Theriologia Ukrainica, **24**: 210–215 (2022)
p-ISSN 2616-7379 • e-ISSN 2617-1120
DOI: 10.15407/TU2417

WINTER RECORDS OF KILLER WHALES (*ORCINUS ORCA*) IN THE WATERS OF THE WILHELM ARCHIPELAGO, WEST ANTARCTICA

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Key words

Orcinus orca, ecotypes, winter sightings, West Antarctic Peninsula

doi

http://doi.org/10.15407/TU2417

Article info

submitted 21.12.2022
revised 30.12.2022
accepted 30.12.2022

Language

English, Ukrainian summary

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Abstract

Killer whales (KWs) are apex marine predators. In Antarctica, they have diverse trophic interactions and belong to five ecotypes that have differences in morphology, genetics, and ecology. Around the West Antarctic Peninsula (WAP), two sympatric forms of Type B KWs are the most common. They have similar pigmentation patterns, but a larger form has been observed to feed mainly on seals (B1), and a smaller form feed on *Pygoscelis* penguins (B2). The waters of the WAP are experiencing ecosystem transformations caused by climate change at one of the fastest rates on Earth. Little is known about the austral winter distribution and ecology of KWs in this changing environment. The purpose of the study was to reveal the winter distribution and ecology patterns of KWs in the waters of the Wilhelm Archipelago. Boat-based visual observations and photo-identification were performed. The boat cruises were conducted within 14 nm of the Ukrainian Akademik Vernadsky Research Station, Galindez Island. In 2019, 10 surveys of a total of 194 nm were conducted, and in 2021 – 37 surveys of 605 nm. During both winters, three groups of KWs were recorded. A group of 7 KWs was encountered on 27 June 2019 near Hovgaard and Pleneau Islands. It consisted of adults of both sexes and juveniles. In the same area, on 13 July 2021, another group of KWs was encountered, consisting of at least five individuals (up to 7): 1 adult male, two adult females, a calf, and a juvenile of unknown sex. On 22 July 2021, a group of KWs consisting of 2 adult males was sighted in the Penola Strait. Observations of their joint feeding on a crabeater seal were performed. According to the external morphology patterns, all groups belong to the Type B, feeding behaviour of the third group confirms that they belong to the bigger form (B1). As Antarctic krill move inshore during winter, penguins and crabeater seals likely took advantage of ice-free areas to feed on it, and their observed gatherings could attract both Type B KWs. Future work should include collecting photogrammetry data, skin biopsy samples, behaviour observations, and acoustic recordings to differentiate between KW types and better understand their winter distribution and ecological patterns.

Cite as

Savenko, O. 2022. Winter records of killer whales (*Orcinus orca*) in the waters of the Wilhelm Archipelago, West Antarctica. *Theriologia Ukrainica*, **24**: 210–215. [In English, with Ukrainian summary]

Реєстрації косаток (*Orcinus orca*) в зимовий період у водах архіпелагу Вільгельма, Західна Антарктика

Оксана Савенко

Резюме. Косатка (КО) є хижаком найвищого рівня, що в Антарктиді має різноманітні трофічні взаємодії та на-лежить до п'яти екотипів, які мають відмінності в морфології, генетиці та екології. В районі Антарктичного півострова (АП) найбільш поширені дві симпатричні форми КО екотипу В, що мають подібні особливості забарвлення, але більша форма харчується переважно тюленями (В1), а менша — пінгвінами роду Pygoscelis (В2). Морські екосистеми району західної частини АП переживають трансформації, що викликані змінами клімату, які є одними з найбільш швидких на Землі. Мало що відомо про особливості поширення та екології КО в зимовий період у цьому районі. Метою дослідження було визначити особливості зимового розподілу та екології КО у водах архіпелагу Вільгельма. Було проведено візуальні спостереження та фотоідентифікаційні дослідження з човнів в межах 14 мм від української науково-дослідної станції «Академік Вернадський» (о. Галіндез). У 2019 р. було виконано 10 рейсів на човні загальною довжиною 194 мм, у 2021 — 37 рейсів довжиною 605 мм. Впродовж обох зим нам трапилось три групи КО. Першу групу з 7 КО спостерігали 27 червня 2019 р. біля островів Ховгаард і Плено, вона складалася з дорослих КО обох статей і молодих особин. У цьому ж районі 13 липня 2021 р. трапилась друга група КО, розміром не менше 5 особин (до 7). До неї входили дорослий самець, дві дорослих самки, дитинча та молода особина невідомої статі. Третю групу КО із двох дорослих самців спостерігали 22 липня 2021 р. в протоці Пенолі, вони разом вполювали тюленя-крабоїда. За зовнішніми морфологічними ознаками було визначено, що усі групи належать до типу В, живлення представників третьої групи тюленем-крабоїдом, підтверджує що ці КО належать до більшої форми — В1. Оскільки антарктичний криль взимку у великих скупченнях переміщається до прибережних вод, пінгвіни та тюлені-крабоїди, скупчення яких ми спостерігали в обидві зими, ймовірно, користуються перевагами наявності вільних від льоду акваторій, щоб живитися крилем, а їх присутність може приваблювати КО типу В обох форм. Майбутня робота має включати фотограмметричні дослідження, відбір зразків шкіри, спостереження за поведінкою та акустичні реєстрації, щоб мати змогу чітко розрізняти екотипи КО і краще розуміти закономірності їх зимового розподілу.

Ключові слова: *Orcinus orca,* екотипи, зимові реєстрації, західна частина Антарктичного півострову.

Introduction

The killer whale (KW) *Orcinus orca* is the largest species of the family Delphinidae and has a cosmopolitan distribution. This apex marine predator has morphologically, genetically, and ecologically distinct populations [Ford 2009]. In Antarctica, they have diverse trophic interactions and are represented by five ecotypes (A, B1, B2, C, and D) [Pitman & Ensor 2003; Pitman *et al*., 2011; Durban *et al*. 2017].

The Wilhelm Archipelago is located off the West Antarctic Peninsula (WAP). The waters of the WAP are experiencing climate change at one of the fastest rates and transformations in marine ecosystem structure and function, affecting the Southern Ocean food web [Vaughan *et al*. 2003; Clarke *et al*. 2007; Ducklow *et al*. 2012; Stammerjohn *et al*. 2012; Gladrow & Wright 2020; Rogers *et al*. 2020]. The WAP is the northernmost part of the Antarctic; the continental shelf there is a biologically productive area important for Antarctic krill *Euphausia superba* stocks [Atkinson *et al*. 2004]. Krill is important prey source for different species essential for KW feeding. Studies of top predators such as KWs are crucial for a better understanding of the impact of changes in the food web.

In waters of the WAP, two distinct sympatric forms of Type B KWs are the most common and could be potentially overwintering in the area. Both types have similar pigmentation patterns, but the larger form has been observed to feed mainly on seals (B1), and a smaller form typically feeds on *Pygoscelis* penguins (B2) [Pitman & Durban, 2010; Durban *et al*. 2017]. Stable isotope analysis of skin biopsies indicated a significantly lower nitrogen 15N/14N ratio in B2s supported observations of feeding primarily on krill consumers, while B1s prey mainly on predators of krill consumers

[Durban *et al*. 2017]. These partially sympatric ecotypes have genome-wide differentiation [Foote *et al*. 2016], and reproductive isolation quickly becomes established after the formation of new ecotypes of the species [Morin *et al*. 2010]. Pagophilic Type B KWs can overwinter in Antarctica in the pack-ice [Taylor 1957], and perform some migratory movements [Pitman & Ensor 2003]. Amongst other Antarctic KW ecotypes, there is only evidence for overwintering inside the sea ice of Type C KWs north of the Adelie Land coast, on the other side of the Antarctic continent [Gill & Thiele 1997]. But still very little is known about the austral winter distribution and ecology of KWs in this changing environment. The purpose of the present study was to reveal the winter presence, distribution and ecology patterns of KWs in the waters of the Wilhelm Archipelago.

Material and Methods

Boat-based visual observations and photo-identification were performed within 14 nautical miles (nm) of the Ukrainian Akademik Vernadsky Research Station (Galindez Island, Argentine Islands, Wilhelm Archipelago). During the austral winter of 2019, 10 surveys of a total of 194 nm were conducted: 4 trips in June and 6 in July. In 2021, 37 surveys of a total of 605 nm were conducted: 12 trips in June, 14 in July, and 11 in August. Penola Strait and French Passage were our central research locations (Fig. 1). Surveys were performed when the ice conditions were suitable. Visual observations were conducted under good or moderate weather conditions (Beaufort Sea state ≤ 2). The following data were collected: GPS tracks, observational effort, and weather conditions. For the KW sightings, data on group size, composition, and behaviour were collected.

For identification, images of KWs were taken using professional digital single-lens reflex cameras with telephoto zoom lenses: Canon EOS 70D and Canon EOS 7D digital cameras with Canon EF 100–300mm f/4.5–5.6 USM and Canon EF 100–400mm f/4.5–5.6L IS II USM lenses. High-quality images of dorsal fin profiles, pigmentation patterns, naturally acquired notches, and scars have been collected to identify KWs and their ecotypes [e.g. Wursig 1990; Durban *et al*. 2017].

Results and Discussion

During both austral winters, we encountered only three groups of KWs. In our previous studies conducted in the same region during the summer and early autumn months of 2019, KW was the least numerous species with sightings rate of 1% of all cetaceans [Savenko 2020].

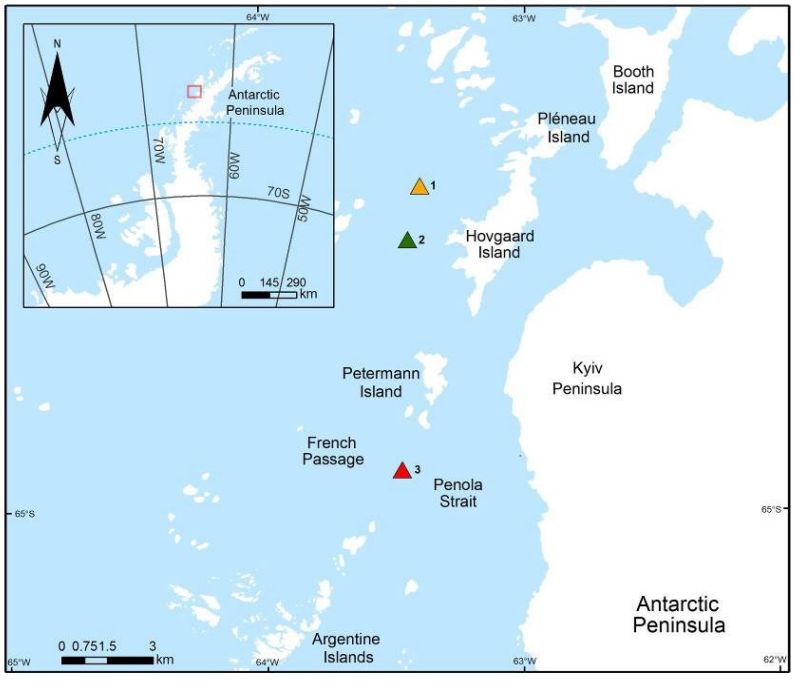

Fig. 1. Locations of the winter sightings of killer whales: (1) 27 June 2019; (2) 13 July 2021; (3) 22 July 2021.

Рис. 1. Місця зимових реєстрацій косаток: (1) 27 червня 2019 р.; (2) 13 липня 2021 р.; (3) 22 липня 2021 р.

A group of 7 KWs was encountered on 27 June 2019 near Hovgaard and Pleneau islands (Fig. 1 No. 1; 65°10.151'S, 64°8.886'W). The group consisted of adults of both sexes and juvenile individuals (Fig. 2). The observations lasted about 10 minutes. KWs travelled in two subgroups.

In the same area, on 13 July 2021, another group of KWs was sighted (Fig. 1, No. 2; 65°7.882'S, 64°9.599'W) consisting of at least five individuals (up to 7). This group included one adult male, presumably two adult females, a calf, and at least one juvenile of unknown sex (Fig. 3). The observations lasted 38 minutes. KWs surveyed the area in two or three subgroups at a distance of up to several dozen metres between them. We did not observe feeding.

Fig. 2. Images of KWs encountered in June 2019 (No. 1): adult females (left and right) with juveniles (right front).

Рис. 2. Зображення косаток, яких спостерігали у червні 2019 р. (№ 1): дорослі самиці (ліворуч і праворуч) з молодими особинами (праворуч на передньому плані).

Fig. 3. Images of KWs sighted in July 2021 (No. 2): female (left) and male with female (right; female in front).

Рис. 3. Зображення косаток, яких спостерігали у липні 2021 р. (№ 2): самиця (ліворуч) і самець з самицею (праворуч; самиця на передньому плані).

Fig. 4. Images of the adult male KW encountered in July 2021 (No. 3); feeding on crabeater seal hunted by him and another adult male (left).

Рис. 4. Зображення дорослого самця косатки, якого спостерігали у липні 2021 р. (№ 3); він живиться тюленем-крабоїдом, якого вполював спільно з іншим дорослим самцем (ліворуч).

On 22 July 2021, a group of KWs consisting of two adult males was sighted in Penola Strait (Fig. 1, 4; No. 3; 65°11.965'S; 64°9.984'W). They were observed feeding jointly on a crabeater seal *Lobodon carcinophaga* (Figs 4–5). In total, the KWs were observed for over 30 minutes, of which half they spent hunting and feeding. Whales were surveying the area at a distance of 50–200 m from each other. They united after one encountered a group of more than twenty crabeater seals in the water. Within minutes, one seal was hunted and killed. Some previous studies showed that KWs were hunting almost exclusively by wave-washing seals off ice floes using cooperative hunting behaviour [Pitman & Durban 2012]. Feeding whales were seen swimming at the surface with flesh in their mouth (Fig. 4). When the KWs were dismembering the seal, it attracted over a dozen snow petrels *Pagodroma nivea*, which were feeding on the seal tissues when KWs surfaced with its carcass. After KWs left the area, several fragments of skin and blubber of the crabeater seal floated at the surface. One fragment was examined (Fig. 5). It was a single piece of skin and blubber from the anterior part of the body, including a part of a fore flipper. The maximum sternum blubber depth on the examined fragment of the seal's body was over 4 cm, which is typical in winter for adult individuals of both sexes [e.g. McDonald *et al.* 2008]. After the feeding, males travelled together. On this day, we also encountered another crabeater seal in the area with KW teeth marks and a large wound on the back of its body (Fig. 5). However, it is known that KWs prefer feeding on Weddell seals *Leptonychotes weddellii* when available and were seen avoiding taking crabeater seals [Pitman & Durban 2012].

According to external morphological patterns, it was determined that all groups belong to Type B (Fig. 2–4); images show the dorsal cape and large eye patch characteristic of Type B [Pitman & Ensor 2003]. Type B has a large, horizontally-oriented eyepatch and dorsal cape; they are two-toned-grey and white; a dark grey dorsal cape is set off against a medium-grey lateral field, and the paler lateral field merges over the back immediately behind the saddle, making that area noticeably lighter than in front of the saddle [Pitman & Ensor 2003; Durban *et al*. 2017]. In all sighted KWs (Figs. 2–4), there was no visible yellow cast on the body caused by a diatom film often typical for Type B KWs [Pitman & Ensor 2003; Durban *et al*. 2017].

According to their feeding behaviour, the third group belonged to a large form of Type B (B1) [e.g. Pitman & Ensor 2003; Durban *et al*. 2017]. Group sizes of all sighted groups were more typical for B1, known to form smaller groups (mean 7, range 1–14) [Durban *et al*. 2017].

A comparison of the photos showed different individuals in the three groups. As in the area of the WAP both the annual mean sea ice extent and the duration of winter sea ice have substantially decreased in recent decades [Smith & Stammerjohn, 2001; Ducklow *et al*. 2013] and Antarctic krill moves inshore during winter [Nowacek *et al*. 2011], the *Pygoscelis* penguins and crabeater seals likely took advantage of ice-free areas to feed on it. Their gatherings potentially could attract KWs of both Type B ecotypes. Large gatherings of gentoo penguins *Pygoscelis papua*, Adélie penguins *Pygoscelis adeliae*, crabeater seals, and humpback whales *Megaptera novaeangliae* were observed in this area during winter in both years. Humpback whales were resting and feeding, not paying any attention to killer whales that were nearby on 13 July 2021. We also had some Antarctic minke whale *Balaenoptera bonaerensis* sightings in June–July 2019.

Fig. 5. Crabeater seals after being attacked by killer whales on 22 July 2021: an escaped individual with a large wound and KW teeth marks.

Рис. 5. Тюлені-крабоїди після нападу косаток 22 липня 2021 року: особина, якій вдалося втекти від косаток, з великою раною та слідами від зубів косатки.

Conclusions

The non-migratory statuses of prey species and their availability during winter months together with ice-free areas could provide an opportunity for year-round residency for both Tybe B KWs in the WAP. Further work is needed to understand migration statuses of both Type B KWs in Antarctica; it should include collecting photogrammetry data, skin biopsy samples, feeding behaviour observations, and acoustic recordings to differentiate between KW types and to better understand their winter distribution and ecological patterns in this rapidly changing marine ecosystem, which is critical for their conservation.

Acknowledgements

The study was funded by the State Institution National Antarctic Scientific Center, Ministry of Education and Science of Ukraine in the framework of the State Special-Purpose Research Program in Antarctica for 2011–2023. I want to express my gratitude to the members of the 24th and 26th Ukrainian Antarctic Expeditions, and especially to those involved in the surveys as zodiac drivers: I. Dykyy, O. Knyzhatko, and O. Mylashevskiy. The manuscript was strengthened by the suggestions of A. Friedlaender. The research was conducted under Ministry of Education and Science of Ukraine Permit Series AP No. 075-19/2.

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