

Andrzej MYRCHA<sup>1)</sup> and Alina KOSTELECKA-MYRCHA<sup>2)</sup>

<sup>1)</sup> Department of Polar Research, Institute of Ecology, Polish Academy of Sciences, Dziekanów Leśny

<sup>2)</sup> Institute of Biology, Branch of Warsaw University, Białystok

## Hematological studies on Antarctic birds I. Hematological indices in some species of the birds studied during australian summer \*)

**ABSTRACT:** The red blood picture was studied in 7 species of the Antarctic birds from the regions around Arctowski Station. King George Island (South Shetland Islands). The values of hematological indices were analysed, dependent on the mode of life and body weight of the examined species.

Key words: Antarctic, birds, blood

### 1. Introduction

Data on the morphological indices of the blood of the Antarctic birds are very scarce. Only Koržuev, Aljakrinskaja and Glazova (1977) have carried out more thorough studies on *Eudyptes cristatus*, but these penguins were brought to Europe by boat. It is possible to find for a few species some random data on the values of various indices obtained most often as a supplement to other physiological investigations and determined on a comparatively meagre material (Block and Murrish 1974, Douglas, Iockner and Murrish 1976, Guard and Murrish 1973, Milson, Johansen and Millard 1973).

Morphological picture of blood is a good indicator of adaptability of the animals to environmental conditions. Therefore, it seems purposeful to undertake more detailed hematological investigations, as it would make possible to characterize the respiratory function of a unit of blood volume in a range of species of the Antarctic birds living under low-temperatures environmental conditions.

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## 2. Material and methods

Investigations were conducted during austral summer from December 22, 1977 to March 5, 1978, at the Arctowski Station, on King George Island, the South Shetlands Archipelago (62°09'45''S, 58°27'45''W). Birds captured for these studies were used also by other scientific teams.

Altogether, 30 specimens of *Oceanites oceanicus* (Kuhl), 20 — *Sterna vittata* (Gmelin), 21 — *Larus dominicanus* (Lichtenstein), 10 — *Catharacta lonnbergi* (Saunders), 24 — *Pygoscelis adeliae* (Homborn et Jacquinnot), 21 — *P. antarctica* (Forster), and 20 — *P. papua* (Forster) were under examination. All the examined birds were mature.

Hemoglobin content in blood (*Hb/g* %), hematocrit (*Hct* %) and the number of erythrocytes per 1 mm<sup>3</sup> of blood (*RBC* mln/mm<sup>3</sup>) were determined. The length and width of erythrocytes were measured in stained preparations. On the basis of these data, the mean cell hemoglobin (*MCH* γγ), the mean cell hemoglobin concentration (*MCHC* %), and the average volume of erythrocytes were calculated.

## 3. Results

Statistically significant differences pertinent to sex were found only in the *Hb* content in *O. oceanicus* specimens (males — 16.5 ± 0.6 g %, n = 19, females — 17.9 ± 0.4 g %, n = 11).

In flying birds the highest values of *Hb*, *Hct* and *RBC* were noted in *O. oceanicus*, the species of the smallest body weight. The values of these indices decrease with the increasing body weight (Table I). Since these changes are not uniform this regularity is not revealed in the comparisons of *MCHC*. In this case, however, the smallest *O. oceanicus* has the highest mean cell hemoglobin concentration (*MCHC* %). The length and width of erythrocytes do not change with the increase of the body weight of the birds, merely the average volume of red cells in *L. dominicanus* is significantly smaller as compared with the remaining species.

Penguins of the genus *Pygoscelis* differ distinctly from the flying birds in values of hematological indices (Table I). They are characterized by a high level of *Hb* and *Hct* and a significantly smaller number of erythrocytes per 1 mm<sup>3</sup> of blood. These penguins are also marked off by considerably greater dimensions of erythrocytes and consequently the average volume of the erythrocytes is twice as large as that in the other four species. In result of this, penguins have also significantly higher *MCH* and *MCHC* values.

Though the differences between three species of the genus *Pygoscelis* are smaller than in the case of the examined flying birds nonetheless they have in all likelihood some biological significance. The highest *Hb*, *Hct*, *RBC* and *MCH* values were noted in *P. adeliae*, the lowest in *P. papua*. The intermediate values were obtained for *P. antarctica*. The

Table I.

## Haematological values of some antarctic birds

Species	N	Body weight (g)	Hb (g%)	Hct (%)	RBC (mln mm <sup>3</sup> )	MCH (γγ)	MCHC (%)	RBC vol. (μm <sup>3</sup> )	Erythrocyte measurements	
									Length (μm)	Width (μm)
<i>Oceanites oceanicus</i>	30	37.2 ± 1.0	17.0 ± 0.4	49.3 ± 0.8	4.016 ± 0.028	43.1 ± 2.0	34.7 ± 1.1	124.6 ± 4.6	11.81 ± 0.17	6.41 ± 0.09
<i>Sterna vittata</i>	20	159.6 ± 5.1	14.4 ± 0.6	47.9 ± 2.8	3.780 ± 0.192	38.2 ± 1.7	29.5 ± 1.2	127.1 ± 5.7	12.05 ± 0.33	6.57 ± 0.15
<i>Larus dominicanus</i>	21	1086.8 ± 71	12.6 ± 0.5	39.0 ± 1.6	3.640 ± 0.143	34.6 ± 1.4	32.3 ± 1.0	107.2 ± 2.3	12.59 ± 0.19	6.60 ± 0.18
<i>Catharacta lonnbergi</i>	10	1401.0 ± 254	12.7 ± 0.8	42.2 ± 3.5	3.404 ± 0.391	37.9 ± 2.9	30.2 ± 1.3	125.2 ± 7.2	11.82 ± 0.48	6.57 ± 0.28
<i>Pygoscelis adeliae</i>	24	4258 ± 186	17.6 ± 0.3	50.3 ± 1.2	2.169 ± 0.122	81.6 ± 2.5	35.0 ± 0.5	235.2 ± 10.2	13.68 ± 0.94	8.47 ± 0.11
<i>Pygoscelis antarctica</i>	21	3786 ± 178	16.6 ± 0.8	46.3 ± 2.1	1.910 ± 0.113	87.2 ± 3.8	35.9 ± 2.9	243.3 ± 9.8	13.36 ± 0.67	8.64 ± 0.71
<i>Pygoscelis papua</i>	20	5104 ± 183	16.3 ± 0.6	45.0 ± 1.4	1.770 ± 0.102	92.5 ± 4.3	36.3 ± 0.9	255.0 ± 11.4	14.11 ± 0.31	8.24 ± 0.20

analysis of these indices allows to surmise that *P. adeliae* has the highest and *P. papua* the lowest degree of adaptability to environmental conditions in the Antarctic cold zone. This surmise is in agreement with the data concerning the range of the distribution of these species (Watson 1975).

On the basis of the obtained results it may be asserted that Antarctic birds are characterized by a high level of the respiratory function of a unit of blood volume, which indicates good adaptation to the extreme climatic conditions, requiring the maintenance of a high level of energy metabolism. This high level of the respiratory function of a unit of blood volume is reached by the Antarctic birds in two ways. The flying birds have a great number of smaller erythrocytes with high hemoglobin saturation. Consequently, due to the decreased viscosity the blood flow in the vessels is quicker and oxygen transport is intensified. Small, very active *O. oceanicus* are characterized, moreover, by highest, in this group of birds, *Hb* and *MCHC* level, which satisfies the increased oxygen demand.

The blood of less active on the land but quickly swimming and diving penguins shows high level of the *Hb* content, similar to that in *O. oceanicus* birds. The high *Hct* value observed in these birds is ensured by greater size of erythrocytes in spite of a much smaller number of these cells per 1 mm<sup>3</sup> of blood. This mechanisms produces simultaneously high hemoglobin concentration in blood corpuscles and consequently an adequate quantity of oxygen may be transferred to the tissues, which is indispensable during swimming and particularly during diving activities.

## 4. Summary

The erythrocyte image of blood of seven species of antarctic birds (*Oceanites oceanicus*, *Sterna vittata*, *Larus dominicanus*, *Catharacta lonnbergi*, *Pygoscelis adeliae*, *P. antarctica* and *P. papua*) from the surroundings of Arctowski Station, King George Island, South Shetlands was studied (Table I). Values of the hematological indices were analysed as dependent from the way of life and body size of studied species.

It was found that among the flying species the highest values of hemoglobin, hematocrite and number of erythrocytes had *O. oceanicus*. With an increase of the body weight the values of above indices decreased. Penguins of the genus *Pygoscelis* are characterized by higher level of hemoglobin and hematocrite and by significantly lower number of larger, on the other hand, erythrocytes in 1 mm<sup>3</sup> of blood.

The obtained data suggest that antarctic birds are distinguished by a high level of the respiratory function of the unit of blood volume, attained in different way by flying birds than by penguins.

## 5. Резюме

Проведено исследование образа красной крови 7 видов антарктических птиц (*Oceanites oceanicus*, *Sterna vittata*, *Larus dominicanus*, *Catharacta lonnbergi*, *Pygoscelis adeliae*, *P. antarctica*, *P. papua*) из окрестностей Станции Арцтовского, остров Кинг Джорж, Южные Шетланды (таблица I). Проанализировано качества гематологических показателей в зависимости от образа жизни и величины тела исследованных видов.

Установлено, что среди летающих птиц высшее количество гемоглобина, гематокрита а также повышенное количество эритроцитов имеет *O. oceanicus*. По мере увеличения веса тела количество этих уровней показателей уменьшается. Пингвины рода *Pygoscelis* характеризуются высшим уровнем гемоглобина и гематокрита, а также существенно меньшим количеством, но за то больших красных кровяных шариков в 1 мм<sup>3</sup> крови.

Полученные данные свидетельствуют о том, что антарктические птицы отличаются высоким уровнем дыхательной функции единицы объёма крови, которого летающие птицы и пингвины достигают разным путём.

## 6. Streszczenie

Zbadano czerwonekrwinkowy obraz krwi 7 gatunków ptaków antarktycznych (*Oceanites oceanicus*, *Sterna vittata*, *Larus dominicanus*, *Catharacta lonnbergi*, *Pygoscelis adeliae*, *P. antarctica*, *P. papua*) z okolic Stacji Arctowskiego, Wyspa Króla Jerzego, Południowe Szetlandy (tabela I). Przeanalizowano wartości wskaźników hematologicznych w zależności od trybu życia i wielkości ciała badanych gatunków.

Stwierdzono, że wśród ptaków latających najwyższe wartości hemoglobiny, hematokrytu i liczby erytrocytów posiada *O. oceanicus*. W miarę wzrostu ciężaru ciała ptaków wartości tych wskaźników maleją. Pingwiny z rodzaju *Pygoscelis* charakteryzują się wyższym poziomem hemoglobiny i hematokrytu oraz istotnie mniejszą liczbą, ale za to większych, czerwonych krwinek w 1 mm<sup>3</sup> krwi.

Otrzymane dane świadczą o tym, że ptaki antarktyczne odznaczają się wysokim poziomem oddechowej funkcji jednostki objętości krwi, który jest osiągany różnymi drogami u ptaków latających i u pingwinów.

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### AUTHORS' ADDRESSES:

Doc. dr Andrzej Myrcha  
Zakład Badań Polarnych  
Instytutu Ekologii PAN  
Dziekanów Leśny  
05-150 Łomianki  
Doc. dr Alina Kostelecka-Myrcha  
Zakład Biologii Filii Uniwersytetu Warszawskiego  
w Białymstoku  
Lipowa 41  
15-424 Białystok, Poland