Antarctic Specially Protected Area (ASPA) No. 161

TERRA NOVA BAY, ROSS SEA

1. Description values to be protected

A coastal marine area encompassing 29.4 km^2 between Adélie Cove and Tethys Bay, Terra Nova Bay, is proposed as an Antarctic Specially Protected Area (ASPA) by Italy on the grounds that it is an important littoral area for well-established and long-term scientific investigations. The Area is confined to a narrow strip of waters extending approximately 9.4 km in length immediately to the south of the Mario Zucchelli Station (MZS) and up to a maximum of 7 km from the shore. No marine resource harvesting has been, is currently, or is planned to be, conducted within the Area, nor in the immediate surrounding vicinity. The site typically remains ice-free in summer, which is rare for coastal areas in the Ross Sea region, making it an ideal and accessible site for research into the near-shore benthic communities of the region. Extensive marine ecological research has been carried out at Terra Nova Bay since 1986/87, contributing substantially to our understanding of these communities which had not previously been well-described.

High diversity at both species and community levels make this Area of high ecological and scientific value. Studies have revealed a complex array of species assemblages, often co-existing in mosaics (Cattaneo-Vietti, 1991; Sarà *et al.*, 1992; Cattaneo-Vietti *et al.*, 1997; 2000b; 2000c; Gambi *et al.*, 1997; Cantone *et al.*, 2000). There exist assemblages with high species richness and complex functioning, such as the sponge and anthozoan communities, alongside loosely structured, low diversity assemblages. Moreover, the sponge and anthozoan communities at Terra Nova Bay show an unique structure and long-term transects have been established to monitor changes in coastal benthic communities, both natural and human-induced. The presence of a population of Adélie penguins (*Pygoscelis adeliae*) at Adélie Cove allows assessment of the effects of this colony on the adjacent marine environment (Povero *et al.*, 2001).

It is important to protect the Area as far as possible from direct human impacts in order that it can be used to monitor potential impacts arising from activities at the nearby permanent scientific station of MZS at Terra Nova Bay (Mauri *et al.*, 1990; Berkman & Nigro, 1992; Focardi *et al.*, 1993; Minganti *et al.*, 1995; Bruni *et al.*, 1997; Nonnis Marzano *et al.*, 2000). The high ecological and scientific values derived from the diverse range of species and assemblages, in particular through the collection of extensive data on these features, together with the vulnerability of the Area to disturbance by pollution, over-sampling and alien introductions, are such that the Area requires long-term special protection.

2. Aims and objectives

Management at Terra Nova Bay aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance to the Area;
- allow scientific research on the ecosystem, in particular on the marine species assemblages, while ensuring it is protected from oversampling or other possible scientific impacts;
- allow other scientific research and support activities provided they are for compelling reasons which cannot be served elsewhere;
- maintain long-term monitoring sites to evaluate natural changes in marine communities;
- monitor the effects of the research station and its associated activities on the marine ecosystem;
- minimise the possibility of introduction of alien plants, animals and microbes to the Area;

- allow visits for management purposes in support of the aims of the management plan.

3. Management activities

The following management activities are to be undertaken to protect the values of the Area:

- A map showing the location of the Area (stating the special restrictions that apply) shall be displayed prominently, and a copy of this Management Plan shall be kept available, at MZS (Italy);
- A sign illustrating the location and boundaries with clear statements of entry restrictions shall be installed at MZS at a prominent location;
- Buoys, or other markers or structures erected for scientific or management purposes shall be secured and maintained in good condition, and removed when no longer necessary;
- Visits shall be made as necessary to assess whether the Area continues to serve the purposes for which it was designated and whether management and maintenance measures are adequate.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

Map 1: Terra Nova Bay, Antarctic Specially Protected Area No. 161, bathymetric map.

Map specifications: Projection: UTM Zone 58S; Spheroid: WGS84. Bathymetric contour interval 50 m. Land contours and coast derived from 1:50,000 Northern Foothills Satellite Image Map (Frezzotti *et. al.* 2001). Bathymetry within ASPA derived from high resolution sidescan sonar data surveyed by Kvitek, 2002. Bathymetry outside of ASPA supplied by Italian Hydrographic Office 2000. Marine data collected under Terra Nova Bay marine protected area Project (PNRA 1999-2001). <u>Inset 1:</u> The location of Terra Nova Bay in Antarctica. <u>Inset 2:</u> Terra Nova Bay location map, showing the region covered by Map 1, stations, and sites of nearby protected areas.

6. Description of the Area

6(i) Geographical co-ordinates, boundary markers and natural features

The designated Area is situated in Terra Nova Bay, between the Campbell Glacier Tongue and Drygalski Ice Tongue, Victoria Land. The Area is confined to a narrow strip of coastal waters to the south of MZS (Italy), extending approximately 9.4 km in length and generally within 1.5 – 7 km of the shore, comprising an area of 29.4 km^2 (Map 1). No marine resource harvesting has been, is currently, or is planned to be, conducted within the Area, nor in the immediate surrounding vicinity.

The western boundary of the Area is defined as the mean high water mark along the coastline extending between 74°42'57"S in the north (2.3 km south of MZS) and 74°48'00"S in the south (the southern shore of Adélie Cove), and includes the intertidal zone (Map 1). The northern boundary of the Area is defined as the 74°42'57"S line of latitude, extending from the coast 1.55 km eastward to the 164°10'00"E line of longitude. The boundary position may be recognised near the shore by the presence of a large and distinctive offshore rock in the northernmost cove on the coast south of MZS, which is an unique feature on this stretch of coast. The southern boundary is defined as the 74°48'00"S line of latitude, extending from the coast 3.63 km eastward to the 164°10'00"E line of longitude. The boundary position may be recognised visually as being at the southern shore of the mouth of Adélie Cove, immediately south of a distinctive rocky outcrop at the base of the coastal cliffs. The eastern boundary of the Area is defined as the 164°10'00"E line of longitude extending between 74°42'57"S in the north and 74°48'00"S in the south.

The coastline of Terra Nova Bay is characterised predominantly by rocky cliffs, with large boulders forming occasional ‘beaches’ (Simeoni *et al.*, 1989). In the sheltered areas, the soft bottom begins at a depth of 20–30 m. The tidal range is 1.5–2 m and pack ice approximately 2–2.5 m thick covers the sea surface for 9–10 months of the year (Stocchino & Lusetti, 1988; 1990). Data available for the summer period suggest that ocean currents in the Area are likely to be slow and to flow generally in a north-south direction. Along the coastline of the Area there are two main coves; the larger Adélie Cove in the south and a smaller cove around 3 km to its north. The sea floor substrate of the smaller consists of pebbles of various sizes, while Adélie Cove is characterised by fine-grained, muddy sediments. An Adélie penguin (*Pygoscelis adeliae*) colony is situated at Adélie Cove, with a 1991 population of 7899 breeding pairs. Outside of the coves, the sea floor characteristics and benthic species assemblages are relatively homogenous along the coastal length of the Area, and are observed to vary more particularly with the vertical gradient.

An aerial survey on cetacean species, conducted in the coastal area surrounding the Italian Station Mario Zucchelli in summer 2004, showed the presence of Killer Whale (*Orcinus orca* (L.)), types B and C and Minke Whale (*Balaenoptera bonaerensis* Burmeister). (Lauriano et al., 2007a; 2007b; Lauriano pers.com.)

The seafloor within the Area is primarily granitic rock, with softer substrates composed of coarse sands or gravels. In the supralittoral zone, only cyanobacteria and diatoms colonise the hard substrates, while the intertidal zone (1.5–2.0 m wide) has, in the most sheltered areas, a high coverage of the green alga *Urospora penicilliformis* and *Prasiola crispa* (Cormaci *et al.*, 1992b). Below the tidal zone, down to 2–3 m depth, the community is very poor, due to the persistent presence and scouring action of pack ice, and is mainly composed of epilithic diatoms and the crustacean amphipod *Paramoera walkeri*. Immediately deeper, rocks can be fully colonised by the red alga *Iridaea cordata* (Cormaci *et al.*, 1996), frequently found with *Plocamium cartilagineum,* to a depth of 12 m (Gambi *et al.*, 1994; 2000a). At this level large sessile animals such as *Alcyonium antarcticum* and *Urticinopsis antarctica* can be occasionally observed, while frequent are the asteroid *Odontaster validus* and the echinoid *Sterechinus neumayeri*. *Phyllophora antarctica* is another red alga forming expanded mats from 12 to 25 m depth, often fully colonised by sessile organisms, mainly hydroids (Cerrano *et al.*, 2000c, Puce *et al.*, 2002), serpulids and bryozoans (*Celleporella antarctica* and *Harpecia spinosissima*). The upper algal belts represent shelter and a food source for diversified and abundant communities of mobile fauna. Numerous invertebrates, such as the polychaete *Harmothoe brevipalpa*, the mollusc *Laevilittorina antarctica*, the crustacean amphipod *Paramoera walkeri* and the isopod *Nototanais dimorphus* feed on these algal species and can be very abundant. On rocky bottoms in deeper layers, the algal colonisation is replaced by a calcareous crustose coralline alga (*Clathromorphum lemoineanum*) on which sea-urchins feed.

The soft bottoms from 20–40 m depth are coarse sands and gravels, where the community is characterised by the mollusc bivalve *Laternula elliptica* and the polychaete *Aglaophamus ornatus* (Nephtiidae). The bivalve *Yoldia eightsi* is abundant in fine-sand sediments.

Between 30–70 m, the substrate becomes finer and is completely colonised by the bivalve *Adamussium colbecki*, the shells of which are colonised by a micro-community comprising mainly forams, bryozoans (*Aimulosia antarctica, Arachnopusia decipiens, Ellisina antarctica*, *Micropora brevissima*) and the spirorbid *Paralaeospira levinsenii* (Albertelli *et al.*, 1998; Ansell *et al.*, 1998; Chiantore *et al.*, 1998; 2000; 2001; 2002; Vacchi *et al.*, 2000a; Cerrano *et al.*, 2001a; 2001b). In this region, large predators such as the gastropod *Neobuccinum eatoni* and the nemertean *Parborlasia corrugatus* are frequent. The echinoid *Sterechinus neumayeri* and the starfish *Odontaster validus* are still very frequent at all depths on both hard and mobile substrates (Chiantore *et al.*, 2002; Cerrano *et al.*, 2000b).

Below 70–75 m down to 120–130 m depth, heterogeneous substrates allow hard- and soft-bottom communities to coexist. On the sparse rocky outcrops the encrusting algae disappear and the benthic communities are dominated by the sessile zoobenthos. This diversified filter feeding assemblage is mainly characterised by sponges and anthozoans, while in soft sediments detritus-feeder polychaetes and bivalves dominate. Among sponges, which can reach very high biomass values, A*xociella nidificata*, *Calyx arcuarius*, *Gellius rudis*, *Phorbas glaberrima*, *Tedania charcoti*, are very abundant (Sarà *et al.*, 1992; 2002; Gaino *et al.*, 1992; Cattaneo-Vietti *et al.*, 1996; 2000c; Bavestrello *et al.*, 2000; Cerrano *et al.*, 2000a). Numerous invertebrates constitute an important component of this assemblage which develops down to 120-140 m depth. These include the epibiont polychaete *Barrukia cristata* on Thouarellid gorgonians, crustacean peracarids, pycnogonids, mollusc opisthobranchs (*Austrodoris kerguelenensis, Tritoniella belli*) (Cattaneo-Vietti, 1991; Gavagnin *et al.*, 1995) and bivalves, ophiuroids and holothuroids, bryozoans, and the endobionts. The conspicuous sponge spicule mats found at these depths underline the important role of sponges in this area, besides the one played by diatoms, in determining the sediment texture and silica content. A peculiar community, dominated by polychaetes and by the bivalve *Limatula hodgsoni*, can be associated with these mats.

Below 130 m the hard substrates become very sparse and are mainly colonised by the polychaete *Serpula narconensis* (Schiaparelli *et al.*, 2000) and several bryozoans (*Arachnopusia decipiens, Ellisina antarctica*, *Flustra angusta*, *F. vulgaris* and *Isoschizoporella similis*). The dominant muddy bottoms are instead characterised by tubicolous polychaetes (Gambi *et al.*, 2000b), mainly *Spiophanes*. Much deeper, at about 150-200 m depth, brachiopods and various species of bivalves characterise the environment on small gravels as well as on the soft bottom (Cattaneo-Vietti *et al.*, 2000b). The great heterogeneity of these substrates contributes to the creation of communities with considerable species richness, diversity and biomass.

Finally, the faunal assemblage of the Area includes notothenioid fishes, represented especially by species of the *Trematomus* group, including *T. bernacchi*, *T. pennelli*, *T. hansoni* and *T. loennbergii*. These exert an important role in benthic food webs as consumers of many invertebrate species, mainly crustaceans and polychaetes (Vacchi *et al.*, 1991; 1992; 1994a; 1994b; 1995; 1997; 2000b; La Mesa *et al.*, 1996; 1997; 2000; Guglielmo *et al.*, 1998).

The platelet ice occurring at Terra Nova Bay in early spring has been shown to house an important nursery for the Antarctic silverfish, *Pleuragramma antarcticum,* a key organism in the ecology of Antarctic food webs (La Mesa et al., 2004; Vacchi et al., 2004). The platelet ice environment has strong prooxidant characteristics at the beginning of austral spring, and the marked responsiveness of antioxidant defences represents a fundamental strategy for *P. antarcticum* (Regoli et al., 2005b). The elevated prooxidant challenge, to which these organisms are naturally adapted, also influences the susceptibility of *P. antarcticum* toward prooxidant chemicals of anthropogenic origin (Regoli et al., 2005b).

Oxyradical metabolism and antioxidant defenses have a fundamental role in several marine invertebrates, fish and penguins from Terra Nova Bay, representing important counteractive strategies toward, i.e. extreme environmental conditions, marked seasonal fluctuations of biotic and abiotic factors, symbiotic relationships, specific physiological features, long-term protection of biological macromolecules and aging (Regoli et al., 1997a,b; 2000a,b, 2002, 2004; Corsolini et al., 2001; Cerrano et al., 2004).

Susceptibility to oxidative stress is of particular value also for monitoring the impact of human activities and cellular responses to pollutants were characterized in key Antarctic organisms developing a wide array of biomarkers sensitive to biological disturbance (Focardi et al., 1995; Regoli et al., 1998; Jimenez et al., 1999; Regoli et al., 2005a; Benedetti et al., 2005, 2007; Canapa et al., 2007; Di Bello et al., 2007). At the moment, there is no evidence of polluted areas in Terra Nova Bay, but organisms are exposed to a naturally elevated bioavailability of cadmium causing tissue concentrations generally 10-50 folds higher than those typical of temperate species (Mauri et al., 1990; Nigro et al., 1992, 1997; Canapa et al., 2007). Despite elevated levels of this element do not cause direct adverse effects to the organisms, nonetheless the environmental characteristics of Terra Nova Bay influence the responsiveness of organisms to other chemicals with important implications for monitoring the impact of anthropogenic pressure or accidental spills (Regoli et al., 2005a); in particular, elevated level of cadmium at Terra Nova Bay modulates bioaccumulation and metabolism of polycyclic aromatic hydrocarbons and of organochlorine xenobiotics in local marine organisms suggesting also endocrine effects from the chronic exposure to this element (Regoli et al., 2005a; Benedetti et al., 2007; Canapa et al., 2007).

Human impacts within the Area are believed to be minimal and confined to those arising from the nearby Terra Nova Bay Station and scientific work conducted within the Area. The station can accommodate approximately 80 people, has facilities for helicopter operations and a jetty for the docking of small boats. Fuel used at the station is a light petroleum diesel, stored in three double-walled steel tanks with a total capacity of 1.8 million litres. Fuel is transferred to the station annually from resupply ship either via hoses routed across sea ice or via barge when sea ice is not present. Station waste water, purified by a biological plant, is discharged into the sea adjacent to the station on the eastern side of the peninsula on which the station is located, 2.3 km from the northern boundary of the Area. Combustible rubbish generated at the Station is incinerated and the smoke washed and filtered with water. This water is discharged into the waste water treatment plant at time intervals which intovary with incinerator usage. An atmospheric monitoring facility (locally referred to as ‘Campo Icaro’) is situated approximately 650 m north of the northern boundary of the Area and 150 m from the shore: no wastes are discharged from this facility. A support ship regularly visits Mario Zucchelli Station during the summer, and there are occasional visits by tourist ships. These usually stop offshore several kilometres to the north of the Area.

6(ii) Restricted zones within the Area

None.

6(iii) Structures within and near the Area

There are no structures within the Area. The nearest structure is the atmospheric monitoring facility (locally referred to as ‘Campo Icaro’) 650 m north of the northern boundary of the Area, while Mario Zucchelli Station (74°41'42"S, 164°07'23"E) is situated on a small peninsula on the coast adjacent to Tethys Bay, a further 1.65 km to the north.

6(iv) Location of other protected areas within close proximity of the Area

ASPA No. 118, summit of Mount Melbourne, is a terrestrial site situated 45 km to the NE, which is the only other protected area within close proximity.

7. Permit conditions

Entry into the Area is prohibited except in accordance with a Permit issued by the appropriate national authority. Conditions for issuing a Permit are that:

- it is issued for scientific study of the marine environment in the Area, or for other scientific purposes which cannot be served elsewhere; and/or
- it is issued for essential management purposes consistent with plan objectives such as inspection, maintenance or review;
- the actions permitted will not jeopardise the values of the Area;
- any management activities are in support of the objectives of the Management Plan;
- the actions permitted are in accordance with the Management Plan;
- The Permit, or an authorised copy, shall be carried by the holderwithin the Area;
- a visit report shall be supplied to the authority named in the Permit;
- permits shall be issued for a stated period.

7(i) Access to and movement within the Area

Access into the Area shall be by sea, land, over sea ice or by air. There are no specific restrictions on routes of access to and movement within the Area, although movements should be kept to the minimum necessary consistent with the objectives of any permitted activities and every reasonable effort should be made to minimise disturbance. Anchoring is prohibited within the Area. There are no overflight restrictions within the Area and aircraft may land by Permit when sea ice conditions allow. Ship or small boat crew, or other people on small boats or ships, are prohibited from moving beyond the immediate vicinity of their vessel unless specifically authorized by Permit.

7(ii) Activities that are or may be conducted within the Area, including restrictions on time or place

- Scientific research or essential operational activities that will not jeopardise the values of the Area;
- Essential management activities, including monitoring;
- Activities that involve trawling, dragging, grabbing, dredging, or deployment of nets within the Area should be undertaken with great care because of the sensitivity of the rich bottom communities to disturbance: before Permits are granted for such activities careful consideration should be given to the impact of such activities on the ecosystem under special protection versus the expected scientific or management benefits, with consideration given to alternative, more selective and less-invasive, sampling methods;
- The appropriate authority should be notified of any activities/measures undertaken that were not included in the authorized Permit.

7(iii) Installation, modification or removal of structures

Structures or scientific equipment shall not be installed within the Area except as specified in a Permit. All markers, structures or scientific equipment installed in the Area shall be clearly identified by country, name of the principal investigator and year of installation. All such items should be made of materials that pose minimal risk of contamination of the Area. Removal of specific equipment for which the Permit has expired shall be a condition of the Permit. Permanent installations are prohibited.

7(iv) Location of field camps

None within the Area. An occasional field camp has been positioned on the beach at Adélie Cove.

7(v) Restrictions on materials and organisms which can be brought into the Area

No living animals, plant material, pathogens or microorganisms shall be deliberately introduced into the Area. Poultry products, including food products containing uncooked dried eggs, shall not be released into the Area. No herbicides or pesticides shall be introduced into the Area. Any other chemicals, including radio-nuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the Permit, shall be used in the minimum quantities necessary to achieve the purpose of the activity for which the Permit was granted. Such chemicals shall be used with due regard for the values of the Area. All materials shall be stored and handled so that risk of their accidental introduction into the environment is minimized. Where practical, materials introduced shall remain for a stated period only and shall be removed at or before the conclusion of that stated period. If release occurs which is likely to compromise the values of the Area, removal is encouraged only where the impact of removal is not likely to be greater than that of leaving the material *in situ*. The appropriate authority should be notified of any materials released that were not included in the authorized Permit.

7(vi) Taking or harmful interference with native flora or fauna

Taking or harmful interference with native flora or fauna is prohibited, except by Permit issued in accordance with Annex II to the Protocol on Environmental Protection to the Antarctic Treaty. Where taking or harmful interference with animals is involved, the *SCAR Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica* should be used as a minimum standard.

7(vii) Collection and removal of anything not brought into the Area by the Permit holder

Material may be collected or removed from the Area only in accordance with a Permit and should be limited to the minimum necessary to meet scientific or management needs. Permits shall not be granted if there is a reasonable concern that the sampling proposed would take, remove or damage such quantities of substrate, native flora or fauna that their distribution or abundance within the Area would be significantly affected. All samples collected shall be described in terms of their type, quantity and the location from which they were taken. This information shall held in an archive accessible at MZS in order to maintain a record of usage that will assist assessment of the impacts of sampling activities and in the planning of future sampling. Material of human origin likely to compromise the values of the Area, which was not brought into the Area by the Permit Holder or otherwise authorized, may be removed unless the impact of removal is likely to be greater than leaving the material *in situ*: if this is the case the appropriate authority should be notified.

7(viii) Disposal of waste

All wastes, including all human wastes, shall be removed from the Area.

7(ix) Measures that are necessary to ensure that the aims and objectives of the Management Plan can continue to be met

1. Permits may be granted to enter the Area to carry out biological monitoring and site inspection activities, which may involve the collection of limited samples for analysis or review, or for protective measures.
2. Any specific sites of long-term monitoring that are vulnerable to inadvertent disturbance should be appropriately marked on site where practical and, as appropriate, on maps of the Area.
3. To help maintain the ecological and scientific values of the marine communities found within the Area, visitors shall take special precautions against marine pollution. Of concern are the release or spillage of hydrocarbons from ships, and biological introductions. To minimize the risk of such pollution, visitors shall ensure that sampling equipment or markers brought into the Area are clean. Vessels that are found to show fuel leakage, or a significant risk of such leakage, are prohibited from entering the Area. If a fuel leak from a vessel is discovered while within the Area, the vessel shall leave the Area unless the leak can be promptly stopped. Handling of fuels and oil within the Area shall be the minimum necessary consistent with meeting the objectives of the permitted activities.

7(x) Requirements for reports

Antarctic Treaty Parties should ensure that the principal holder for each Permit issued submits to the appropriate authority a report describing the activities undertaken. Such reports should include, as appropriate, the information identified in the Visit Report form suggested by SCAR. Parties should maintain a record of such activities and, in the Annual Exchange of Information, should provide summary descriptions of activities conducted by persons subject to their jurisdiction, which should be in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be used both in any review of the management plan and in organizing the scientific use of the Area.

8. References

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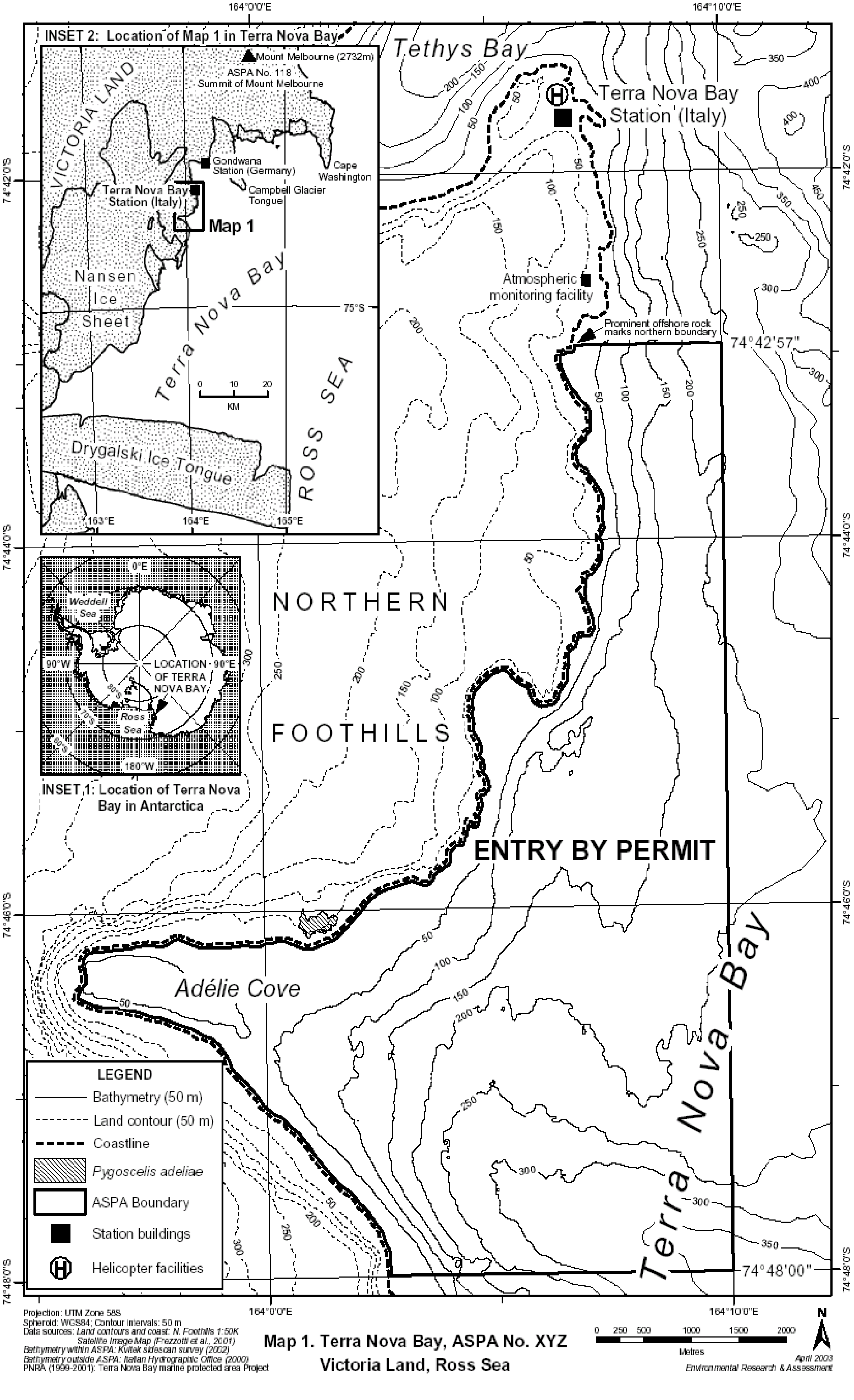

Map 1 Terra Nova Bay ASPA N° 161, Victoria Land, Ross Sea.

Appendix 1

Recent bibliography and other publications of interest for the research activities in the Terra Nova Bay.

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Appendix 2

During 2010-2012 Italian Antarctic Campaigns, few permits for activities and sampling into the Terra Nova Bay ASPA 161 have been issued:

Antarctic Campaign 2010-11

Activity site	Terra Nova Bay ASPA N° 161
N° of authorized entries	5
Lenght of each entry	4 h
Involved living organisms	teleostei fish, n° 150 Generic zooplancton, 120 samples adamussium colbacki n° 100

Antarctic Campaign 2011-12

Activity site	Terra Nova Bay ASPA N° 161

N° of authorized entries	8
Lenght of each entry	4 h
Involved living organisms	generic zooplancton 150 samples Invertebrate 200 samples Sponges 10 samples Adamussium colbacki n° 30

Sampling and studies activities into the ASPA area have been carried out in 13 different times for a total of 52 hours of work.

Besides, the following fish species and quantities, caught by barracude nets according to CCAMLR rules, have been collected inside the Terra Nova Bay marine ASPA N° 16 during 2011-2012 Italian Antarctic Campaign:

N°	**Species**	**Total weight [kg]**
29	Ch. hamatus	13.850
13	T. bernacchii	1.800
1	T. hansoni	0.150
2	Cr. antarcticus	0.300