APPENDIX 1

Other species observed at Point 8

Brown skuas were observed periodically near the colonies in 2020, 2023 and 2024. Adélie penguins were observed in the early breeding season and a few Adélie *Pygoscelis adeliae* and chinstrap penguins *P. antarcticus* molted here in 2023 and 2024. Kelp gull *Larus dominicanus* fledglings and adults, south polar skuas *Stercorarius maccormicki*, blue-eyed shags *Phalacrocorax atriceps* and snowy sheathbills *Chionis albus* were occasionally observed on land. Humpback *Megaptera novaeangliae* and minke whales *Balaenoptera acutorostrata* and leopard seals *Hydrurga leptonyx* were seen a few times feeding or traveling in the nearshore water. Southern elephant *Mirounga leonina*, crabeater *Lobodon carcinophagus*, Antarctic fur *Arctocephalus gazella*, and Weddell seals *Leptonychotes weddellii* hauled out and/or were observed in nearshore waters. Elephant seals (cows, bulls and pups) were prevalent in November to mid-January when pupping occurs with ~10 pups born here in 2023 and 3 pups in 2024. The total number of elephant seals ranged from a few to ~100 per visit. In general, when crabeater or Weddell seals were observed, numbers were small ($n \leq 3$). Fur seals arrive in the Palmer Station region in early February (Larsen et al., 2025), and there appeared to be more fur seals present in 2024 than in 2023 (generally $n<20$ in 2023; $n<20$–40, max=98 in 2024). During an opportunistic count on 9 May 2021, we counted 195 fur seals. In December 2023, elephant seals were present a few times in sub-colony 3 ($n=2$ seals) and 8 ($n=2$–9 seals), and in December–early January 2024, elephant seals ($n=1$–5) were observed on a few occasions in all sub-colonies except 2 and 9. Penguins and seals did not appear to compete for habitat, so co-occurrence may simply reflect a shared preference.

Additional Gentoo Penguin observations and colonies

Other recent Gentoo Penguin colonizations near Palmer Station include Joubin Island 20 and, adjacent to the glacier, Patterdo and Parmelee Islands (Fig. 1). Penguins were first noticed on Patterdo and Parmelee in 2009 when an ice ramp connected the region to the glacier, but chicks were not observed until 2023 and 2018, respectively. During the earlier years, the glacier-adjacent colonies were occasionally wiped out by large waves from nearby calving events. While nest or chick censuses did not occur in all years, there were generally few nests observed during 2009–2022, and nests failed in most years (Table A2, A3). Joubin Island 20 was colonized in 2023 with penguins rearing chicks during that first year.

Individual nests were occasionally observed in new locations. For example, one nest with two eggs was observed adjacent to Palmer Station in November 2021, but the eggs were abandoned and later predated (M. Goerke, *pers. comms.*). On Cormorant Island, within an active Adélie Penguin colony, we observed one Gentoo nest that failed in 2023 and two nests that each reared one chick in 2024.

TABLE A1

The dates and file names for each satellite image used in our analyses. The season refers to the first year in the austral summer season split year (e.g., November 2006 to April 2007, is referred to as 2006). The row shaded gray was not used in the glacier terminus analysis but is shown in Fig. 2.

Season	Date	File Name
2006	12/24/06	QB02_20061224134906_1010010005643400_06DEC24134906-P1BS-052550353130_01_P002_u08rf3031
2009	1/12/10	WV01_20100112133953_102001000BD6CC00_10JAN12133953-P1BS-052316133010_01_P002_u08rf3031
2010	4/21/11	WV01_20110402142049_102001001108F900_11APR02142049-P1BS-052850952060_01_P001_u08rf3031
2011	2/7/12	WV02_20120207141649_1030010010514900_12FEB07141649-P1BS-500177766110_01_P003_u08rf3031
2012	3/10/13	WV02_20130310134525_1030010020426D00_13MAR10134525-P1BS-500177766010_01_P001_u08rf3031
2016	3/3/17	WV03_20170303133753_1040010029B68000_17MAR03133753-P1BS-503738598070_01_P001_u08rf3031
2017	3/31/18	WV02_20180331135121_103001007A60F200_18MAR31135121-P1BS-502130715010_01_P001_u08rf3031
2018	2/28/19	WV02_20190228141021_10300100BBB6E800_19FEB28141021-P1BS-503054783040_01_P003_u08rf3031
2020	1/22/21	WV01_20210122170143_10200100A40B8400_21JAN22170143-P1BS-505092494030_01_P005_u08rf3031
2023	3/4/24	WV03_20240304131713_10400100924FDC00_24MAR04131713-P1BS-508314274010_01_P001_u08rf3031
2023	12/6/23	WV02_20231206135952_10300100F178E200_23DEC06135952-P1BS-508051982080_01_P001_u08rf3031

TABLE A2

Gentoo Penguin *Pygoscelis papua* censuses conducted at Parmelee Island from 2009 to 2024. The table includes information on the season, date of census, the number of adults, active nests, and chicks, any relevant notes and the estimated breeding success (chicks per active nests). Multiple censuses per island occurred in some years as time allowed.

Season	Date	Adults	Active Nests	Chicks	Notes	Estimated Breeding Success
Parmelee Island:						
2009	11/6/09	150	0	0		0
2009	11/11/09	NA	>1	0	At least 1 nest with eggs	
2009	12/3/09	161	105	0		
2009	1/12/10	0	0	0	Colony wiped out by glacier calving	
2010	11/24/10	30	1	0	Roughly half of the adults were paired on nests but only 1 active nest	0
2010	12/9/10	18	0	0		
2011	12/20/11	1	0	0		0
2012	12/9/12	19	5	0		0
2012	12/15/12	14	6	0		
2012	1/14/13	4	0	0		
2013	*No census*					NA
2014	11/24/14	NA	9	0	No eggs observed	0
2014	12/2/14	0	9	0	Nests attended but not active	
2015	11/26/15	79	0	0	Nests observed but no eggs; a few adults sitting tight	0
2015	12/7/15	50	17	0	Eggs only observed in 2 nests, likley more; adults sitting tight	
2015	12/15/15	0	0	0		
2016	11/26/16	15	0	0	Birds not sitting tight. No sign of nests	0
2016	12/17/16	4	0	0		
2017	11/28/17	2	0	0		0
2018	12/5/18	13	6	0		1
2018	12/17/18	11	5	0	Estimated from boat	
2018	1/23/19	8	0	5	1 egg still present	
2019	*No census*					NA
2020	12/17/20	0	0	0	Evidence of guano	0
2021	*No census*					NA
2022	12/3/22	30	25	0	Estimated from boat	Unknown
2023	11/22/23	50	17	0	Estimated from boat	1.3
2023	1/21/24	182	80	105		
2024	12/7/24	439	248	0		0.6
2024	2/7/25	NA	NA	153		

TABLE A3
Same as Table A2 but for Patterdo Island.

Season	Date	Adults	Active Nests	Chicks	Notes	Estimated Breeding Success
Patterdo Island:						
2009	11/10/09	57	0	0		0
2009	12/2/09	34	2	0		
2009	1/20/10	0	0	0		
2010	11/22/10	10	2	0		0
2011	12/6/11	2	1	0		0
2011	1/20/11	0	0	0		
2012	12/19/12	26	8	0		0
2012	12/26/12	16	7	0	Eggs confirmed	
2013	*No census*					NA
2014	*No census*					NA
2015	*No census*					NA
2016	11/26/16	18	0	0		0
2016	11/28/16	21	0	0		
2017	*No census*					NA
2018	12/21/18	0	0	0		0
2019	*No census*					NA
2020	12/8/20	5	0	0	Some guano build up, adults on island but not on nests	0
2021	*No census*					NA
2022	11/27/22	15	7	0	Estimated from boat. 20-30 more on beach	0
2022	12/2/22	9	8	0	Estimated from Cormorant Island. ~10 on beach	
2022	12/10/22	0	0	0	No visible adults or nests from Cormorant Island	
2023	11/17/23	28	NA	0	Estimated from boat	1.2
2023	1/20/24	16	10	12		
2024	12/6/24	65	39	0		0.9
2024	1/31/25	37	NA	35		

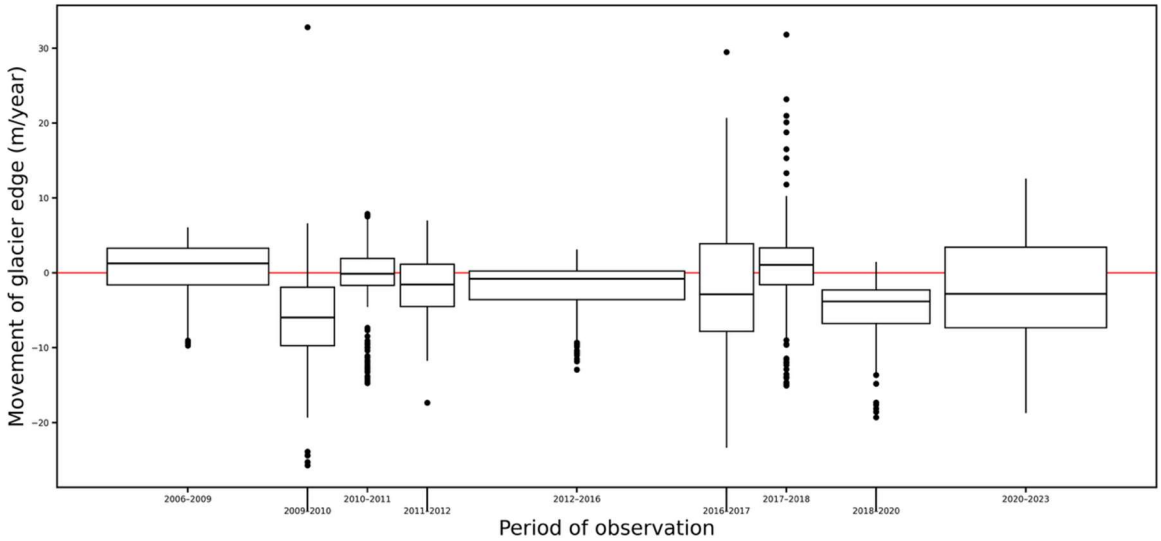


Fig. A1. Movement rates of sample points along the glacier terminus across periods of measurement from consecutive satellite images. Box width scales with period of measurement (time between images). Positive values indicate advancement of the glacier terminus or adjacent snow that did not melt by the latter date of observation, whereas negative values indicate retreat. Boxplots describe the median (horizontal line), the range from the first to third quartile (box), the range spanning 1.5 × the interquartile range beyond the first and third quartile (whiskers), and outlying values.

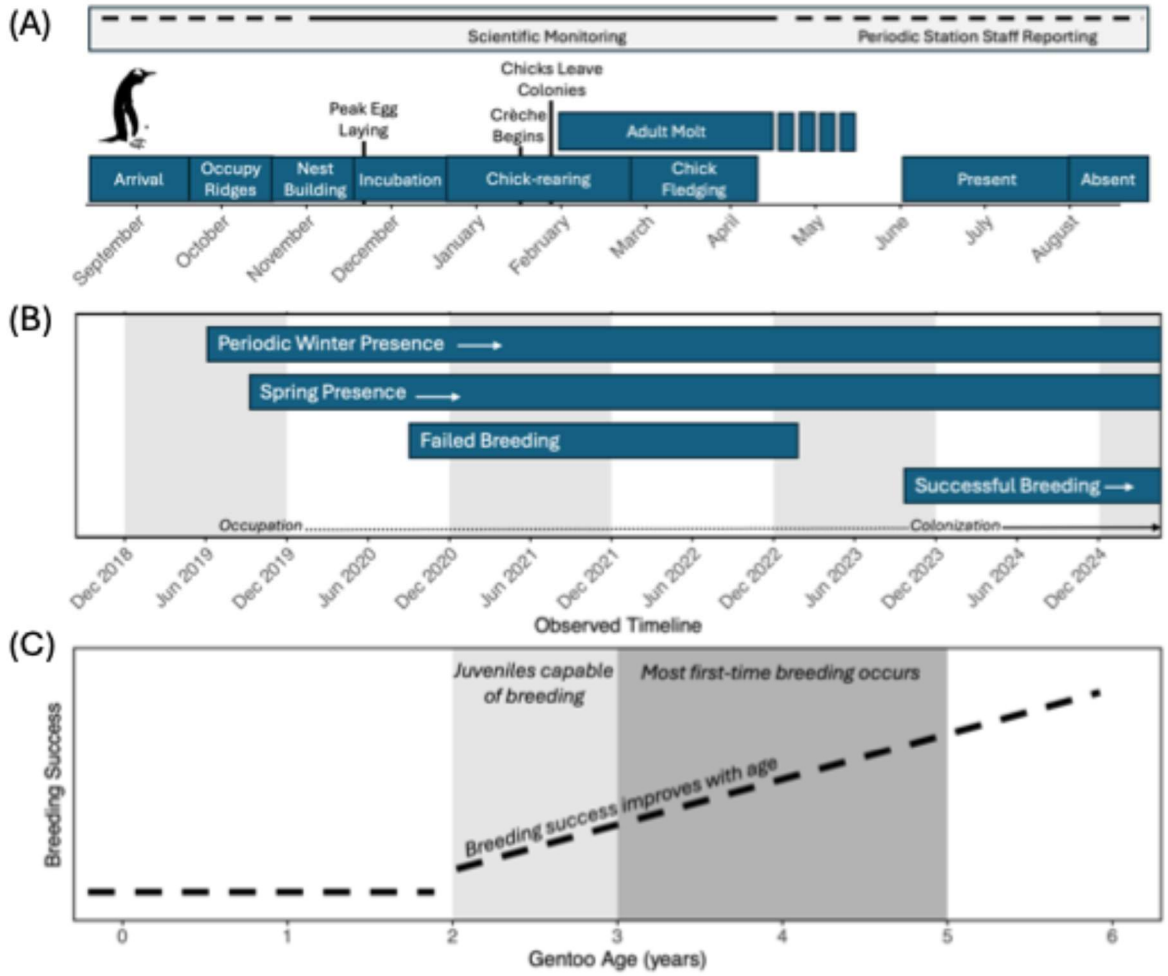


Fig. A2. Conceptual illustration of Gentoo penguin *Pygoscelis papua* phenology and activity patterns surrounding colonization at Point 8. **(A)** A generalized timeline of events and phenological phases based on scientific monitoring and periodic reports from Palmer Station staff. **(B)** These observations provide a timeline of Gentoo penguin occupancy from the first observed presence (winter 2019) through successful breeding (summer 2023), with year intervals (alternate shading) defined by the approximate hatch date of Gentoo chicks in December. **(C)** A general timeline of Gentoo reproductive maturity and breeding success from literature. Based on the alignment of these timelines (**B** & **C**), we propose that Gentoo penguins born in December 2018 arrived at Point 8 during the winter of 2019, and maintained at least a periodic presence through 2024–25, beginning to breed without success in 2020-2022, and achieving successful breeding in 2023 onward.