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## PRELIMINARY RESULTS OF STUDIES ON PATHOLOGY OF THE LIVER OF CORMORANTS *PHALACROCORAX CARBO* FROM NORTH-EASTERN POLAND

**ABSTRACT:** The livers of cormorants shot at the natural ponds near Warlity and Sorkwity in north-eastern Poland were used in the study. The pathomorphological changes of the livers and the contamination of chlorinated hydrocarbons and heavy metals were studied. Degree of

pathomorphological changes of the cormorant liver depends on the contents of chlorinated hydrocarbons and heavy metals.

**KEY WORDS:** cormorant, pathology of the liver, chlorinated hydrocarbons contamination, heavy metals contamination, north-eastern Poland

### 1. INTRODUCTION

There is well known that terrestrial and aquatic ecosystems are contaminated with a large number of pollutants. Chlorinated hydrocarbons and heavy metals are extremely persistent in the environment and can influenced heterogeneously on food during its processing as well as on the consumer's body (Zasadowski and Buszko 1988, Walker et al. 1993). Assessing the environmental effects of such combinations of compounds is a problem of daunting complexity. There are indications for suspecting that the effects of most combinations of chemicals are additive. However, it is known that the interaction of certain com-

pounds can lead to an enhancement of the toxicity. The combination of the reaction of few pollutants may be substantially greater than the accumulation of the toxicities of the individual compounds (Szarek et al. 1992, Walker et al. 1993).

In the light of introduced facts the developing of the cormorant *Phalacrocorax carbo* population is an interesting object for studying of the chlorinated hydrocarbons and heavy metals contamination in their body due to pathomorphological pattern of the liver, what is the aim of this study.

## 2. MATERIAL AND METHODS

The studies were carried out on cormorants selectively shot during post-breeding period in 1992 at the permission of the Ministry of Environmental Protection, Natural Resources and Forestry in Poland. Birds originated from two sites in north-eastern Poland: 11 cormorants (3 females and 8 males) from natural lakes near Warlity (W) and 15 birds (9 females and 6 males) from lakes near Sorkwity (S). Both villages are situated in the distance of 70 km each other; the vicinity of S is more afforested than vicinity of W.

The cormorants were autopsied with particular attention to the liver. Cuts were taken from different parts of this organ for microscopic examination. Liver tissue were fixed in 10% neutralized formalin solution. Paraffin sections were stained with haematoxylin and eosin (Bagiński 1969, Pearse 1968), and using PAS method according to McManus (1948). Frozen sections of the liver were stained with Sudan III according to Lillie Ashburn (Bagiński 1969). Chlori-

nated hydrocarbons were determined by the simple Amarowicz et al.' method (Amarowicz et al. 1986). The qualification and quantification were performed by gas-liquid chromatography with electron capture detection in standard conditions. Chlorinated insecticides were separated on a silicic acid column and DDE was destroyed by the Górski and Syrowatka's method (Górski and Syrowatka 1979). The final analysis was performed with a Pye-Unicam GL-chromatograph with electron capture detection. mercury content was evaluated following the mineralisation of liver using nitric and sulphuric acid, and measured by atomic absorption spectrometry (so called "cold vapour method"). Lead and cadmium were measured after having ashed and resolved the tissue in 0.1 M HNO<sub>3</sub>, employing flameless atomic absorption method. An apparatus, "Solar 939 AA" spectrometer equipped with the data station and "FS-90" graphic furnace were used.

## 3. RESULTS

### 3.1. PATHOMORPHOLOGICAL PATTERN OF THE LIVER

Parenchymatous degeneration of the liver was found in 80% of birds from W and in 47% from S. The necrosis of some liver cells was revealed almost in the half of the preparation of the birds from W and in 20% examined cormorant livers from S. In the birds from W the above changes were frequently accompanied by the congestion and infiltration of the mononuclear cells. The oedema of stellate cells was detected in four cases and the

proliferation of these cells occurred in two further cases. The congestion of the liver, in the cormorants from S, was observed in 60% examined cases.

The level of glycosaminoglycanes in liver cells of the both groups of birds (W and S) varied from low to very high. In few cases only weak colour PAS reaction occurred. Sometimes high concentration of glycosaminoglycanes was noticed at the marginal part of the liver cells.

### 3.2. CONTENT OF THE CHLORINATED HYDROCARBONS

The average level of HCH in cormorant liver was similar in both examined groups (Table 1), but in both cases average content of HCH was lower in males than in females (Fig. 1). DDE level in the liver fat of cormorants from surroundings of Warlity was lower than in those from Sorkwity (Tab. 1). The average content of DDE was higher in females than in males

in birds from W, but in cormorant colony from S the situation was opposite (Fig. 2). The average level of total DDT was higher twice in birds from Sorkwity (Tab. 1); in female birds from W was nearly twice as high as in males. But these compounds in birds from S were more abundant in males than in females (Fig. 3).

Table. 1. Average content of chlorinated hydrocarbons in the liver fat of cormorants from two study sites in north-eastern Poland ( $\text{mg kg}^{-1}$  of liver fat)

Name of study					Total
Site (N)	HCH	DDE	DDD	DDT	DDT
Warlity (11)	0.0108	1.0208	0	0.0707	1.8001
Sorkwity (15)	0.0107	1.5823	0	2.8113	4.4236

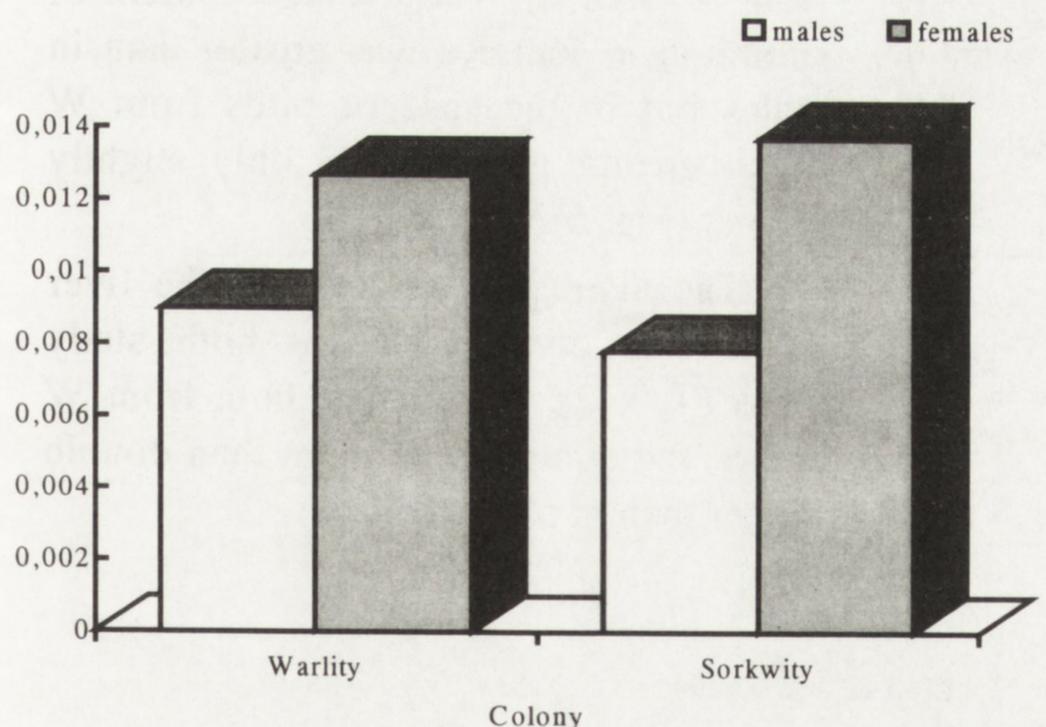


Fig. 1. The average content of HCH in the liver of cormorants ( $\text{mg kg}^{-1}$  of liver fat); lighter column – males, darker column – females

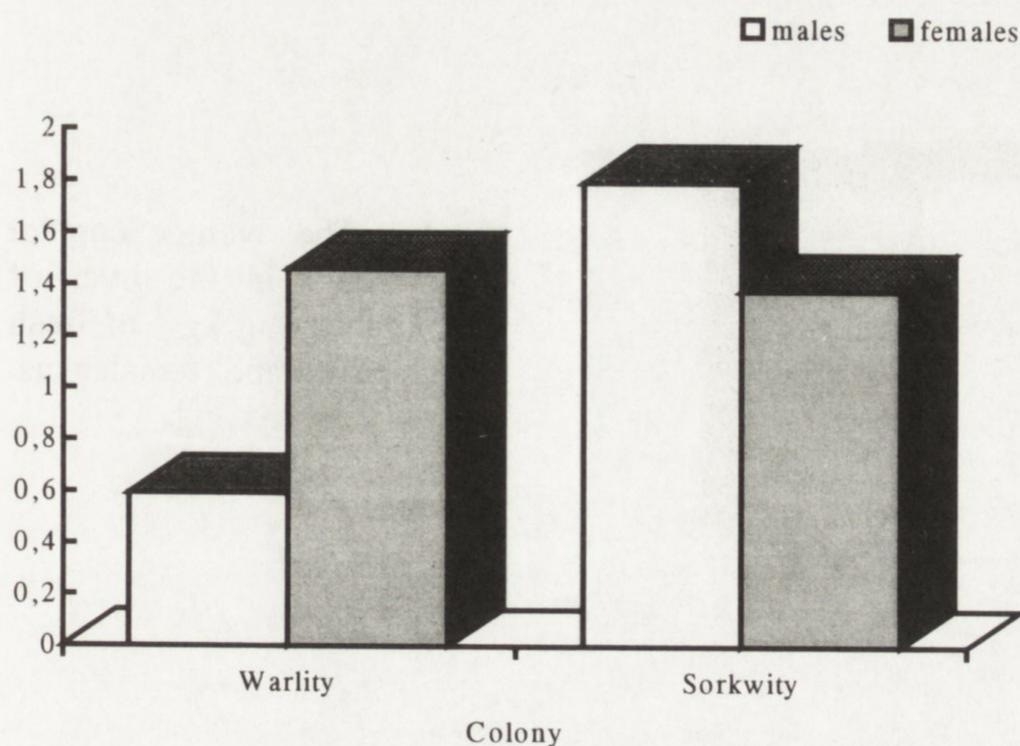


Fig. 2. The average content of DDE in the liver of cormorants ( $\text{mg kg}^{-1}$  of liver fat); males and females as in Fig. 1

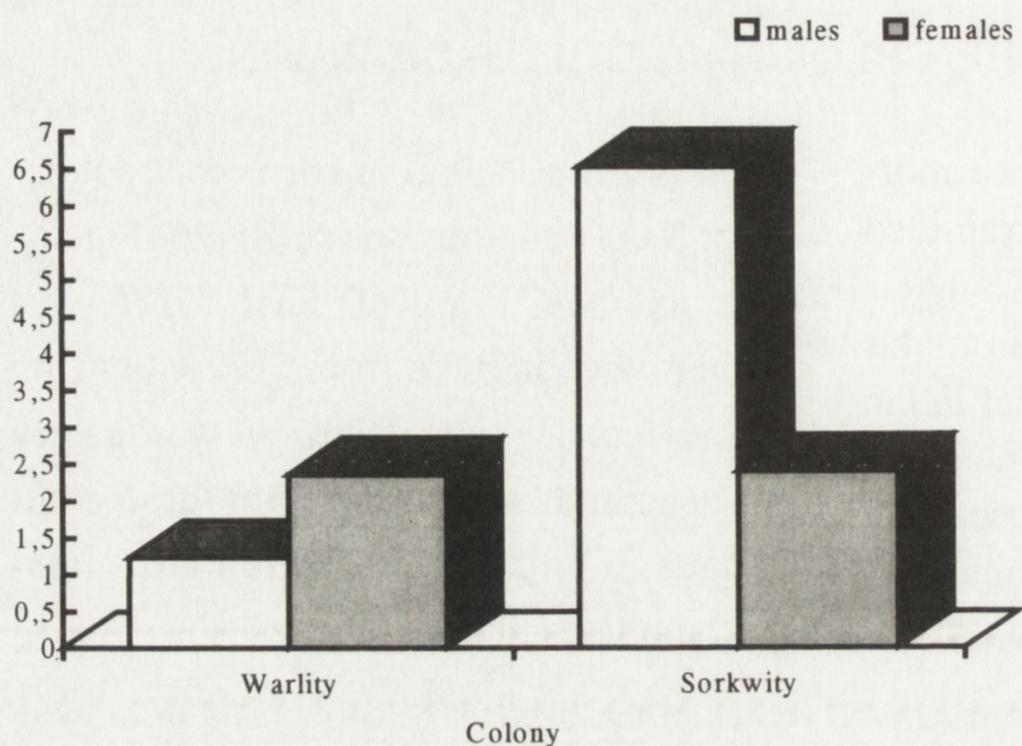


Fig. 3. The average content of total DDT in liver of cormorants ( $\text{mg kg}^{-1}$  of liver fat); males and females as in Fig. 1

### 3.3. CONTENT OF HEAVY METALS

Mercury level in the liver of cormorants from W was slightly higher than in birds from S (Tab. 2). Both sexes showed

Table 2. The content of heavy metals (mercury – Hg, cadmium – Cd and lead – Pb) found in the liver of cormorants from two study sites in north-eastern Poland ( $\text{mg kg}^{-1}$  of fresh liver mass)

Name of study site (N)	Hg	Cd	Pb
Warlity (11)	1.92	0.16	0.22
Sorkwity (15)	1.45	0.05	0.16

similar level of mercury contamination (Fig. 4).

The liver of cormorants from W contained also more cadmium than birds from S (Tab. 2). The average content of cadmium in females was greater than in males but in the case of birds from W much greater and from S only slightly greater (Fig. 5).

The average lead level in the liver tissue was comparable for both study areas (Tab. 2). In females, both from W and S, the content was more than double higher than in males (Fig. 6).

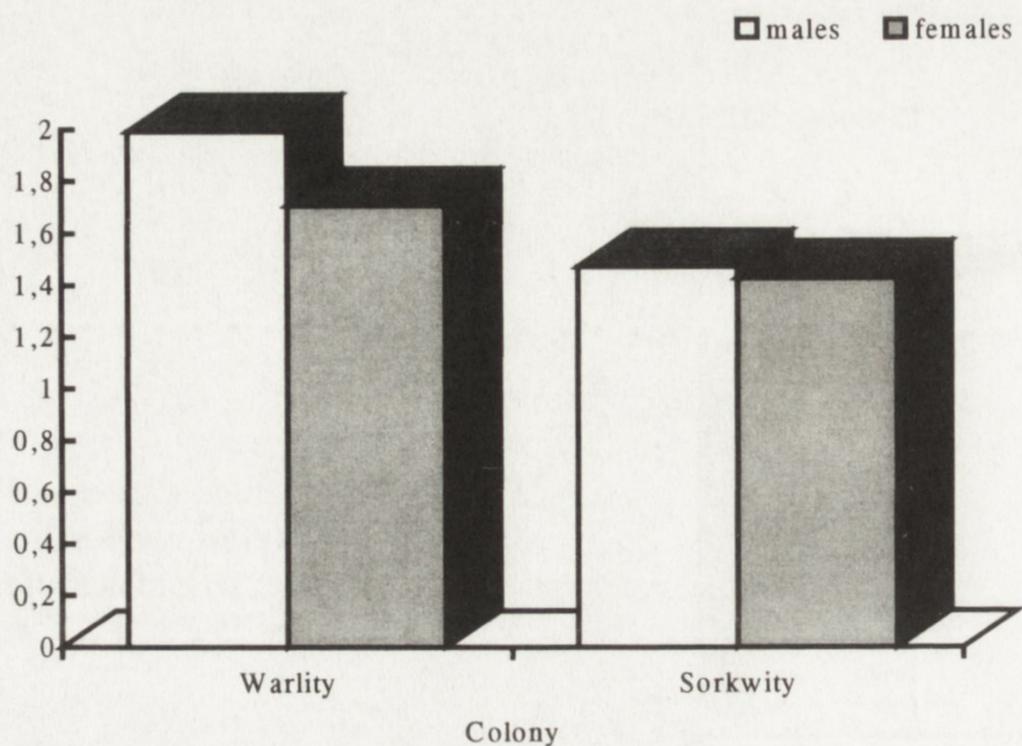


Fig. 4. The average content of mercury in the liver of cormorants ( $\text{mg kg}^{-1}$  of fresh liver); males and females as in Fig. 1

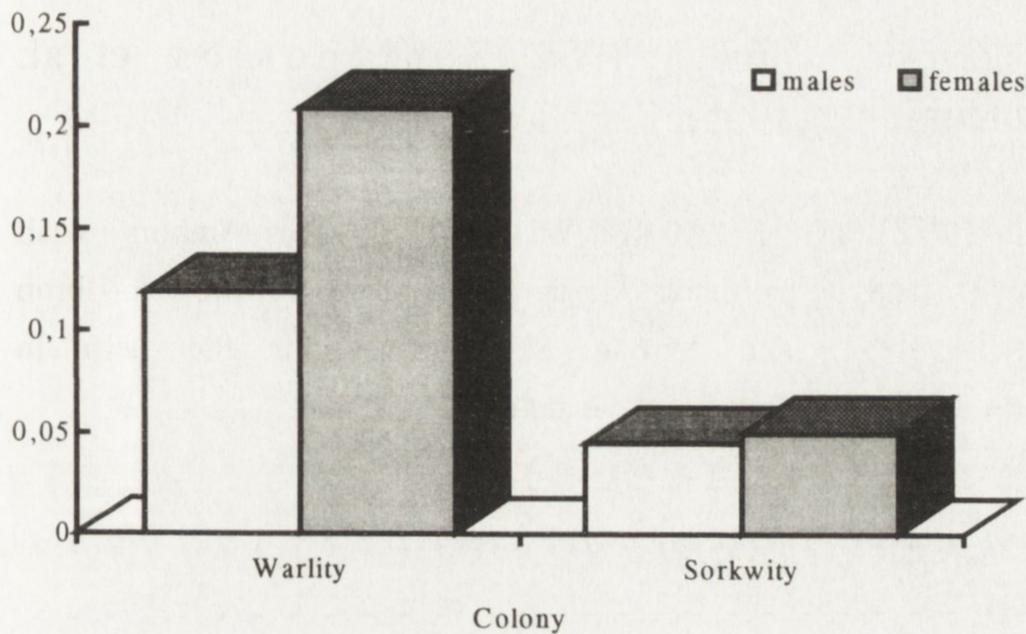


Fig. 5. The average content of cadmium in the liver of cormorants ( $\text{mg kg}^{-1}$  of fresh liver); males and females as in Fig. 1

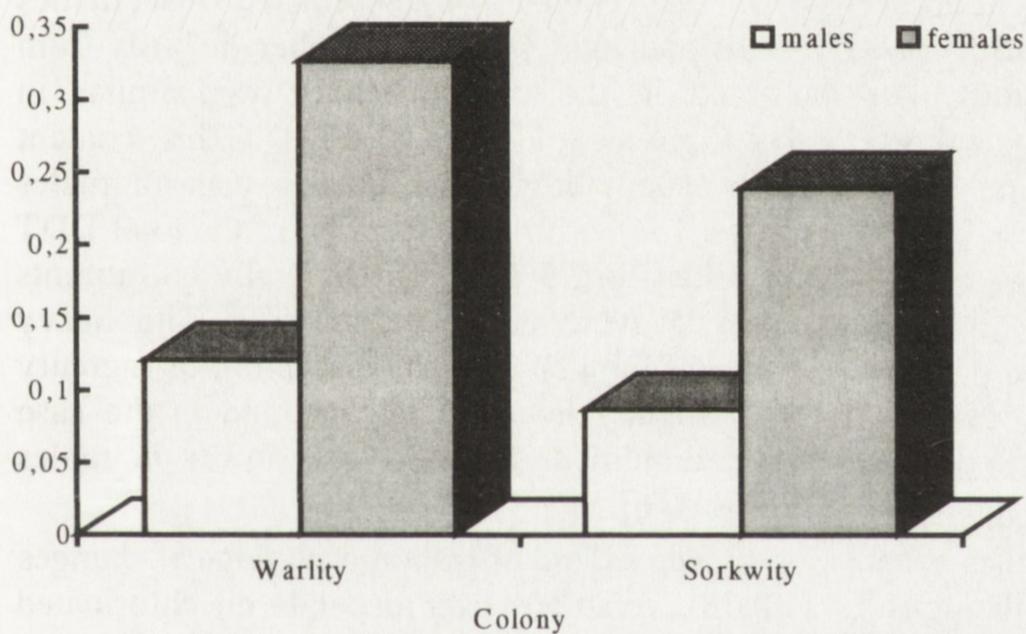


Fig. 6. The average content of lead in the liver of cormorants ( $\text{mg kg}^{-1}$  of fresh liver); males and females as in Fig. 1

#### 4. DISCUSSION

Our studies indicated more frequent occurrence of pathomorphological changes in the cormorant livers from the group W and its higher intensity degree as well. It is particularly distinct concerning retrogressive changes, necrosis, infiltration of mononuclear cells and stellate cells proliferations. The congestion was observed slightly more frequently in livers of birds from S. The level of glycosaminoglycans in both examined groups of birds varied from low to very high and often depended upon the presence of pathomorphological changes.

The content of the chlorinated hydrocarbons in the liver fat was higher in birds from S than in W. The level of HCH, DDR and total DDT was higher in females comparing with males of W birds, but the same levels (except HCH) in

group W were higher in case of males than females.

Analysis of cadmium content in the cormorant livers indicates a higher level in birds from W. Moreover an average mercury and lead level in both groups was similar. Generally the contamination of heavy metals was higher in females than in males.

Our results indicate that the intensity of pathomorphological changes in analyzed cormorant livers depends on the level of chlorinated hydrocarbons and heavy metals hence more advanced microscopical changes of liver occurred in birds from W. Similar tendency was observed in the grey heron *Ardea cinerea* (originating from the same vicinity as cormorants for presented studies) and in the coot *Fulica atra* (Fabczak et al. 1994, Szarek et al. 1995). It is remarkable

that the location of hepatic cells necrosis in lobules in most cases was typical for intoxication (Zasadowski and Buszko 1988, Zantopoulos et al. 1992). It is suggested that the pathogenesis of this phenomenon has been influenced by the environmental agents (Reisen-

brough 1986, Zantopoulos et al. 1992).

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## 5. SUMMARY

The livers of 26 cormorants shot in north-eastern Poland, near the villages Warlity (W) and Sorkwity (S), were used in the study. The subject of analysis were: pathomorphological patterns of the liver, the content of chlorinated hydrocarbons and the content of heavy metals.

Pathomorphological changes were observed in both groups of birds, but generally they were more often observed and more strongly pronounced in the cormorants from the surroundings of W. Also in this group of birds the deeper microscopical changes of liver cells were found. The level of glycosaminoglycans often depended on the presence of histopathological changes.

The content of chlorinated insecticides DDE and total DDT was higher in birds from S and in the case of HCH was similar in both groups of birds (Tab. 1). This content was usually higher in females than in males (Figs. 1–3), with the exception of the total DDT in birds from S (Fig. 3). Generally cormorants from W were more contaminated with heavy metals (Tab. 2). The contamination of mercury was slightly lower in females and in the case of cadmium and lead it was lower in males (Figs. 4–6).

The extend of pathomorphological changes of the cormorant liver depends on chlorinated hydrocarbons and heavy metal contents.

## 6. POLISH SUMMARY

Przebadano wątroby 26 kormoranów zastrzelonych w okresie polęgowym w koloniach usytuowanych w okolicy wsi Warlity (W) i Sorkwity (S), w północno-wschodniej Polsce. Tereny te znajdują się w odległości około 70 km od siebie, w pobliżu naturalnych zbiorników wodnych otoczonych polami i lasami. Badania dotyczyły patomorfologicznych zmian wątroby badanych ptaków, zawartości węglowodorów chlorowanych oraz metali ciężkich.

Zmiany patomorfologiczne wątroby kormoranów stwierdzono u obu grup ptaków, z tym że częstość ich wystąpienia i rozmiar były większe u ptaków z okolic W. Również u tych ptaków znaleziono bardziej rozległe zmiany mikroskopowe komórek wątroby. Poziom gliko-

zaminoglikanów przeważnie zależał od obecności zmian histopatologicznych.

Zawartość węglowodorów chlorowanych DDE i DDT była wyższa u ptaków z okolicy S, a w przypadku HCH była podobna u obu grup ptaków (tab. 1). Zawartość ta była przeważnie wyższa u samic niż u samców (rys. 1–3), z wyjątkiem zawartości DDT u ptaków z okolic S (rys. 3). Ogólnie kormorany z okolic W były bardziej skażone metalami ciężkimi (tab. 2). Poziom rtęci był nieco niższy u samic, a w przypadku kadmu i ołowiu był niższy u samców (rys. 4–6).

Wyniki badań sugerują, że stopień zmian patomorfologicznych w wątrobie kormoranów zależy także od zawartości metali ciężkich i węglowodorów chlorowanych.

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