Supplementary Material

**Table S1.** Time of the year, location, killer whale identifications (when known) and sources of information for the 19 cases of natural killer whale entrapment recorded in 1949 - 2019 in the North Pacific and North Atlantic Oceans and included in this study (N/A: no data available)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Case ID | Year (Mo) | Location | Latitude,  Longitude | Identifications of the killer whales  (corresponding catalogue) | Source(s) |
| #1 | 1949 (Mar) | Von Donop Lagoon,  Cortes Island, Canada | 50.1627,  -124.9448 | N/A | Emery (1960),  CIMAS (2021) |
| #2 | 1977 (Aug) | Menzies Bay, Campbell River, Vancouver Island, Canada | 50.1266,  -125.3732 | ‘*Miracle*’ | Francis and Hewlett (2007) |
| #3 | 1977 (Sep) | Kekertelung Island, Cumberland Sound, Canada | 66.3123,  -66.5259 | N/A | Reeves and Mitchell (1988) |
| #4 | 1982 (Sep) | Provincetown, Massachusetts, USA | 42.0481,  -70.1810 | ‘*Elsa*’ | Goodwin and Dodds (2008) |
| #5 | 1991 (Apr) | Skookumchuk Narrows,  Sechelt Inlet, Canada | 49.6963,  -123.8703 | J2, J12, J14, J1, J8, J4, J11, J19, J6, J3, J16, J5, J17, J10, J18, J20, J22  (from Ford et al., 1994) | JKBF, GME unpublished data |
| #6 | 1992 (Jun) | Måsøvalen, Frøya, Norway | 63.7084,  8.5234 | N/A | DV, unpublished data |
| #7 | 1994 (Aug) | Barnes Lake, Alaska, USA | 56.0117,  -132.9624 | O055, O160, O161, N/A  (GME, unpublished catalogue) | Bain (1995) |
| #8 | 1995 (Mar) | Aunsundet, Vikna, Norway | 64.9261,  11.1466 | NV-1, NV-2, NV-4, NV-7  (DV, unpublished catalogue) | DV, unpublished data |
| #9 | 1997 (Oct) | Dyes Inlet, Washington, USA | 47.6211,  -122.6893 | L21, L47, L83, L91, L26, L60, L71, L90, L81, L92, L57, L7, L53, L27, L55, L62, L93, L82, L96 (from Ford et al., 1994) | Kitsapsun (2007) |
| #10 | 2001 (Jul) | Nootka Sound, Vancouver Island, Canada | 49.6496,  -126.4502 | L98 (‘*Luna*’) (from Ford et al., 2000) | Francis and Hewlett (2007) |
| #11 | 2002 (Jan) | Seattle, Washington, USA | 47.5274,  -122.4547 | A73 (‘*Springer*’) (from Ellis et al., 2007) | Francis and Hewlett (2007) |
| #12 | 2003 (Jan) | Hood Canal, Washington, USA | 47.6696,  -122.8531 | T14, T74, T73, T73A, T73B, T073C, T77, T77A, T77B, T123, T123A  (from Ellis et al., 2008) | London (2006), Ford et al. (2013) |
| #13 | 2005 (Jul) | Hood Canal, Washington, USA | 47.6696,  -122.8531 | T71, T71A, T71B, T124A, T124A1, T124A2  (from Ellis et al., 2008) | London (2006), Ford et al. (2013) |
| #14 | 2011 (Oct) | Nushagak River (Ekwok),  Alaska, USA | 58.9218,  -157.8994 | N/A | Raverty et al. (2020) |
| #15 | 2013 (Jul) | Bent Harbor, Aristazabal Island, Canada | 52.5146,  -129.0529 | T46C2 (from Towers et al., 2012) | JKBF, LBL, JRT unpublished data |
| #16 | 2016 (Feb) | Kvalvågen, Austrheim, Norway | 60.8098,  4.9196 | NKW-366, -366a, -877, -877a, -704  (from Jourdain and Karoliussen, 2018) | EJ, RK unpublished data |
| #17 | 2017 (May) | Brønnøysund, Brønnøy, Norway | 65.4747,  12.2352 | NKW-366, -366a, -877, -877a, -878, -704, -704a, -879, -880  (from Jourdain and Karoliussen, 2018) | Jourdain et al. (2019) |
| #18 | 2018 (Aug) | Comox Harbor, Vancouver Island, Canada | 49.6631,  -124.9348 | T73B (from Ellis et al., 2008) | JKBF, JRT unpublished data |
| #19 | 2019 (Nov) | Lille Skorøya, Karlsøy, Norway | 70.1370,  19.9780 | NKW-788, -788a  (from Jourdain and Karoliussen, 2018) | EJ, RK, GME unpublished data |

**Table S2.** Characteristics of the sites where killer whales became entrapped in the North Pacific and North Atlantic Oceans in 1949 - 2019 for cases assigned to *Categories 1* and *2*. For Cases #1 and #6, two channels led to open water resulting in two measurements; the outer is given first (N/A: no data available).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Channel | | | | | | Entrapment Site | | |
| (Case ID) Location | Length1 (m) | Min  width1 (m) | Min  depth1 (m) | Tidal range  (m) | Currents1 | Man-made structures1 | Surface area5  (km2) | Maxi depth1 (m) | Notes |
| *Category 1* |  |  |  |  |  |  |  |  |  |
| (#1) Von Donop | 600, 500 | 60, 20 | <2, 2 | N/A | Tidal rapids | None | 0.5 | N/A | Limited prey availability, Brackish water |
| (#6) Måsøvalen | 200, 100 | 7, 40 | 2, 2 | N/A | N/A | None | 0.4 | 80 | Limited prey availability |
| (#7) Barnes Lake | 2,300 | 30 | 0.9 | 6.722 | Tidal rapids <8 kn | None | 2.5 | 13 | Highly seasonal prey availability, Brackish water 6 |
| (#8) Aunsundet | 2,600 | 25 | 1 | 2.763 | N/A | None | 0.2 | 10 | Limited prey availability |
| (#14) Nushagak | >100 km | <100 | 0.2 | 1.702 | River flow  <5 kn | Raised bridge | N/A | N/A | Limited prey availability, Brackish water |
| (#15) Bent Harbor | 200 | 40 | 2.1 | 5.424 | Negligible | None | 0.2 | 14 | Limited prey availability |
| (#16) Kvalvågen | 1,500 | <10 | <2 | 1.323 | N/A | Raised bridge | 0.05 | 15 | Limited prey availability |
| (#17) Brønnøysund | 1,000 | 60 | 1.8 | 2.133 | Tidal stream | None | 1.5 | 88 | Limited prey availability |
| (#19) Lille Skorøya | 400 | 20 | 0.5 | 2.173 | Tidal stream | None | 0.01 | 5 | No prey availability |
| *Category 2* |  |  |  |  |  |  |  |  |  |
| (#5) Sechelt Inlet | 2,000 | 160 | 11 | 3.694 | Tidal rapids <18 kn | None | 70 | 307 | - |
| (#9) Dyes Inlet | 6,000 | 280 | 6.1 | 4.552 | Tidal stream <5 kn | 2 raised bridges | 15 | 30 | Highly seasonal prey availability |
| (#12, 13)  Hood Canal | N/A | N/A | 40 | 5.17 (2003)2  4.94 (2005)2 | Negligible | Floating bridge that opens for ship passage | 350 | 185 | ~1,000 seals7 |

1Measured in Navionics (https://www.navionics.com); 2,3,4Tidal data retrieved from https://tidesandcurrents.noaa.gov, https://www.kartverket.no and https://waterlevels.gc.ca, respectively; 5Measured in Google Earth (https://www.google.com/earth/); 6see Bain 1995; 7see London 2006

**Table S3.** Simplified chronology of the main events that characterized four of the entrapment cases assigned to *Category 3*

|  |  |
| --- | --- |
| Date | Event(s) |
| Case #2: ‘*Miracle*’ (1977-1982) - Sources: Francis and Hewlett (2007), Hoyt (2019) | |
| 2 Aug 1977 | Miracle was first sighted in Menzies Bay, near Campbell River on Vancouver Island. The young killer whale had been seen swimming near Nanaimo a month earlier. When found, the whale seemed to be in poor shape as indicated by fungal patches and a brown slime on the skin, abrasions on the flukes and dorsal fin, bleeding wounds from collisions with boats and from a bullet and was covered in parasites. |
| 8 Aug 1977 | Researcher Michael Bigg from Fisheries and Oceans Canada (DFO), Bob Wright from Sealand of the Pacific and veterinarian Jay Hyman from the New York Aquarium visited the whale to assess its health. |
| 9 Aug 1977 | DFO issued permission to capture the killer whale for treatment. |
| 10 Aug 1977 | The whale was live-captured and transported to Oak Bay Beach Hotel where it was kept temporarily in a saltwater pool. |
| Feb 1978 | After apparent recovery, Miracle was transported to Sealand of the Pacific in Victoria. |
| Jan 1982 | Miracle died after becoming entangled and drowning in a net that made one side of her pool. |
| Case #4: ‘*Elsa*’ (1982) - Source: Goodwin and Dodds (2008) | |
| Sep 1982 | Elsa entered the Provincetown Harbor, Massachusetts, USA, following a fishing boat on its way in. She remained at the location for about a month where she engaged in interactions with people and boats. One day, she left, reportedly following the same fishing vessel and was never seen again. |
| Case #10: L98 or ‘*Luna*’ (2001-2006) - Sources: Francis and Hewlett (2007), Hoyt (2019) | |
| 6 Jul 2001 | An unidentified lone killer whale calf was first reported in Mooyah Bay, Nootka Sound on Vancouver Island. |
| Oct 2001 | The young whale was identified as L98. At the last sighting of his family pod in May 2001, L98 was absent and presumed dead. |
| Sep 2002 | After a monitoring program was initiated, Luna was seen expanding his range for the first time and begun visiting Gold River. |
| Feb 2003 | DFO convened a scientific advisory panel to discuss the case and started considering a possible relocation. Because Luna was in an area not typically part of his pod’s range, the chances for the young whale to reunite with his family group were judged slim unless an intervention was carried out. |
| Oct 2003 | After interactions between Luna and boats had intensified during the summer, DFO announced its plan to relocate Luna to southern Vancouver Island in spring 2004, to be carried out by the Vancouver Aquarium. |
| Apr 2004 | As DFO announced the details of the relocation plan, opposition grew within the local Mowachaht-Muchalaht First Nations. |
| 9 Jun 2004 | DFO gave final permission for the relocation operation. |
| 22 Jun 2004 | A first attempt to capture Luna was made but countered by canoes paddled by opposed local First Nations. |
| 24 Jun 2004 | Due to growing controversy and conflict between stakeholders, DFO suspended its efforts to relocate Luna pending further consultations. |
| 10 Mar 2006 | Luna was killed in Mooyah Bay as he was sucked into the propeller blades of an ocean tugboat. |
| Case #11: A73 or ‘*Springer*’ (2002) - Sources: Francis and Hewlett (2007), Hoyt (2019) | |
| 1 Nov 2001 | A lone whale that might have been Springer was first sighted in Puget Sound. |
| 12 Jan 2002 | A new observation off Vashon Island, near Seattle, WA confirmed the lone killer whale was Springer. |
| Feb 2002 | The Vancouver Aquarium visited Springer to assess her health and proposed a rescue plan to the US National Marine Fisheries Service (NMFS), which convened a scientific panel. |
| 24 May 2002 | NMFS announced its plan to intervene and capture Springer. |
| 12 Jun 2002 | Springer was captured and placed into a sea pen in Manchester, WA for medical treatment and condition recovery. |
| 13 Jul 2002 | Springer was transported onboard a high-speed catamaran to Johnstone Strait, BC where she was put into a sea pen at Dongchong Bay, Hanson Island for rehabilitation and while waiting for her family group to be spotted in the area. |
| 14 Jul 2002 | Springer was released. |
| 18 Jul 2002 | Springer was seen for the first time in close association with other killer whales. |
| 9 Jul 2003 | Springer was seen returning to Johnstone Strait with her family pod A4 after surviving her first winter after release and her relocation was considered a success. |
| Summer 2013 | Springer was seen returning with her pod A4 and was seen with her first calf near Spirit Island, BC. |
| 2017 | Springer was seen with her second calf A116. |

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