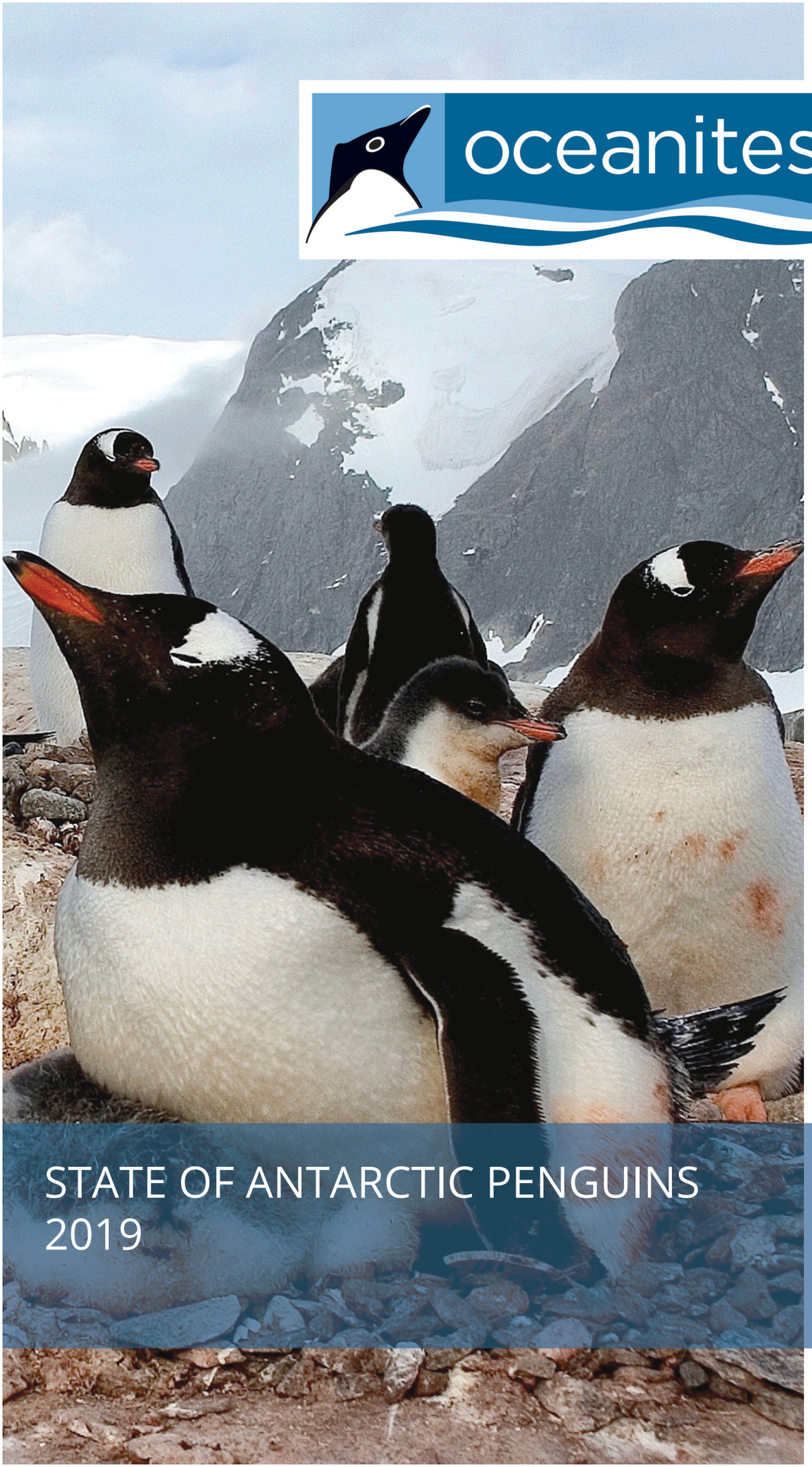

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STATE OF ANTARCTIC PENGUINS 2019

MAPPPD

penguinmap.org

STATE OF ANTARCTIC PENGUINS 2019

ABSTRACT
This report comprehensively summarizes the status — population size and population trends — of Antarctica's five penguin species, continent-wide and in key regions. These species total at least 6.186 million breeding pairs nesting at 662 or more sites across the entire Antarctic continent. This report uses the most current scientific data, including 3,736 records from 116 sources of on-the-ground colony counts and satellite photo analyses. We continue to closely track the notable changes in the Antarctic Peninsula, which has warmed faster than anywhere else in the world except the Arctic. There, Adélies and chinstraps have declined and gentoos have increased; however, there are indications that the warming trend has leveled off and that the Adélie population in the southern Peninsula has stabilized. The report also notes key concerns, including ice sheet and glacier collapses both in West Antarctica and East Antarctica that potentially affect penguin populations. Our report relies on Oceanites' open access, and publicly available MAPPPD tool and, again, we encourage those who have not yet contributed to do so.

We are pleased to present our 3rd State Of Antarctic Penguins Report (SOAP), which, as we've noted previously is intended to be is a living document buttressed by ongoing science. We trust it assists stakeholders everywhere, particularly, the entire community of Antarctic interests: decision-makers and governments, scientists, NGOs, the private sector including fishing and tourism operators, and concerned citizens throughout the world.

The 2018/2019 season marked the 25th field expedition for Oceanites Inc. which has championed, and continues to champion, science-based conservation. One of its first programs was the Antarctic Site Inventory (ASI), which began in 1994 and continues to monitor the entirety of the vastly warmed Antarctic Peninsula. There was an initial focus on identifying potential penguin population changes from human activity, which, now, has shifted to distinguishing the direct and interactive effects of climate change, fishing, tourism, and other human activities on the Antarctic Peninsula ecosystem.

In October 2016, the Mapping Application for Penguin Populations and Projected Dynamics (MAPPPD), another major initiative involving Oceanites, went live. MAPPPD is an open access decision support tool that was designed by the Lynch Lab for Quantitative Ecology at Stony Brook University and Black Bawks Data Science Ltd., with support from the US National Aeronautics and Space Administration (NASA) and Oceanites. MAPPPD assembles penguin population data from all of Antarctica and makes it publicly available. Over the past 3 years, MAPPPD has quickly become a primary resource for scientific and other information about Antarctic penguins, integrating expert biological field surveys, satellite imagery analyses, and citizen science.

Our goal is to keep the world fully apprised of the latest, most accurate population data about Antarctic penguins; both continent-wide and regionally, and of the latest trends in such numbers. Additionally, we will note key references and report on the latest scientific papers and publications relating to Antarctica's five breeding species of penguins.

Work on MAPPPD's predictive trend models continues, but analysis involving Adélie penguin population trends are available to be browsed. SOAP 2019 again focuses on the vast amount of penguin population data already compiled in the MAPPPD database, continent-wide and for three key regions where trends can be identified, the Antarctic Peninsula (CCAMLR Areas 48.1, 48.2 and 48.5), the Ross Sea (CCAMLR Areas 88.1 and 88.2), and East Antarctica (CCAMLR Areas 58.4.1 and 58.4.2). We do this by aggregating the latest available counts of breeding pairs (i.e. nests) in each of the regions. This method is reasonably accurate in parts of the Antarctic Peninsula that have been recently visited; however, there are many shortcomings to this technique in other areas, particularly since many sites have not been counted since the 1980s. Specific details can be found at http://www.penguinmap.com.

This report also may be accessed via the Oceanites website (https://oceanites.org/future-of-antarctica/penguin-conservation/state-of-antarctic-penguins-reports/), either online or through your mobile device, where we'll additionally post maps depicting sites from which MAPPPD would value the submission of more recent, up-to-date data.

We trust SOAP 2019 is useful to all of you! Please let us know and suggest what you might want to see in future issues.

Ron Naveen
President, Founder
Oceanites, Inc.

Grant Humphries
Black Bawks Data Science Ltd.
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May 15, 2019

THE ANTARCTIC PENGUINS

There are five penguin species breeding in Antarctica: emperor, Adélie, chinstrap, gentoo, and macaroni. The emperor and Adélie are the only two which breed around the entire continent, while the other three are restricted to the northern sections of the Antarctic Peninsula (in addition to also breeding north of the Antarctic continent).

Emperor Penguin

(Aptenodytes forsteri)

ANTARCTIC POPULATION SIZE

283,000 breeding pairs per Fretwell et al. (2012), data stored and displayed in MAPPPD.

ACCURACY

Satellite imagery analyses, as utilized in this survey, expand the capacity to discover previously undescribed emperor colonies and enable better estimates of species population size. Estimates are expected to change as analytical techniques for satellite imagery are refined and improved. No updates to this estimate since the 2017 report.

REFERENCE:

Fretwell et al. (2012)

Gentoo Penguin

(Pygoscelis papua)

ANTARCTIC POPULATION SIZE

116,083 breeding pairs per the MAPPPD database, an increase of 44% from an estimated 80,645 breeding pairs per Naveen (1997). The worldwide population is estimated at 387,000 breeding pairs per Lynch (2013). This year's estimate is 3,133 nests fewer (2.6%) than the 2018 estimate.

ACCURACY

MAPPPD data are comprised almost entirely of recent ground counts, which are very accurate.

REFERENCES:

Lynch (2013), Lynch et al (2008, 2009, 2012), Naveen & Lynch (2011), Naveen (1997), Woehler (1996)

Adélie Penguin

(Pygoscelis adeliae)

ANTARCTIC POPULATION SIZE

3,790,000 breeding pairs per Lynch & LaRue (2014), which is larger than an estimate from more than 20 years ago of 2,465,800 breeding pairs per Woehler (1993). The estimate from the MAPPPD database is 4,211,530, breeding pairs. This is 12,541 fewer nests (0.3%) than in 2018.

ACCURACY

Many sites were last counted in the 1980s, however we continue to add new counts through estimates in the published literature, plus counts performed on rarely visited sites (e.g. Lagotellerie Island and Red Rock Ridge) for the Antarctic Site Inventory.

REFERENCES:

Borowicz et al (2018), Southwell et al (2017), Casanovas et al (2015), Lynch and LaRue (2014), Lynch et al (2010), Woehler (1993)

Chinstrap Penguin

(Pygoscelis antarctica)

ANTARCTIC POPULATION SIZE

1,563,119 breeding pairs per the MAPPPD database; however, many sites have not been counted since the 1980s. Existing estimates of the worldwide population range from 4.0-7.5 million breeding pairs. This year's estimate represents a slight increase of 3,223 nests (0.2%) from SOAP 2018.

ACCURACY

The Antarctic estimate is expected to be revised by a new survey, presently underway, using satellite imagery analyses; updated colony counts; and MAPPPD predictive trend models, which are still being developed.

REFERENCES:

Naveen et al (2012), Woehler (1993)

Macaroni Penguin

(Eudyptes chrysolophus)

ANTARCTIC POPULATION SIZE

13,249 breeding pairs estimated in the Antarctic Peninsula per Crossin et al (2013). The worldwide population is believed to have declined 30% to an estimated 6,300,000 breeding pairs.

ACCURACY

These data come from counts made in the 1980s. There are insufficient, recent surveys enabling an updated assessment of trends.

REFERENCES:

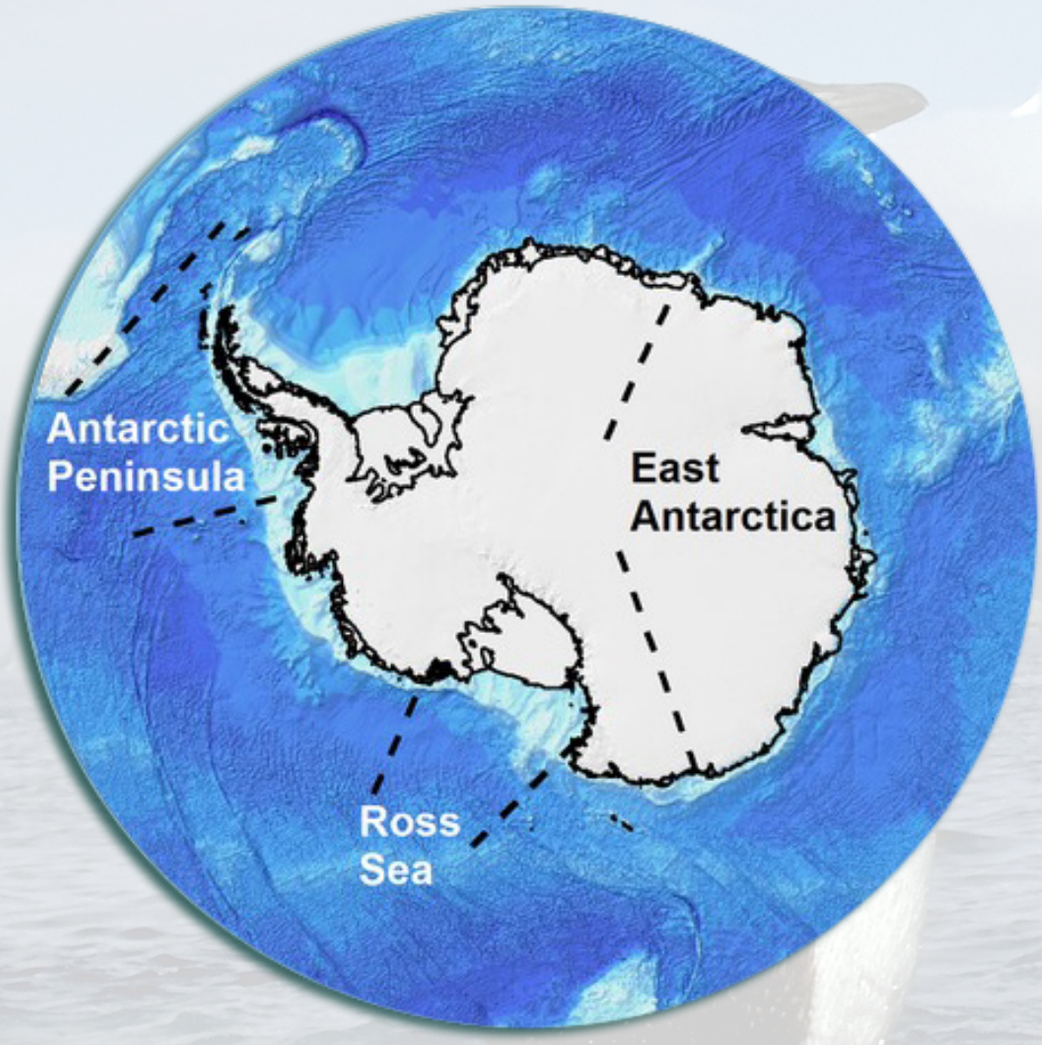
Convey (1999), Crossin et al (2013), Woehler & Croxall (1996), Woehler (1993)

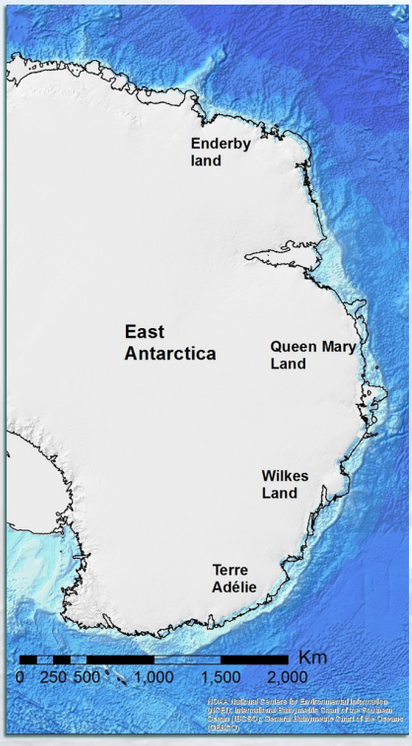
KEY ANTARCTIC REGIONS

As per the inaugural State Of Antarctic Penguins Report 2017, we focus on three key regions — the Antarctic Peninsula, comprising Areas 48.1, 48.2 and 48.5 demarcated by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR); Ross Sea, comprising CCAMLR Areas 88.1 and 88.2; and East Antarctica, comprising CCAMLR Areas 58.4.1 and 58.4.2.

The Antarctic Peninsula is where Oceanites' Antarctic Site Inventory concentrates and has collected data from more than 235 sites over 25 field seasons. This region has warmed considerably over more than six decades, year-round by 2˚ C. / 5˚ F. and in winter by 5˚ C. / 9˚ F., but the warming trend appears to have slowed, consistent with natural variability; by contrast, in East Antarctica and the Ross Sea, there has been a cooling trend (Turner et al 2005, 2013, 2016). Paralleling Adélie penguin declines in the Antarctic Peninsula, Adélie populations in East Antarctica and the Ross Sea appear to be increasing.

No gentoo or chinstrap penguins appear to be breeding in East Antarctica or the Ross Sea. These two species breed in West Antarctica, but with different responses to the warmed, regional climate: gentoos increasing, while chinstraps appear to be declining, although many sites lack enough data to draw firm conclusions.





Map Sources: NOAA National Centers for Environmental Information (NCEI); International Bathymetric Chart of the Southern Ocean (IBSCO); General Bathymetric Chart of the Oceans (GEBCO)

ANTARCTIC PENINSULA | (CCAMLR Areas 48.1, 48.2 and 48.5)

Emperor Penguin

(Aptenodytes forsteri)

REGIONAL POPULATION SIZE

48,343 breeding pairs in the Weddell Sea per Fretwell et al (2012), data stored and displayed in MAPPPD.

ACCURACY

Counts are from seven sites in 2009, of medium to high accuracy, and are reported in Fretwell et al (2012).

TREND

Appears to be extirpated from its former breeding site in the Dion Islands. Satellite imagery analyses expand the capacity to discover previously undescribed emperor colonies and enable better estimates of species population size and regional trend. This estimate has not changed since 2017 due to a lack of new census data. Estimates are expected to change as analytical techniques for satellite imagery are refined and improved.

Adélie Penguin

(Pygoscelis adeliae)

REGIONAL POPULATION SIZE

1,462,131 breeding pairs per the MAPPPD database.

ACCURACY

Counts are from 117 sites: 73 counts are of high accuracy, 27 of medium accuracy, 17 are estimates from satellite imagery, and most were accomplished in the last decade.

TREND

In this region, Adélie penguin populations have, in general, declined significantly. Several large colonies around Joinville island have declined by 20% since the mid-990s, and other well visited colonies such as Petermann island have been showing consistent year to year declines over the last two decades. Our 2019 estimate has 11,744 fewer nests than in SOAP 2018 (0.8%).

Chinstrap Penguin

(Pygoscelis antarctica)

REGIONAL POPULATION SIZE

1,563,095 breeding pairs per the MAPPPD database.

ACCURACY

Of 341 sites, mostly counted within the last decade, 112 are of high accuracy ground counts, 167 involve medium accuracy estimates, and 27 involve satellite imagery analyses. Some key, large sites lack updated counts, and many lack complete time series. This estimate is expected to be revised by a new survey, presently underway and using satellite imagery analyses; updated colony counts; and MAPPPD predictive trend models, which are still being developed.

TREND

At Deception Island, declines have been significant, with populations at neighboring chinstrap penguin breeding sites also declining, though to a lesser degree. The new survey, presently underway and using satellite imagery analyses, will enable the regional trend to be reassessed. Our estimate for 2019 is 0.2% higher than our estimate for 2018.

Gentoo Penguin

(Pygoscelis papua)

REGIONAL POPULATION SIZE

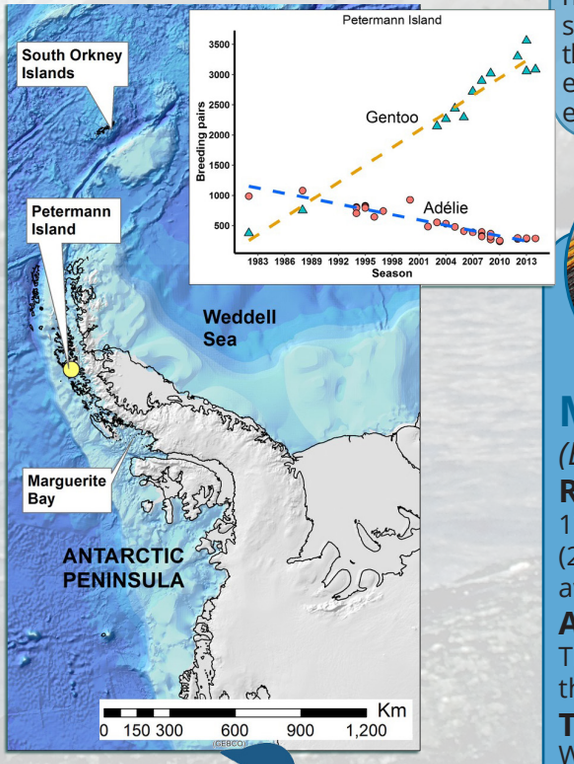
116,083 breeding pairs per the MAPPPD database.

ACCURACY

Of 270 sites, 91 involved high accuracy ground counts, the rest evenly spread between satellite imagery analyses or medium accuracy ground counts. About 65% of the latest counts were made in the last decade, and 40% within the last two seasons.

TREND

In this region, the gentoo penguin breeding population has increased significantly. Our 2019 estimate is 3% lower than that of 2018, and nearly identical to our 2017 estimate of 115,943 nests.



Macaroni Penguin

(Eudyptes chrysolophus)

REGIONAL POPULATION SIZE

13,249 breeding pairs per Crossin et al (2013). Macaroni penguin data are not available in MAPPPD

ACCURACY

These data come from counts made in the 1980s and need to be updated.

TREND

Worldwide, macaronis appear to be decreasing. In the Antarctic Peninsula, there are insufficient, recent surveys enabling an updated assessment of trends; this has not changed since our 2017 report.

ROSS SEA | (CCAMLR Areas 88.1 and 88.2)

Emperor Penguin
(Aptenodytes forsteri)

REGIONAL POPULATION SIZE

90,851 breeding pairs per Fretwell et al (2012), data stored and displayed in MAPPPD.

ACCACCURACY

Counts are from 12 sites, were made in 2009, and reported in Fretwell et al (2012). All counts are medium to high accuracy.

TREND

Satellite imagery analyses expand the capacity to discover previously undescribed emperor colonies and enable better estimates of species population size and regional trend. Estimates are expected to change as analytical techniques for satellite imagery are refined and improved.

Adélie Penguin
(Pygoscelis adeliae)

REGIONAL POPULATION SIZE

1,486,335 breeding pairs per the MAPPPD database.

ACCURACY

Estimates from 35 of the 54 sites in this region were high or medium accuracy, with 19 low accuracy estimates.

TREND

In the Ross Sea region, which has not experienced a regional warming trend like the Antarctic Peninsula, Adélie penguin populations appear to have increased. Estimates are expected to change as analytical techniques for satellite imagery are refined and improved. Our 2019 estimate has not changed from the 2018 estimate as new data for this region have yet to be acquired

EAST ANTARCTICA | (CCAMLR Areas 58.4.1 and 58.4.2)

Emperor Penguin
(Aptenodytes forsteri)

REGIONAL POPULATION SIZE

58,092 breeding pairs per Fretwell et al (2012), data stored and displayed in MAPPPD.

ACCURACY

Counts are from 16 sites and were made in 2009, and reported in Fretwell et al (2012). All counts are medium to high accuracy.

TREND

Satellite imagery analyses expand the capacity to discover previously undescribed emperor colonies and enable better estimates of species population size and regional trend. Estimates are expected to change as analytical techniques for satellite imagery are refined and improved.

Adélie Penguin
(Pygoscelis adeliae)

REGIONAL POPULATION SIZE

1,093,313 breeding pairs per the MAPPPD database.

ACCURACY

These estimates (78 of 88 sites) are made primarily using satellite counts from Lynch and Larue (2014) for the year 2011. Few ground counts have been made at these sites due to their remoteness. Estimates are expected to be revised using refined satellite imagery analyses and updated ground surveys, augmented by the recent estimate, per Southwell et al (2017), of East Antarctica breeding individuals

TREND

In East Antarctica, which has not experienced a regional warming trend like the Antarctic Peninsula, Adélie penguin populations appear to have increased. Estimates are expected to change as analytical techniques for satellite imagery are refined and improved. No new data have become available since our 2017 or 2018 reports.

TRENDS, CONCERNS & FUTURE WORK

We again note that, over the past 60+ years in the warmed Antarctic Peninsula, gentoo populations have increased significantly; Adélie penguin populations in parts of this region have declined significantly; and chinstrap penguin populations have declined and, at some locations, significantly. By contrast, Adélie penguin populations in East Antarctica and the Ross Sea appear to be increasing.

The Peninsula continues to draw our attention knowing that warming in this region appears to have slowed, consistent with natural variability (Turner et al 2005, 2013, 2016). And as noted in SOAP 2017 and 2018, there is the sharp transition zone at the northern boundary of Marguerite Bay in the southern Antarctic Peninsula, north of which are widespread declines in Adélie penguin populations and increasing populations of gentoo penguins, but south of which Adélie penguin populations have remained stable or increased (Casanovas, et al 2015). This lends support to the hypothesis that ocean productivity and sea ice dynamics are critical factors regulating Adélie penguin abundance in this location.

The 2018/2019 field season was a notably unusual year on the Antarctic Peninsula, with deeper than usual snow on sites in the Gerlache Strait. Furthermore, mid-season visits (late January) found many colonies with gentoo penguins still sitting on eggs, when by that time, most should have hatched. At some sites it was clear that gentoos had either re-lain eggs, or had abandoned for the season, which is likely why we found a decrease in the most recent estimate of the gentoo population.

Inevitably, these trends and concerns encourage further work distinguishing climate change impacts from other factors potentially causing Antarctic penguin population changes. Oceanites and colleagues are proceeding with some of this effort (https://oceanites.org/future-of-antarctica/climate-challenge/) while keeping abreast of work by other researchers around Antarctica.

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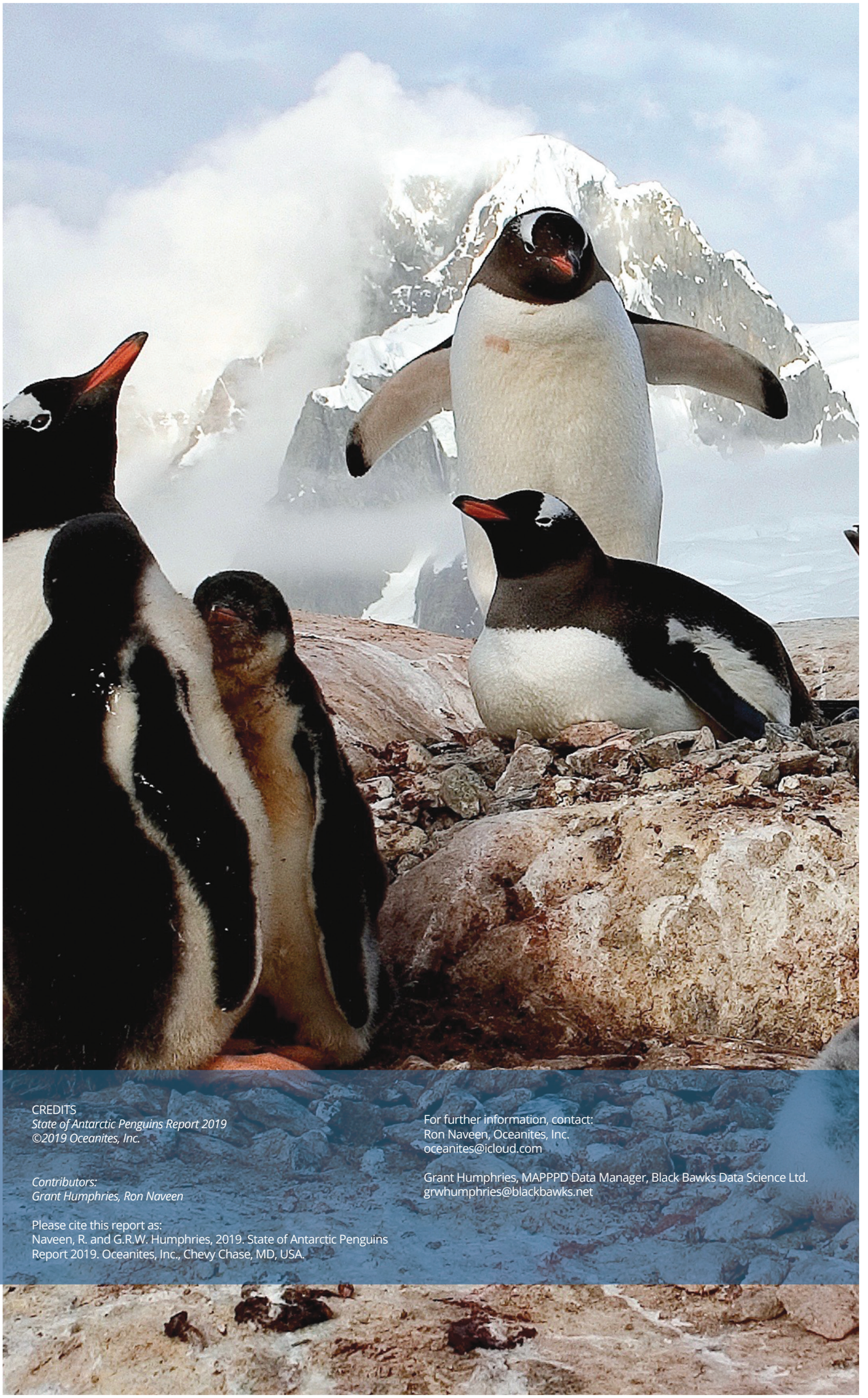

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