

Possible Relationships between Seabird Colony Population Changes and Anthropogenic Pressures in and around Magadan and the Staritskogo Peninsula

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This study looked the census of seabird colonies around Magadan conducted in 2009 and 2019 to document changes and possible relationships with anthropogenic pressures. The Staritskogo Peninsula and its surrounding four bays are the most affected by anthropogenic pressures on the coastline and islands in the Magadan region. There are no islands in the Svetlaya and Nagaeva Bays. Kekurny Islet is located at the edge of Gertnera Bay. Vdovushka Island and the small Three Brothers Islets are located in the Veselaya Bay. The regional center, the city of Magadan, is located on the isthmus of the Staritskogo Peninsula between Nagaeva Bay and Gertnera Bay. Urban development occupies the entire isthmus. The shores of Nagaeva Bay near the city are the territory of commercial and fishing ports; in the shallow part of the bay there is a city beach. The shallow Gertnera and Veselaya Bays are traditional places of recreation for regional residents. The entire coastline from Chorny Cape (Gertnera Bay) to Ostrovnoy Cape (Nagaeva Bay) is constantly used by people for recreation and fishing from rowboats and motor boats. In contrast, there are no permanent settlements on the territory of Staritskogo Peninsula and the surrounding bays' coastlines, except for the lighthouse on the Chirikova Cape and the dacha district along the coast in the city area. Lack of roads, mountainous terrain, difficult hiking, and steep banks leave the landscape of the peninsula almost unaffected by anthropogenic impact.

The Magadanka River, which flows through the city, and the nearby Dukcha River both flow into Gertnera Bay. Magadanka River has always served as a collector for the disposal of industrial and municipal wastewater. In the 1990s, a number of industrial enterprises were closed in the city, which had introduced aggressive chemical pollution into the river. Since 1992, wastewater from the main part of the city has been mechanically treated and discharged into Gertnera Bay through an underwater pipeline between Gertnera Bay and Veselaya Bay. The treatment facilities did not provide standard wastewater treatment. The wastewater discharge continued until the end of August 2018. A municipal solid waste (MSW) landfill is located at a distance of about 4 km from the mouth of the Dukcha River. The facility's capacity is 54.5 thousand tons of waste per year. Humpback Salmon (*Oncorhynchus gorbuscha*) enter for spawning in the Dukcha River. A licensed fishing zone of salmon is open near the mouth of the Dukcha River.

The following seabird species breed in 27 colonies on the seashores and islands: Pelagic Cormorant (*Phalacrocorax pelagicus*), Slaty-backed Gull (*Larus schistisagus*), Black-legged Kittiwake (*Rissa tridactyla*), Common Murre (*Uria aalge*), Spectacled Guillemot (*Cephus carbo*), Tufted Puffin (*Lunda cirrhata*), Horned Puffin (*Fratercula corniculata*), and Parakeet Auklet (*Cyclorhynchus psittacula*). There are no seabird colonies in Svetlaya Bay or Nagaeva Bay, nor on Vdovushka Island.



Pelagic Cormorant



Slaty-backed Gull



Black-legged Kittiwake



Common Murre



Spectacled Guillemot



Tufted Puffin



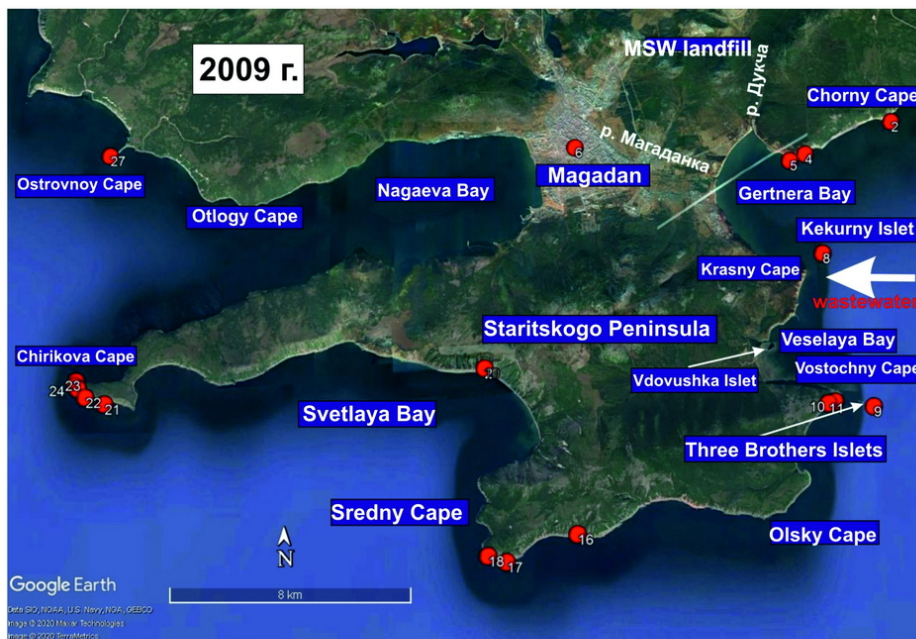
Horned Puffin



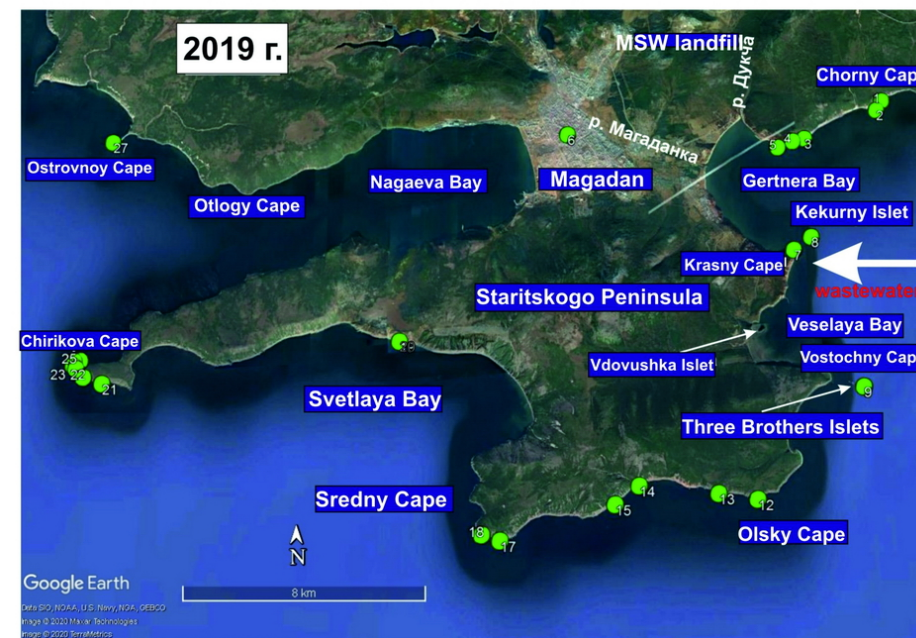
Parakeet Auklet

Table 1. Numbers of seabirds in colonies around the Staritskogo Peninsula (individuals).

Species & Census Year	City of Magadan	Coast		Island Colonies		
		Gertnera Bay	Staritskogo Peninsula	Ostrovnoy Cape	Three Brothers	Kekurny
<i>Phalacrocorax pelagicus</i> 2009	-	800	694	160	376	2
<i>Phalacrocorax pelagicus</i> 2019	-	5512	592	320	430	114
<i>Larus schistisagus</i> 2009	1024	1244	704	3202	733	88
<i>Larus schistisagus</i> 2019	3454	5140	1084	3548	738	146
<i>Rissa tridactyla</i> 2009	-	-	212	1352	9702	204
<i>Rissa tridactyla</i> 2019	-	1384	90	3248	13442	600
<i>Uria aalge</i> 2009	-	-	-	362	13667	-
<i>Uria aalge</i> 2019	-	-	-	1579	17745	1
<i>Cephus carbo</i> 2009	-	-	102	1650	10	-
<i>Cephus carbo</i> 2019	-	24	12	174	114	6
<i>Lunda cirrhata</i> 2009	-	-	102	175	245	-
<i>Lunda cirrhata</i> 2019	-	-	60	180	1060	30
<i>Fratercula corniculata</i> 2009	-	-	-	14	-	-
<i>Fratercula corniculata</i> 2019	-	26	30	88	52	2
<i>Cyclorhynchus psittacula</i> 2009	-	-	-	-	-	-
<i>Cyclorhynchus psittacula</i> 2019	-	-	-	-	25	-



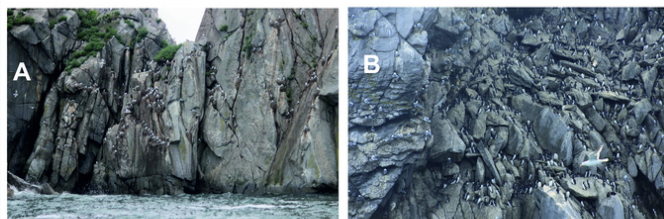
An urban population of Slaty-backed Gulls formed in the city of Magadan, and successfully breeds on the roofs of city buildings, despite the constant attempts of building owners to destroy nests. The productivity of urban gulls is significantly higher than that in the surrounding natural colonies; the growth rate of urban colonies is about 13% per year. The number of nesting gulls has tripled over the past decade (Table 1). The growth of the urbanized population is facilitated by the MSW landfill and the food-rich waters of Nagaeva and Gertnera Bays. The growth of the urban population could also be due to simultaneous emigration of gulls from the surrounding natural colonies.



Slaty-backed Gulls in the nests on the roofs in Magadan.

Currents carry urban wastewater to the Three Brothers Islets, and the number of seabirds rapidly continues to grow in this colony. This colony is now almost four times the size of the colony on the Ostrovnoy Cape, which lies outside the influence of the city's wastewater. Over the past decade, the species composition of this colony has expanded with the reappearance of Horned Puffins and Parakeet Auklets, the last sightings of which were recorded here over 60 years ago.

Anthropogenic pressure on seabird colonies from 2009 to 2019 remained constant; there were no periods of decrease or increase. It consisted of the regular presence of people in the areas of colonies and the flow of nutrients from wastewater and from the MSW landfill into the sea. Wastewater likely makes the benthos of Gertnera Bay more productive, which is reflected in the explosive growth in bottom-feeding breeding Pelagic Cormorants. The total number of breeding seabirds (taking into account the urban population of the Slaty-backed Gull in the city of Magadan) increased from 36 thousand individuals in 2009 to 57.6 thousand individuals in 2019. The distribution of colonies along the coast of the Staritskogo Peninsula has changed little, except for an increase in the number of small colonies in the Chirikova Cape area and in the most inaccessible spots for landing people on the coast.



The fragments of seabird colonies on the Ostrovnoy Cape (A) and on the Three Brothers Islets (B).