Ship traffic connects Antarctica to worldwide locations, with implications for non-native marine species introduction risk

Ship traffic connects Antarctica to worldwide locations, with implications for non-native marine species introduction risk

**Information Paper submitted by the United Kingdom**

# *Summary*

The United Kingdom presents the results of a quantitative analysis of ship movements into Antarctic waters, and a spatially-explicit assessment of introduction risk for non-native marine species in all Antarctic waters by fishing, tourism and national Antarctic operator vessels.

# *Background*

Antarctic environments are increasingly at risk from a variety of impacts from human activities, including the introduction of non-native species (see: ATCM XXXV WP5; ATCM XLII IP27; ATCM XLII IP32). However, relatively little detail is known about the risk of introducing non-native species to the marine environment across all industries and activities (see ATCM XXXV WP5 and ATCM XLIII IP6).

The potential risks of marine non-native species were highlighted at the CEP Non-native Species Workshop in Christchurch in 2006 (see ATCM XXIX WP 13) and Practical Guidelines for Ballast Water Exchange in the Antarctic Treaty area were agreed through Resolution 3 (2006).  The CEP has repeatedly recognised the importance of receiving up-to-date scientific knowledge to evaluate the threat to Antarctic marine ecosystems from marine non-native species introduction, for example:

* The Non-native Species Manual Annex ‘*Guidelines and resources requiring further attention or development*’ identified the need to improve understanding of risks and pathways for marine introduction.
* The CEP Five Year Plan identified the need for an assessment of the risk of marine non-native species introductions; and
* The Climate Change Response Work Programme (CCRWP) identified, as a high priority (Priority 1.8), the need to undertake a risk assessment to identify marine habitats at risk of invasion and pathways for introduction.

The aim of this Information Paper is to provide an update on recent knowledge of ship activity within Antarctic Treaty area, focusing on areas of high ship traffic. It identifies marine locations at high risk of non-native marine species introductions. The contents of this Information Paper are based predominantly on a recent academic paper by McCarthy et al. (2022).

# *Ship traffic to Antarctica*

Recent research has shown that an extensive network of ship activity connects Antarctica directly to all global regions, especially to South American, South Atlantic and European ports. Antarctic gateway cities are important last ports of call, especially for research and tourism vessels and were last ports of call for 63% of voyages to Antarctica during the period 2014 to 2018. However, during the same period, vessels departed direct to Antarctica from a total of 58 ports (Figure 1). Therefore, a wide range of ports and regions may act as direct connections for the introduction of terrestrial or marine non-native species. It may be appropriate for Parties to give further consideration to the potential implementation of appropriate practical biosecurity measures prior to vessel departure for Antarctica.

Imagen que contiene oscuro, luz, grande, sostener

Descripción generada automáticamente

**Figure 1**: The port-to-port traffic network of all ships that visited Antarctica from 2014 to 2018 shows 75 ports had direct links to Antarctica, including 58 last ports of call for Antarctic voyages. Lines show connections between locations but do not show the path travelled. Line opacity reflects the number of voyages between ports, with darker lines representing more voyages. Circle colour indicates the number of visits to each port, and circle size represents the relative importance of ports within the network based on their connectivity to other highly ranked ports.

# *Highest risk areas of introductions*

Research has shown that ship visits are more than seven times higher to the Antarctic Peninsula (especially east of Anvers Island) and the South Shetland Islands than elsewhere around Antarctica: together accounting for 88% of visits to Southern Ocean. Almost all of the locations (18 of 20) most vulnerable to introductions from marine non-native were located in the Antarctic Peninsula and South Shetland Islands (see Table 1). Non-native species are considered more likely to establish in these locations than other parts of Antarctica, with for example the establishment of mussels already reported in Maxwell Bay, King George Island (see [Cárdenas et al., 2020](https://www.nature.com/articles/s41598-020-62340-0#citeas)).

# *Conclusions*

The Southern Ocean is the most isolated marine environment on Earth and is the only global marine region without any known biological invasions. However, ship movements related to fishing, tourism, research and supply expose the Antarctic continent to pollution, disturbance, and invasive non-native species. Increasing ship activities in the region increase the opportunities for non-native species introductions, while climate change makes non-native species establishment more likely. Development and implementation of methods to reduce species transfer on vessels may go some way to reducing this risk marine non-native species present to Antarctic marine habitats.

# *Supporting Reference*

McCarthy, A. H., Peck, L. S., & Aldridge, D. C. (2022). Ship traffic connects Antarctica’s fragile coasts to worldwide ecosystems. *Proceedings of the National Academy of Sciences of the United States of America, 119(3),* e2110303118.

**Table 1. Top 20 sites at risk of non-native species introductions, based on the total number of visits, number of ships and median time stopped from 2014-2018, and four sites from East Antarctica for comparison.** AP = Antarctic Peninsula, SSI = South Shetland Islands, SOI = South Orkney Islands, RS = Ross Sea. Visit trend is increasing (+), decreasing (-) or steady (=), based on the cumulative mean number of visits from 2014-2018. Mean winter temperature for the top 20 locations shown range from -1.727 to -1.379, and for East Antarctic locations -1.890 to -1.784, data from NOAA World Ocean Atlas. The mean ice-free days and estimated percentage of days above 0ºC for each location is for 2014-2018.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Rank | Place (Ecoregion) | Number of visits | Number of ships | Median time stopped (hours) | Visit trend | Estimated percentage of annual sea surface temperature above 0ºC (mean ± SD) | Estimated annual ice-free days (mean ± SD) |
| 1 | Dovizio Rock (SSI) | 284 | 79 | 35.3 | = | 24.5 ± 2.4 | 194.0 ± 21.0 |
| 2 | Maxwell Bay (SSI) | 424 | 64 | 22.2 | + | 19.1 ± 2.6 | 135.0 ± 17.7 |
| 3 | Kristie Cove (AP) | 105 | 23 | 50.6 | = | 19.7 ± 5.6 | 69.0 ± 21.5 |
| 4 | Gloria Punta (AP) | 392 | 47 | 15.5 | + | 19.0 ± 7.0 | 12.0 ± 4.9 |
| 5 | Deception Island (SSI) | 326 | 58 | 14.3 | = | 10.9 ± 3.2 | 277.0 ± 25.1 |
| 6 | British Point (SSI) | 150 | 16 | 21.4 | - | 5.2 ± 2.1 | 37.8 ± 10.4 |
| 7 | Berry Head (SOI) | 48 | 14 | 35.9 | = | 6.8 ± 4.1 | 140.8 ± 56.1 |
| 8 | South Bay (SSI) | 72 | 23 | 20.8 | + | 19.8 ± 4.3 | 148.0 ± 20.9 |
| 9 | Potter Cove (SSI) | 68 | 20 | 21.0 | + | 15.3 ± 2.6 | 147.0 ±13.8 |
| 10 | Kerr Point (AP) | 402 | 43 | 12.2 | = | 22.8 ± 2.7 | 29.2 ± 8.4 |
| 11 | Cheshire Island (AP) | 41 | 12 | 32.8 | = | 18.6 ± 5.7 | 207.8 ± 53.2 |
| 12 | Theta Islands (AP) | 41 | 24 | 19.6 | = | 31.5 ± 4.0 | 246.3 ± 15.36 |
| 13 | Walker Bay (SSI) | 64 | 30 | 14.6 | + | 16.0 ± 3.7 | 176.1 ± 20.0 |
| 14 | Point Thomas (SSI) | 125 | 22 | 12.8 | - | 15.9 ± 2.6 | 59.6 ± 3.4 |
| 15 | Coughtrey Peninsula (AP) | 287 | 38 | 10.0 | + | 8.4 ± 2.3 | 6.2 ± 4.3 |
| 16 | Bombay Island (AP) | 82 | 26 | 12. | + | 18.8 ± 3.9 | 234.6 ± 8.7 |
| 17 | Argentine Islands (AP) | 82 | 25 | 12.4 | - | 15.9 ± 2.5 | 145.6 ± 20.7 |
| 18 | Girardi, Islote (SSI) | 269 | 44 | 9.7 | + | 30.3 ± 2.2 | 226.0 ± 23.0 |
| 19 | Mario Zucchelli Station (RS) | 23 | 11 | 23.5 | - | 8.6 ± 3.7 | 74.6 ± 12.3 |
| 20 | Andvord Bay (AP) | 312 | 39 | 9.2 | = | 21.2 ± 3.1 | 13.6 ± 3.5 |
|  | EAST | ANTARCTIC | LOCATIONS | FOR |  | COMPARISON |  |
| 32 | Arrival Heights | 23 | 8 | 20.3 | - | 0.1 ± 0.3 | 26.5 ± 20.5 |
| 60 | Anchorage Island | 10 | 2 | 165.4 | = | 13.60± 2.1 | 22.6 ±5.4 |
| 90 | Cuvier Island | 7 | 2 | 86.7 | = | 4.0 ± 2.6 | 3.6 ± 5.9 |
| 230 | Atka Bank | 3 | 2 | 3.6 | = | 0.04 ± 0.08 | 47.0 ± 11.3 |