 | 2 | 3.1 | |
| 27 | *Helophorus aquaticus* | 1 | 4 | 3.1 | |
| 28 | *Hydrobius sp.* | 1 | 3 | 3.1 | |
| 29 | *Notonecta glauca* | 1 | 3 | 3.1 | |
| 30 | *Acrida hungarica* | 1 | 1 | 3.1 | |
| 31 | *Agriotes sp*. larva | 1 | 1 | 3.1 | |
| 32 | *Amara aenea* | 1 | 1 | 3.1 | |
| 33 | Chrisomelidae sp. | 1 | 1 | 3.1 | |
| 34 | *Copris* sp. | 1 | 1 | 3.1 | |
| 35 | *Corixa punctata* | 1 | 3 | 3.1 | |
| 36 | *Epheremoptera* sp. larva | 1 | 1 | 3.1 | |
| 37 | *Grillus campestris* | 1 | 1 | 3.1 | |
| 38 | Ortoptera sp. | 1 | 1 | 3.1 | |
| 39 | Otiorrhynchus sp. | 1 | 1 | 3.1 | |
| 40 | *Planorbis* sp. | 1 | 1 | 3.1 | |
| 41 | *Valvata piscinalis* | 1 | 1 | 3.1 | |
| 42 | *Viviparus* sp. | 1 | 1 | 3.1 | |
| | 2. Vertebrates | | | | |
| | 2.1. Pisces | | | | |
| 43 | *Cyprinus carpio* | | 1 | 3.1 | To 70 mm |
| | 2.2. Amphibia | | | | |
| 44 | *Rana* sp. | 2 | 3 | 3.1 | |
| 45 | *Triturus* sp. | 1 | 1 | 3.1 | |
| | 2.3. Aves | | | | |
| 46 | Aves sp. | 1 | 1 | 3.1 | Pullus indet. |
| | 2.4. Mammalia | | | | |
| 47 | *Mus* sp. | 1 | 1 | 3.1 | |
| 48 | *Microtus* sp. | 1 | 1 | 3.1 | |

Distribution of evidence over time: Aug.-13, Sept.-12, Oct.-5, Nov.-2.
Distribution by area: Murighiol - 15, Sarinasuf - 6, Maliuc-7, Mila 23 - 2, Dunavățul de Sus - 2.

Table 7. The comparative relationship of the fish trophic component to other food in some species of birds.

| Crt. No. | The researched species, | *Phal. carb.* (n=10) | | *Phal. pygm.* (n=71) | | *Nyct. nyct.* (n=32) | | *Ard. rall.* (n=18) | | *Ard. pur.* (n=26) | | *Pleg. fal.* (n=26) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | number of samples | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| 1 | Exclusive consumption of fish | 7 | 70 | 45 | 65.2 | 7 | 21.9 | 4 | 22.2 | 1 | 3.8 | - | - |
| 2 | Mostly fish and other components | 2 | 20 | 8 | 11.5 | 3 | 9.4 | 2 | 11.1 | 5 | 19.2 | - | - |
| 3 | Mosly other components but also fish | 0 | 0 | 4 | 5.7 | 3 | 9.4 | 2 | 11.1 | 5 | 19.2 | 1 | 3.2 |
| 4 | Other components only | 0 | 0 | 6 | 8.6 | 7 | 21.9 | 2 | 11.1 | 13 | 50 | 26 | 81.2 |
| 5 | Empty samples | 1 | 10 | 6 | 8.6 | 12 | 37.5 | 12 | 44.4 | 2 | 7.6 | 5 | 15.6 |

As it is shown by tables 1-6, the food spectrum of consumed animal and plant materials of the studied bird species is very wide, and the food preference of the species can be characterised. Our results prove that the diet of birds living near water bodies can be very varied, and fish species only form a small fraction of it. Some species of the consumed fish have no commercial value, though their ecological role in the food chain can be significant. Several invasive, intentionally or unintentionally introduced fish species were identified in our samples, possibly due to the fact that most of our samples were collected around fisheries.

As to the extent of piscivores (Tab. 7.), the Great Cormorant was found to be a specialised piscivorous bird. As it poses a real threat to fishery stocks due to its diet and its rising population numbers, the fisheries require that the management of Great Cormorant populations should be legalised by the European Union. The piscivore tendency of the five other species in descending order: second comes the Pygmy Cormorant, while the Night Heron and Squacco Heron are almost identical in terms of fish consumption, and from among the herons the Purple heron consumes the least fish. The Glossy Ibis only consumes fish occasionally, in our samples there was only a single fish item. Its food composition is the most diverse from among all the studied species.

Taking into account, that all these species are protected, this is a purely scientific issue, without any economic consideration.

**B. Other species (Tables 8-10).**

Table 8. Trophic components identified in the gastrointestinal contents of *Gallinula chloropus* collected in the Danube Delta during the period 25.02.1973-23.09.1985 (n=26).

| Crt. No. | Components | No. frequ. | No. Spec. | % Frequ./No. |
|---|---|---|---|---|
| | **A. Components of vegetable origin** | | | |
| 1 | *Plygonum lapathifolium* | 8 | 2476 | 30.7 |
| 2 | *Solanum nigrum* | 4 | 843 | 30.7 |
| 3 | *Bolboschoenus maritimus* | 4 | 263 | 30.7 |
| 4 | *Echinocloa crus-galli* | 4 | 161 | 30.7 |
| 5 | *Carex* sp. | 3 | 79 | 11.5 |
| 6 | *Potamogeton* sp. | 2 | 3 | 7.7 |
| 7 | *Polygonum convulvulus* | 2 | 2 | 7.7 |
| 8 | *Amaranthus retroflexus* | 1 | 104 | 3.8 |
| 9 | *Potamogeton natans* | 1 | 23 | 3.8 |
| 10 | *Atriplex* sp. | 1 | 11 | 3.8 |
| 11 | *Potamogeton* sp. | 1 | 8 | 3.8 |
| 12 | *Sparganium* sp. | 1 | 7 | 3.8 |
| 13 | Gramineae sp. | 1 | 4 | 3.8 |
| 14 | *Convolvulus arvensis* | 1 | 2 | 3.8 |
| 15 | *Coronella varia* | 1 | 2 | 3.8 |
| 16 | *Picris hieraciodes* | 1 | 2 | 3.8 |
| 17 | *Polygonum aviculare* | 1 | 1 | 3.8 |
| 18 | *Chara spors* | 1 | x | 3.8 |
| 19 | Fragm. veget. | 1 | x | 3.8 |
| 20 | *Miriophillum* sp. | 1 | x | 3.8 |
| | **B. Components of animal origin**<br>1. Invertebrates | | | |
| 21 | Gasteropoda sp. | 9 | x | 3.8 |
| 22 | Coleoptera sp. | 5 | 31 | 3.8 |
| 23 | *Amara aenea* | 2 | 5 | 3.8 |

| | | | | |
|---|---|---|---|---|
| 24 | *Planorbis planorbis* | 2 | 2 | 3.8 |
| 25 | *Harpalus* sp. | 2 | 47 | 3.8 |
| 26 | Insecta sp. eggs | 1 | 3 | 3.8 |
| 27 | Carixidae sp. | 1 | 3 | 3.8 |
| 28 | *Hydous* sp. | 1 | 2 | 3.8 |
| 29 | Odonata sp. | 1 | 2 | 3.8 |
| 30 | Arahnoidea sp. | 1 | 2 | 3.8 |
| 31 | *Otiorrhhynchus* sp. | 1 | 1 | 3.8 |
| 32 | *Sagmantina nilotica* | 1 | 1 | 3.8 |
| 33 | Chitin fragments | 1 | x | 3.8 |

Distribution of evidence over time: Aug.-10, Sept.-14, Oct.-2.
Distribution by area: Murighiol - 20, Sarinasuf - 4, Periteașca – 2.

Table 9. Trophic components identified in the gastrointestinal contents of *Vanellus vanellus* collected in the Danube Delta during the period 25.02.1973-17.09.1980 (n=20).

| Crt. No. | Trophic component | Frecv. | No. spec. | % Frequ./No.. |
|---|---|---|---|---|
| | **A. Components of vegetable origin** | | | |
| 1 | *Helianthus annuus* | 2 | 2 | 10 |
| 2 | *Bolboboschoenus* sp. | 1 | 1 | 5 |
| 3 | *Carex* sp. | 1 | 1 | 5 |
| 4 | *Conium* sp. | 1 | 1 | 5 |
| 5 | *Vitis vinifera* | 1 | 1 | 5 |
| | **B. Components of animal origin**<br>1. Invertebrates | | | |
| 6 | *Otiorrhynchus* sp. | 5 | 9 | 25 |
| 7 | Chitin fragments | 4 | x | 20 |
| 8 | Hydrophilidae sp. | 3 | 2 + x | 15 |
| 9 | *Bembidion lampros* | 2 | 6 | 10 |
| 10 | *Harpalus* sp. | 2 | 5 | 10 |
| 11 | *Calliptamus* sp. | 2 | 3 | 10 |
| 12 | Carabidae sp. | 1 | 1 + x | 5 |
| 13 | *Zabrus tenebroides* | 1 | 4 | 5 |
| 14 | *Forficula* sp. | 1 | 1 | 5 |
| 15 | Gastropoda sp. | 2 | x | 5 |
| 16 | *Agriotes lineatus* larvae | 1 | 5 | 5 |
| 17 | *Asaphidion flavipes* | 1 | 4 | 5 |
| 18 | *Formica* sp. | 1 | 3 | 5 |
| 19 | *Carabus granulatus* | 1 | 2 | 5 |
| 20 | Isopoda sp. | 1 | 2 | 5 |
| 21 | Ortoptera sp. | 1 | 2 | 5 |
| 22 | Lamellibranchiata sp. | 1 | x | 5 |
| 23 | Lepidoptera sp. larva | 1 | 1 | 5 |
| 24 | *Limnaea palustris* | 1 | 1 | 5 |
| 25 | *Lymnea stagnatilis* | 1 | 1 | 5 |

Distribution of evidence over time: Febr. 2, May-2, July-1.
Distribution by area: Murighiol - 5, Sarinasuf - 5, Letea - 3, Rândunica - 3, Beștepe - 1, C.A. Rosetti - 1, Crișan - 1, Grindul Lupilor - 1.

Table 10. Trophic components identified in the gastrointestinal contents of *Limosa limosa* collected in the Danube Delta duringthe period 27.07.1974-17.07.1985 (n=18).

| Crt. No. | Trophic component | Frequ. | No. sspec. | % Frequ./No. |
|---|---|---|---|---|
| 1 | **A. Components of vegetable origin** | | | |
| 2 | *Potamogeton* sp. | 2 | 71 | 11.1 |
| 3 | *Carex* sp. | 2 | 30 | 11.1 |
| 4 | *Potamogeton natans* | 2 | 26 | 11.1 |
| 5 | *Sparganium* sp. | 2 | 4 | 11.1 |
| 6 | *Echinocloa crus-galli* | 2 | 2 | 11.1 |
| 7 | *Vitis vinifera* | 1 | 1 | 5.5 |
| 8 | *Chara* sp. filaments | 2 | x | 5.5 |
| 9 | Plant fragments | 1 | x | 5.5 |
| | **B. Components of animal origin**<br>1. Invertebrates | | | |
| 8 | *Valvata piscinalis* | 2 | 3 | 11.1 |
| 9 | Coleoptera sp. | 2 | 2 | 11.1 |
| 10 | Crustacea sp. | 2 | 2 | 11.1 |
| 11 | *Chironomus* sp. | 2 | 2 | 11.1 |
| 12 | Mollusca sp. | 2 | x | 11.1 |
| 13 | Odonata sp. larvae | 1 | 3 | 5.5 |
| 14 | Diptera sp. larva | 1 | 1 | 5.5 |
| 15 | *Bithynia tentaculata* | 1 | 1 | 5.5 |
| 16 | Gasteropoda sp. | 1 | 1 | 5.5 |
| 17 | Orthoptera sp. | 1 | 1 | 5.5 |

Distribution of evidence over time: March-2, Jun.-1, Aug.-8, Sept.-3, Oct.-4.
Distribution by area: Crișan - 5, Sacalin - 3, Sălcioara - 3, Sarinasuf- 3, Letea - 2, Murighiol - 2.

The Lapwing, Moorhen and Bar-tailed Godwit are all birds associated with wetlands, and predominantly consume the abundant invertebrates of these habitats, additionally they take plant material, too, but can generally be considered as consuming a narrow spectrum of food components. In the socialist era, these species could be hunted legally, and hence our samples are temporarily constrained, and mainly originate from the autumn hunting season, opening from August. For this reason and also due to the low sample sizes we cannot draw unquestionable conclusions. Just like most of our data, these are preliminary results, and might serve as additional information for understanding the ecology of wetlands.

## CONCLUSIONS

The detailed analyses of stomach contents provide valuable information on the diet composition and food sources of the studied species from the period when samples were collected, and additionally on the biodiversity of the Danube Delta then, which has surely significantly changed in the past decades.

Even so, our results only constitute partial information for understanding of the ecology of wetland areas.

From the studied bird species that are wrongly considered piscivore, only the Great Cormorant proved to be a real piscivore bird, the Pygmy Cormorant consumes significantly more food items that are not fish. This is also true for a larger extent in the case of the Night Heron and Squacco Heron, we found almost no fish component in the diet of the Purple Heron, and the fish consumption of the Glossy Ibis is negligible.

Through our study we can prove that diet composition analyses can contribute valuable information to understanding the ecological role of different species in their community.

Although the methods available for advancing biological knowledge become more numerous and are constantly evolving, and so-called “high-tech” methods are becoming the norm, classic diet-studies should not be completely omitted.

Nowadays, there are more and more non-invasive methods available through which diet composition can be studied without harming and sacrificing birds.

From the presented data we could gain information on other biological phenomena, for example on the phenology of Night Heron and its tendency of overwintering in the Danube Delta.

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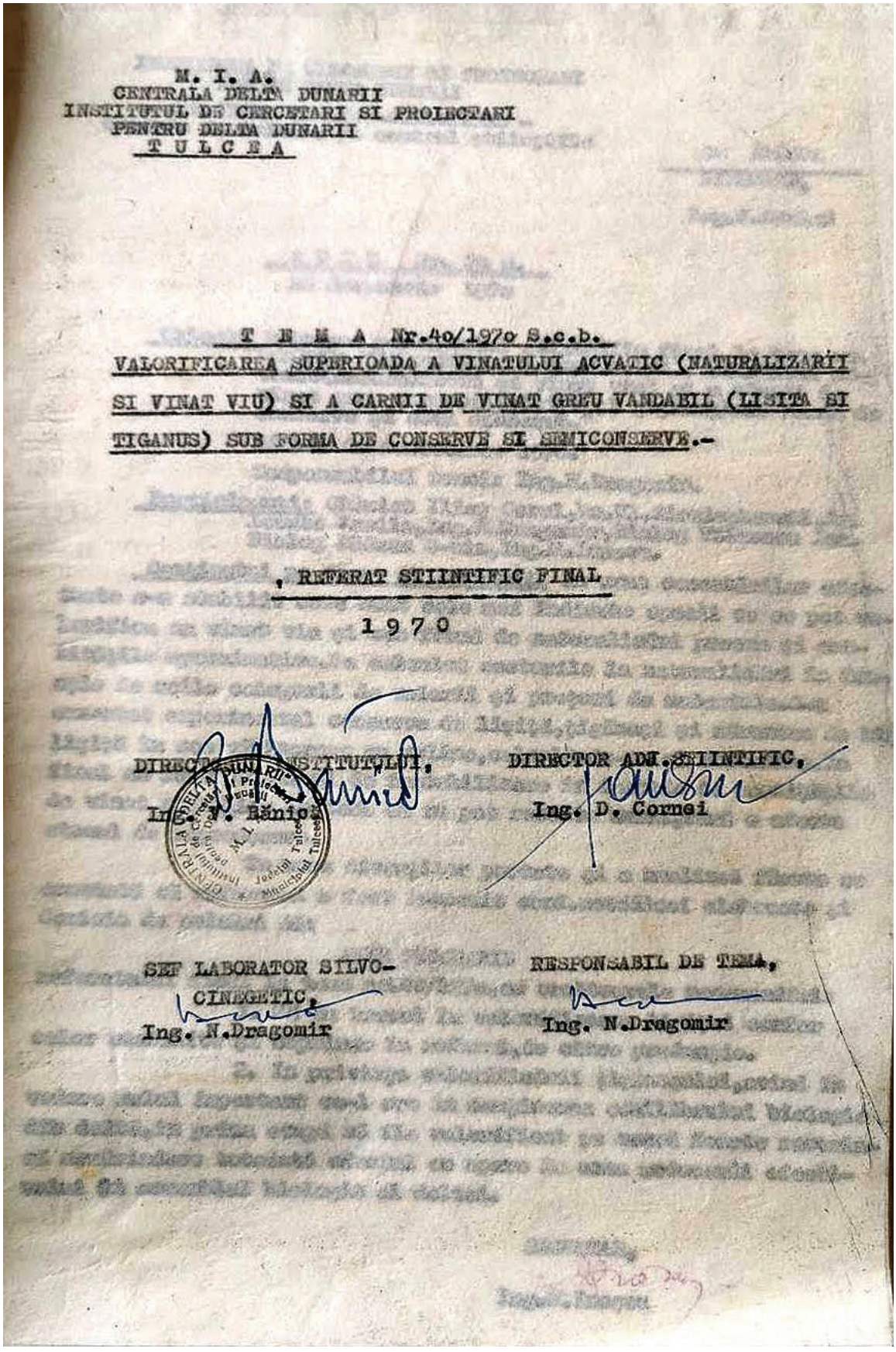

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T U L C E A

T E M A Nr.40/1970 S.c.b.

VALORIFICAREA SUPERIOADA A VINATULUI ACVATIC (NATURALIZARII SI VINAT VIU) SI A CARNII DE VINAT GREU VANDABIL (LISITA SI TIGANUS) SUB FORMA DE CONSERVE SI SEMICONSERVE.-

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RESPONSABIL DE TEMA,
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Figure 1. The widespread sales of the meat of waterfowl (prepared as exhibition mounts and live waterfowl) and species sold with difficulties (Coot and Glossy Ibis) as tinned food and partially processed produce. The title page of the final report (Original).