



## Characteristics of operating locations, Australian Antarctic Air transport system

### *Windmill Islands region*

Casey station is located on the Budd Coast of Wilkes Land, adjacent to Law Dome, a coastal ice dome contiguous with the Antarctic polar plateau. The immediate area (within a 30km radius of Casey station) is characterised by outcroppings of ice free land (40 km<sup>2</sup> in total) at the margin of the polar plateau. The area is known as the Windmill Islands, and includes islands and four peninsulas (Clark, Bailey, Mitchell and Browning). From the coastal fringe, the ice surface rises uninterrupted to the summit of Law Dome (1395m). Beyond Law Dome lies the polar plateau. The Peterson glacier terminates within the Windmill Island group, and the much larger Vanderford glacier forms the southern margin of the area. Map 1 shows the topography of the islands, while map 2 shows more detailed surface contours of the Casey station area. Small lakes and streams (seasonal) are present. Ice free land hosts populations of breeding seabirds, terrestrial plants, and seal haulouts. The sea ice off the coast supports marine wildlife populations.

Climate of the area is frigid-Antarctic. Monthly mean temperatures range from 0.1°C in January to -15°C in August. Mean wind speeds are approximately 10 knots for summer months and 15 knots during winter. Gale force winds are relatively common, and wind speeds can reach more than 85 knots, although Casey does not experience regular katabatic winds. Precipitation is 175mm a year rainfall equivalent, mainly as snow. Sea ice forms in winter but does not develop into reliable, persistent fast ice. Snow accumulates on ice free areas during winter, with drifts persisting into summer. Snow melt provides soil moisture, streams and pools of freshwater.

The Windmill islands region includes three main bedrock types – the extensive Windmill Metamorphics (gneisses, schists and migmatites), the Ardery Charnokite, and a small area known as the Ford Granite. Two swarms of dolerite dykes cut through the area. Surfaces include bare, weathered rock, and boulder fields. Soils are typical of an Antarctic coastal terrestrial environment, described as permafrost-affected cold soils, with a high content of coarse mineral particles, in some places rich in nutrients from input by seabirds. Areas of barren mineral soils, mineral soils with a thin cover of moss and lichen vegetation, and soils under fruticose lichens are present.

The ice free areas support extensive cryptogamic plant communities (map 1), with concentrations of lichens (28 species), mosses (4 species), liverworts (1 species), and terrestrial algae (24 species), influenced by substrate, moisture and microclimate characteristics. The northern peninsulas support the greatest diversity of plants in the area. A short invertebrate food chain of nematodes, mites and tardigrades is based on this flora.

Table 1 is a flora list for the Windmill Islands. Additional information on flora can be found at [http://www-aadc.aad.gov.au/ten\\_facts/stations\\_territories/windmill/default.asp](http://www-aadc.aad.gov.au/ten_facts/stations_territories/windmill/default.asp).



Table 1: Flora, Windmill Islands region

<b>Bryophytes</b>	<b>Algae</b>
<b>Mosses</b>	<i>Chlamydomonas pseudopulsatilla</i>
<i>Bryum pseudotriquetrum</i>	<i>Chlamydomonas sp.</i>
<i>Ceratodon purpureus</i>	<i>Chloromonas brevispina</i>
<i>Grimmia antarctici</i>	<i>Chloromonas polyptera</i>
<i>Grimmia lawiana</i>	<i>Chloromonas rubroleosa</i>
<b>Liverworts</b>	<i>Chloromonas sp. 1</i>
<i>Cephaloziella exiliflora</i>	<i>Chloromonas sp. 2</i>
<b>Lichens</b>	<i>Chlorosarcina sp.</i>
<i>Acarospora gwynii</i>	<i>Desmotetra sp. 1</i>
<i>Buellia frigida</i>	<i>Desmotetra sp. 2</i>
<i>Buellia grimmiae</i>	<i>Ellipsoidion sp.</i>
<i>Buellia papillata</i>	<i>Mesotaenium berggrenii</i>
<i>Buellia soredians</i>	<i>Monoraphidium sp.</i>
<i>Caloplaca athallina</i>	<i>Palmellopsis sp.</i>
<i>Caloplaca citrina</i>	<i>Prasiococcus calcarius</i>
<i>Caloplaca sp.</i>	<i>Prasiola crispa</i>
<i>Candelariella flava</i>	<i>Raphidonema Helvetica</i>
<i>Lecanora expectans</i>	<i>Raphidonema nivale</i>
<i>Lecidea sp.</i>	<i>Raphidonema tatrae</i>
<i>Lecidea cancriformis</i>	<i>Stichococcus bacillaris</i>
<i>Lepraria sp.</i>	<i>Stichococcus minutus</i>
<i>Physcia caesia</i>	<i>Ulothrix sp. 1</i>
<i>Pleopsidium chlorophamus</i>	<i>Ulothrix sp. 2</i>
<i>Pseudophebe minuscula</i>	<i>Unidentified chrysophyte</i>
<i>Rhizocarpon flavum</i>	
<i>Rhizoplaca melanophthalma</i>	
<i>Rinodina olivaceobrunnea</i>	
<i>Rinodina petermannii</i>	
<i>Umbilicaria aprina</i>	
<i>Umbilicaria cristate</i>	
<i>Umbilicaria decussata</i>	
<i>Umbilicaria sp.</i>	
<i>Usnea antarctica</i>	
<i>Usnea sphacelata</i>	
<i>Xanthoria elegans</i>	
<i>Xanthoria mawsonii</i>	

Faunal species recorded in the region are listed in Table 2. Map 1 and map 3 show the main faunal concentrations. Seals haul out on sea ice and beaches, with Weddell seal (*Leptonychotes weddellii*) haulouts (including a known pupping site), and southern elephant seal (*Mirounga leonina*, listed vulnerable) haulout areas shown in maps 1 and 3. Snow petrels (*Pagodroma nivea*, *P. nivea confusa* in mixed colonies) nest within many ice free areas. Some nesting sites have been surveyed on Reeves Hill and Budnick Hill close to Casey station (map 4), and colonies are recorded on Ardery, Nelly, Herring, Peterson and Holl Islands. The Frazier Islands (map 5) and Ardery and Odbert islands are important breeding locations for flying birds (map 6). Southern giant petrel (*Macronectes giganteus* listed endangered, listed migratory) breed on the Frazier Islands. Adélie penguins nest in colonies throughout the Windmill Islands (map 1, map 3). An emperor penguin rookery is located on sea ice offshore at Petersen Bank, approximately 44km NNW of Casey station.



Table 2: Fauna, Windmill Islands region

Common name	Seals	List status	Occurrence
Weddell seal	<i>Leptonychotes weddellii</i>	Not listed	Hauls out to rest, moult and pup on sea ice
Crabeater seal	<i>Lobodon carcinophagus</i>	Not listed	Small numbers haul out on sea ice and ice free land
Ross seal	<i>Ommatophoca rossii</i>	Not listed	Observed in Casey region
Leopard seal	<i>Hydrurga leptonyx</i>	Not listed	Regularly sighted, haul out on sea ice and ice free land
Southern elephant seal	<i>Mirounga leonina</i>	Listed vulnerable	Haul out, mainly immature males for moulting on beaches
Birds			
Emperor penguin	<i>Aptenodytes forsteri</i>	Not listed	Nearest breeding location is Petersen Bank, 44km from Casey
Adélie penguin	<i>Pygoscelis adeliae</i>	Not listed	Breeds on many of the Windmill Islands, and on Clark Peninsula
Southern giant petrel	<i>Macronectes giganteus</i>	Listed migratory Listed endangered	Breeds Frazier Islands
Cape petrel	<i>Daption capense</i> <i>Daption capense capense</i> (southern)	Not listed	Breeds Ardery Island, Odbert Island, Frazier Islands
Southern fulmar	<i>Fulmarus glacialisoides</i>	Not listed	Breeds Ardery Island, Odbert Island, Nelly Island
Antarctic petrel	<i>Thalassoica antarctica</i>	Not listed	Breeds Frazier Islands, Ardery Island,
Snow petrel	<i>Pagodroma nivea</i> , <i>Pagodroma nivea confusa</i>	Not listed	Breeds throughout the Windmill Islands, including Reeve Hill and Budnick Hill close to Casey Station, and Ardery, Nelly, Herring, Peterson, and Holl Islands.
Wilson's storm petrel	<i>Oceanites oceanicus</i> <i>Oceanites oceanicus oceanicus</i> (subantarctic)	Listed migratory ( <i>Oceanites oceanicus</i> )	Breeds throughout the Windmill Islands area
Antarctic skua / South Polar skua	<i>Catharacta maccormicki</i> / <i>Stercorarius maccormicki</i>	Listed migratory as <i>Stercorarius maccormicki</i>	Breeds throughout the Windmill Islands at widely dispersed nests, generally near penguin colonies
Great skua / Subantarctic skua	<i>Catharacta skua</i>	Not listed	Observed in Casey region
Kelp gull	<i>Larus dominicanus</i>	Not listed	Observed in Casey region
Arctic tern	<i>Sterna paradisaea</i>	Listed migratory (Atlantic populations only)	Observed in Casey region

There are three protected areas in the Casey Region (map 3). SSSI 17, Clark Peninsula is designated to protect moss and lichen communities used as control sites to monitor environmental impact at Casey Station, providing baseline data with which to compare changes (map 7). SSSI 16, North-east Bailey Peninsula, is representative of a diverse assemblage of vegetation, contains contrasting habitats and water bodies, has extremely rich lichen and moss communities and an important stand of liverwort. The site is protected primarily to prevent disturbance of study sites due to the close proximity of Casey station (map 8). Specially Protected Area 3, Ardery Island and Odbert Island, is designated because it is a readily accessible location where the four genera of fulmarine petrels (*Thalassoica antarctica*, *Fulmarus glacialisoides*, *Daption capense* and *Pagodroma nivea*) breed in sufficient numbers to allow comparative study (map 6). Management plans for these protected areas can be viewed at <http://www.aad.gov.au/environment/areaprotection/>.

Casey station is a complex of buildings, roads and ancillary support services located on the Bailey Peninsula, and occupied year round by scientists and support staff. Occupancy in summer reaches approximately 50 with around 17 people over winter. Map 2 shows the Casey station area.

Wilkes station is an abandoned research station established by the USA and later operated by Australia. The complex is located on the Clark Peninsula, and now consists of the remnants of a number of buildings and huts, a series of storage dumps and a considerable amount of rubbish (map 8). The Wilkes Station site is being assessed to determine the appropriate strategy for remediation and removal of contaminants and rubbish while preserving the significant heritage values of the site ([http://www.aad.gov.au/science/AntarcticResearch/HumanImpacts/contaminated\\_sites/default.asp](http://www.aad.gov.au/science/AntarcticResearch/HumanImpacts/contaminated_sites/default.asp)). Field refuges are located north of Clark Peninsula, at Robinson's Ridge, at Peterson Island, and on the Browning Peninsula.



Information on benthic species in the Casey region can be viewed at

[http://www.aad.gov.au/science/AntarcticResearch/HumanImpacts/contaminated\\_sites/ecology.asp](http://www.aad.gov.au/science/AntarcticResearch/HumanImpacts/contaminated_sites/ecology.asp).

The immediate area of Casey station, Newcomb Bay, old Casey station, and Wilkes station (map 8) has been affected by placement of structures, construction, roads, quarrying, waste disposal, emissions, surface and sediment contamination, and ongoing activity. A moderate level of degradation of environmental values has occurred in the general area, with high levels of degradation in localised areas. The coastal marine environment adjacent to Casey station and Wilkes has been impacted by contaminants including heavy metals from tip sites, and by sewage input. To a lesser degree, areas in the vicinity of field refuges and installations are modified by human presence and activity. Beyond these immediate areas, environmental quality can be considered near-pristine.

### *Vestfold Hills region*

Davis Station is located on the Ingrid Christensen Coast, Princess Elizabeth Land, on the coastal edge of the Vestfold Hills. The Vestfold Hills are an extensive area (750 km<sup>2</sup>) of ice-free rock dissected by fjords, and bounded by coastal waters, the polar plateau, and the Sørsdal Glacier (map 9). A number of islands extend into the waters of Prydz Bay, and a group of ice free islands (Rauer Group) lies to the south of the Sørsdal Glacier. The area is characterised by low, rounded hills (157m asl maximum, with less than 15% of the area above 60m asl), numerous freshwater and saline lakes (about 10% of the total area), and some ephemeral streams in summer. Two major ephemeral drainage systems (Zvezda and Druzhby) drain to fjords from the ice sheet and Sørsdal glacier through a series of lakes and streams, while much of the remainder drains internally to lakes in closed drainage basins. Such lakes range from fresh to hypersaline. Some lakes and fjord basins have stable, anoxic bottom water layers.

Climate of the area is somewhat milder than other Australian Antarctic stations. Monthly mean temperatures range from 1.1°C in January to -17.5°C in August. Monthly mean wind speed is fairly uniform throughout, around 10 knots, while overall only about 3% of Davis winds are over 30 knots. Katabatic winds occur more regularly at the edge of the Vestfold Hills closest to the plateau. An average of 78mm precipitation in the form of snow falls each year, while more accumulation results from drift snow. Apart from some snow drifts and banks, the Vestfold Hills are snow free in summer, with a light snow cover in winter. Sea ice forms in winter and persists into spring, with ice remaining on fjords for longer periods.

The bedrock geology of the Vestfold Hills is dominated by four Archaean gneiss complexes – Crooked lake gneiss, Mossel gneiss, Chelnok supracrustals, and Tryne metavolcanics. The many dolerite dyke intrusions are a distinctive feature. Bedrock derived soils are hypersaline in many areas as a result of prior marine inundation. Western portions of the hills are influenced by salt spray and a build up of sand and weathered till. Nutrient enrichment is evident around extant or previous bird colonies and nesting sites.

Terrestrial vegetation includes bryophytes (8 species of moss), lichens (23 species), terrestrial algae (82 species) and fungi. Bryophyte vegetation is sparsely distributed in the inland areas, and largely absent from the western section of the hills. Lichens exhibit a similar distribution, although some species occur throughout the whole area. A short invertebrate food chain of nematodes, mites and tardigrades is based on this flora.

Terrestrial fauna (other than invertebrates) and bird species recorded in the region are detailed in Table 3. Map 9 shows the main concentrations of fauna in the area. Weddell seal (*Leptonychotes weddelli*) haulouts include known pupping sites. Southern elephant seals (*Mirounga leonina*, listed vulnerable) haulout on coastal beaches including those close to Davis station (map 9). Snow petrel (*Pagodroma nivea*) nest throughout the ice-free areas with concentrations at the head of Long Fjord. The listed migratory species Wilson's storm petrel (*Oceanites oceanicus*) nests throughout the ice free areas of the Vestfold Hills and Rauer group. The listed endangered species southern giant petrel (*Macronectes giganteus*) nests at Hawker Island (map 10). The Rauer Group to the south is also important as a bird breeding location (map 11).



Table 3: Faunal species, Davis region

Seals	Occurrence
Weddell seal <i>Leptonychotes weddelli</i>	Hauls out, pups on fast ice
Crabeater seal <i>Lobodon carcinophagus</i>	Small numbers haul out on sea ice and ice free land
Ross seal <i>Ommatophoca rossi</i>	Observed
Leopard seal <i>Hydrurga leptonyx</i>	Regularly sighted, haul out on ice and ice free land
Southern elephant seal <i>Mirounga leonina</i>	Haul out, mainly immature males for moulting on beaches
Birds	
Emperor penguin <i>Aptenodytes forsteri</i>	Nearest breeding location at Amanda Bay, approx. 90kms distant (69°16'1", 76°49'58").
Adelie penguin <i>Pygoscelis adeliae</i>	Breed in colonies on islands and on Long Peninsula.
Southern giant petrel <i>Macronectes giganteus</i>	Breeds Hawker Island.
Cape petrel <i>Daption capense</i>	Breeds on offshore islands.
Southern fulmar <i>Fulmarus glacialis</i>	Breeds on Rauer Group.
Antarctic petrel <i>Thalassoica antarctica</i>	Breeds on Rauer Group.
Snow petrel <i>Pagodroma nivea</i>	Breeds on offshore islands and localities in the Vestfold Hills.
Wilson's storm petrel <i>Oceanites oceanicus</i>	Breeds throughout the Vestfold Hills.
Antarctic skua <i>Catharacta maccormicki</i>	Breeds throughout the Vestfold Hills at widely dispersed nests, on most islands and locations near penguin colonies.

The lake types in the Vestfold Hills provide varied habitats for phytoplanktonic and benthic communities, which are of considerable scientific and biogeographical importance. Some lakes contain microbial mats of cyanobacteria, chlorophytes, diatoms, mosses and heterotrophic grazers.

One protected area is located in the Vestfold Hills, SSSI No.25, Marine Plain, Mule Peninsula (map 9). This area is designated to protect fossils of vertebrate fauna. The area also protects important examples of the different lake types in the Vestfold Hills. The management plan for this area can be viewed at <http://www.aad.gov.au/environment/areaprotection/>.

Davis station is a complex of buildings, roads and ancillary support services located on the coast of the Vestfold Hills, occupied year round by scientists and support staff. Occupancy in summer reaches approximately 80, with around 24 people over winter. Map 12 shows the Davis station area. Field refuges include Watts Hut (Watts Lake), Brookes Hut (Shirokaya Bay), Platcha (Long Fjord), Bandits Hut (Tryne Fjord), Magnetic Island Hut, Trajer Ridge hut, Crooked Lake Apple hut, and Rookery Apple hut (map 9). Markers, small installations, and tent depots are also present.

The coastal marine environment includes a varied and abundant benthic fauna on sand, rock and mud substrates, macrophytes and associated epiphytic species, ice-associated microbial species, planktonic species, and vertebrates. 13 species of fish have been recorded from the inshore waters of the Vestfold Hills.

The immediate area of Davis station (map 12) has been affected by placement of structures, construction, roads, quarrying, waste disposal, emissions, contamination, and ongoing activity. A moderate level of degradation of environmental values has occurred in the area. The coastal marine environment adjacent to Davis station has been impacted by heavy metals from tip sites and by sewage input. To a lesser degree, areas in the vicinity of field refuges and installations are modified by human presence and activity. Beyond these immediate areas, environmental quality can be considered near-pristine.

#### *Mawson region*

Mawson Station is located on the Mawson Coast of Mac Robertson Land, on a small area of exposed land (900m by 700m) adjacent to the polar plateau in Holme Bay (map 13). The broader region is characterised by small coastal exposures of ice free land, and nearshore ice free islands. The total area of ice free land in Holme Bay is approximately 12km<sup>2</sup>. To the south of the station, the Framnes Mountains protrude some 300m to 400m from the ice sheet, and comprise around 36km<sup>2</sup> of ice free land in three major ranges (Casey, Masson and David) separated by expanses of exposed glacial ice. The rock exposure on which the station is located has a number of small melt lakes filled by melt and sea spray.

Climate of the Mawson region is generally colder than the other Australian Antarctic stations. Monthly mean temperature is 0.3°C in January, and -18.7°C in August. Monthly mean wind speeds are around 22



knots for most months and 18 knots for December and January. Mawson is subject to strong winds, with over 15% of summer winds over 30 knots. Inland plateau locations are subject to extreme winds. Sea ice forms in winter and persists into January.

Mawson Rock (the location of the station) can be described as a moraine-mantled, ice-polished charnockite exposure. Mawson charnockite is a brownish, weakly-foliated, porphyroblastic charnockite or hypersthene granite. Mount Henderson, North and Central Masson Range, David Range and most of the islands to the near east and north of Mawson are of the same porphyroblastic charnockite. The South Masson Range and nunataks to its south are of even-grained charnockite, as are many islands to the west and north-west of Mawson. There are smaller areas of the region dominated by gneisses.

Vegetation is generally depauperate, and limited to terrestrial algae, snow algae, and pond algae, lichens (21 species), and three moss species, largely restricted to areas that are moist as a result of snow melt.

Terrestrial fauna and bird species recorded in the region are listed in Table 4. Map 13 shows the main concentrations of fauna in the Mawson region. Weddell seals (*Leptonychotes weddelli*) haulout on sea ice and land through the area, and are known to pup west of Mawson at Forbes Glacier.

Adelie penguin (*Pygoscelis adeliae*) breed on many islands along the coast, with a number of colonies close to station on Bechervaise and Welch Islands (map 14). Snow petrels (*Pagodroma nivea*) breed on the Rookery Islands, the David, Casey and Masson Ranges, Mt Henderson, and in ice free areas including the station area. The listed migratory species Wilson's storm petrel (*Oceanites oceanicus*, listed migratory) breeds on the Rookery Islands and other ice free areas. The listed endangered species southern giant petrel (*Macronectes giganteus*) nests at Giganteus Island about 16km west of Mawson, the only breeding locality for this species in the wider area. Emperor penguin (*Aptenodytes forsteri*) breeding colonies are distant from Mawson, the nearest being Auster rookery 56km to the east. Cape petrel breeds on rock outcrops flanking the Forbes Glacier, and in the Rookery islands. Antarctic skua (*Catharacta maccormicki*) breed on Giganteus Island and probably breed near other Adelie penguin colonies.

Table 4: Faunal species, Mawson region

Seals	Occurrence
Weddell seal <i>Leptonychotes weddelli</i>	Common, haul out on ice and ice free land
Crabeater seal <i>Lobodon carcinophagus</i>	Small numbers haul out on ice offshore
Leopard seal <i>Hydrurga leptonyx</i>	Occasionally sighted, haul out on ice
Birds	
Emperor penguin <i>Aptenodytes forsteri</i>	Nearest breeding location at Auster Rookery, approx. 51kms east of Mawson station.
Adelie penguin <i>Pygoscelis adeliae</i>	Breed in colonies on islands in Holme Bay and along MacRobertson Land coast.
Southern giant petrel <i>Macronectes giganteus</i>	Breeds Giganteus Island (Rookery Islands).
Cape petrel <i>Daption capense</i>	Breeds on rock outcrops beside Forbes Glacier and in the Rookery Islands.
Snow petrel <i>Pagodroma nivea</i>	Breeds on Rookery Islands, David Range, Casey Range, Masson Range, Mt Henderson, and in station area.
Wilson's storm petrel <i>Oceanites oceanicus</i>	Breeds in rocky areas on islands and coast including Mawson rock.
Antarctic skua <i>Catharacta maccormicki</i>	Breed on Giganteus Island and probably near other Adelie penguin colonies.

There are two protected areas in the Mawson region. SPA 2, Rookery Islands is located in Holme Bay (map 13), and was designated to protect the unusual association of six bird species breeding in the area - Adélie penguin (*Pygoscelis adeliae*), cape petrel (*Daption capensis*), snow petrel (*Pagodroma nivea*), southern giant petrel (*Macronectes giganteus*), Wilson's storm petrel (*Oceanites oceanicus*) and the Antarctic skua (*Catharacta maccormicki*). The designation also aims to ensure the preservation of a sample offshore island habitat.

SPA 1, Taylor Rookery, is located approximately 90km west of Mawson Station. The site protects a colony of emperor penguins (*Aptenodytes forsteri*) which is one of the few, and probably the largest, of the known colonies of this species located wholly on land. The rookery is also important as the subject of long-term



monitoring of the population (since 1954). The area is protected to prevent unnecessary disturbance to the Emperor penguin colony, and to permit research that cannot be undertaken elsewhere. The management plans for these areas can be viewed at <http://www.aad.gov.au/environment/areaprotection/>.

Mawson station is a complex of buildings, roads and ancillary support services occupied year round by scientists and support staff. Occupancy in summer reaches around 45, with approximately 21 people over winter. Map 15 shows the Mawson station area. Field refuges are located at Béchervaise Island, Mount Henderson, Fang Peak (David Range), Rumdoodle (North Masson Range), Auster Rookery (Macey Island), and Colbeck Archipelago (map 13). Markers, small installations, and tent depots are also present.

The immediate area of Mawson station (map 15) has been affected by placement of structures, construction, roads, quarrying, waste disposal, emissions, contamination, and ongoing activity. A moderate level of degradation of environmental values has occurred in the area, including degradation of vegetation. The coastal marine environment adjacent to Mawson station has been impacted by contaminants including heavy metals from tip sites and by sewage input. To a lesser degree, areas in the vicinity of field refuges and installations are modified by human presence and activity. Beyond these immediate areas, environmental quality can be considered near-pristine.