

# PLANT COMMUNITIES FROM ICE-FREE AREAS OF KELLER PENINSULA, KING GEORGE ISLAND, ANTARCTICA

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## ABSTRACT

This paper presents a study of plant communities developed in the Keller Peninsula, King George Island, Antarctica, during the austral summer of 2002/2003. Based on a systematic evaluation, on GPS referencing and on aerial photographic surveys of each plant community, we drew up a map with their distribution, followed by descriptions based mainly on their biodiversity, physiognomy and relationship to bird communities and ground configurations. In the studied area it was possible to differentiate 35 vegetal communities, which had been described being based mainly on the form of growth of the plants of the species most representative.

**Key-words:** Antarctic, bryophytes, lichens, ornithophilic, ornithophobic.

## RESUMO

**COMUNIDADES DE PLANTAS EM ÁREAS LIVRES DE GELO DA PENÍNSULA KELLER, ILHA REI GEORGE, ANTÁRTICA.** Este trabalho apresenta os resultados do estudo das comunidades vegetais da Península Keller, Ilha Rei George, Shetland do Sul, Antártica, realizado durante o verão austral 2002/2003. Cada comunidade foi estudada baseando-se principalmente na biodiversidade e na fisionomia das populações e suas relações com as comunidades de aves. Para delimitar as comunidades foram utilizados dados de GPS. Na área estudada foi possível diferenciar 35 comunidades vegetais, que foram descritas baseando-se principalmente na forma de crescimento das plantas e pelas espécies mais representativas.

**Palavras-chave:** Briófitas, líquens, ornitocóprfila, ornitocóprfoba, Antártica.

## INTRODUCTION

Despite Antarctica had been discovered in 1599, according to Putzke & Pereira (2001) the first systematic botanical studies made during a scientific expedition were conducted by J. Torrey in 1823. He is considered the first botanist who collected and described an Antarctic species – the lichen *Usnea fasciata* Torrey (*U. aurantiaco-atra* (Jacq.) Bory). J. Eights was the first botanist who collected lichens, bryophytes, algae and the only grass that occurs in the continent, during an expedition conducted between 1829 and 1830.

In Antarctica, the *Magnoliophyta* are represented only by *Deschampsia antarctica* Desv. (*Poaceae*) and *Colobanthus quitensis* (Kunth) Bartl. (*Caryophyllaceae*). The bryoflora is divided in two taxonomic groups: *Marchantiophyta* (hepatics), with 22 species and *Bryophyta* (mosses), with approximately 60 species (Putzke & Pereira 2001). Many other species have

been cited for the region, but most are identification mistakes (Ochyra 1998, Putzke & Pereira 2001). Such names turn the floristic work harder, especially for the genus *Bryum*, where the quantity of invalid names or synonymies is quite big. Nevertheless, Ochyra & Ochi (1986) and Kanda (1986) studies refined the taxonomy of this group.

Most hepatics of the region are easily identified using Ochyra & Vãna (1989) and Bednarek-Ochyra *et al.* (2000) that have keys, illustrations and descriptions for the species that occur in Antarctica.

There are more mosses than hepatics and mosses have also more biomass in the continent, participating in extensive formations and associations. Therefore they are best known and studied. The first attempt to review what had been published about the bryoflora was made by Steere (1961), who made a draft revision of the Antarctic bryophytes. Greene (1968a, 1968b) presented a list of known mosses to that date, but it

was Robinson (1972), who developed one of the first studies on Antarctic mosses with identification keys.

In the 70's and 80's the Antarctic mosses were more intensively studied and new results were published: Ando (1973, 1976), Bell (1973a, 1973b, 1973c, 1974, 1976, 1977a, 1977b), Clark (1973a, 1973b), Greene (1973, 1975), Greene *et al.* (1970), Matteri (1977a, 1977b), Newton (1974a, 1974b, 1974c; 1977a, 1977b; 1979a, 1979b), Ochi (1976, 1979).

In the 80's, many studies on Antarctic mosses had been conducted. From those, we would like to point out: Kanda (1987), Ochyra (1985), Ochyra & Ochi (1986), Ochi (1982), who described moss species of small areas in the Maritime Antarctic. For the King George Island, Putzke & Pereira (1990) identify 39 species, with keys, descriptions, illustrations and ecological roles. But it was only by the end of the 90's that the first comprehensive study on mosses of a large region of Antarctica was published by Ochyra (1998), who presented a monograph on mosses of the King George Island, identifying 58 species for that region.

In regards to other cryptogams, only one genus of land macroscopic algae is known for Antarctica, with only two species: *Prasiola crispa* (Lightfoot) Menegh., which is ornithocoprophillic and *P. cladophylla* (Carmich.) Menegh., which is ornithocoprophobous. The macroscopic fungi, according to Putzke & Pereira (1990), are represented by 10 species. For the lichenized fungi, according to Øvstedal & Lewis-Smith (2001), there are 360 known species.

The distribution of plant communities and the life forms of mosses in Antarctica, according to Pereira & Putzke (1994), depend mainly on light incidence. In the summer there are 20 hours of light per day and in the winter there is only 2 hours of light per day. According to Allison & Lewis-Smith (1973), the temperature, winds, rainfall, shore breeze and bird colonies provide conditions that, once associated to local factors such as ground stability, type of rock and wind erosion, are critical for their occurrence, establishing clear definitions in the limits of survival, forcing some species to be highly specialized in their niches, sometimes so restrict that they can work as good indicators of environmental change.

According to Redon (1985), plant formations have a large number of species with their dispersal center found in the Antarctic Peninsula, in the South Shetlands, South Georgia and occasionally in the

Falklands islands and Tierra del Fuego. For Lewis-Smith & Gimingham (1976), apart from mixed formations, those centers are characterized by presenting three kinds of bryophyte formations: 1) Tufts of mosses, where large tufts are rarely found and species of the genus *Polytrichum* Hedw. are dominant; 2) Carpets of mosses, mainly composed by *Sanionia uncinata* (Hedw.) Loeske, *Warnstorfia sarmentosa* (Wahlenb.) Hedenäs and *W. laculosa* (Müll. Hal.) Ochyra & Matteri; that are found. Aquatic mosses, with *Bryum pseudotriquetrum* (Hedw.) Schwaegr. and *W. sarmentosa*, that are found in lakes that are rich in guano.

The plant formations study in the King George Island is necessary, *a priori*, to know the composition of the vegetation (Putzke & Pereira 1990). For the region this is possible to achieve, using the studies of Ochyra & Vāna (1989) and Bednarek-Ochyra *et al.* (2000) for hepatics, and Redon (1985) and Dodge (1973) for lichens, taking into account that only two species of flowering plants exist in the region. Thus, it is possible to study the vegetation, looking for how they are related, based on phytosociological surveys.

The first attempt to describe the structure of the plant communities in Antarctica was done by Skottsberg (1912), who identified and classified some communities of lichens and mosses, using mainly the physiognomy of the formation. Only three decades later the characterizations received an analytical and quantitative approach (Allison & Lewis-Smith 1973).

In this work we created a map showing the distribution of the plant communities followed by their descriptions, making it possible to follow their evolution, as well as to assess any eventual environmental impact of natural or anthropogenic causes in the future.

## MATERIAL AND METHODS

Our study of the plant communities started by a phytosociological survey, using the quadrat method of Braun-Blanquet (1964), arranged according to antarctic conditions. The choice of places to apply this method was based on the vegetation covering the ground and its biodiversity, which was previously evaluated by observing its physiognomy and location. In those areas a number of parallel lines were traced 10 m apart from each other. The number of lines in

each area depended on the size of plant formation present. These lines were marked with a GPS, also taking into account the aspects of the ground.

The description and classification of the plant communities were based on Pereira & Putzke (1994), Lewis-Smith & Gimingham (1976) and Redon (1985).

The identification of bryophytes was done based on Putzke & Pereira (2001) and Ochyra (1998) and the lichens on Øvstedal & Lewis-Smith (2001) and Redon (1985).

## RESULTS AND DISCUSSION

In the ice-free zones adjoining the Admiralty Bay, especially in the Keller Peninsula, the distribution of plant communities shows a pattern that is closely related to the aspects of the ground (geologic configuration) and the presence of bird colonies.

Among the plant communities that occur in the Keller Peninsula, we distinguished the following areas with their respective communities:

1. In the extreme North of the peninsula, facing Mackellar cove there is a small rocky elevation in the beach (Figure 1.1), where there is a *Larus dominicanus* nest, in which a small plant community exists occupying an area of 30.5 m in diameter. In this community the mosses are represented mainly by populations of *Bryum amblyodon* C.Muell., *Bryum pseudotriquetrum* (Hedw.) Gaertn., *Hennediella antarctica* (Angfr.) Ochyra & Matteri and *Schistidium falcatum* Ochyra. Associated to those mosses there are also *Deschampsia antarctica* Desv. and *Colobanthus quitensis* (Kunth) Bartl. Lichens are represented by only a few small populations of *Caloplaca* spp., *Physcia caesia* (Hoffm.) Fűrnr. and *Xanthoria elegans* (Link) Th. Fr.

2. Towards the South, in a small rocky elevation (Figure 1.2), next to a *Larus* nest, it is growing a miscellaneous community formed mainly by *Deschampsia antarctica* and *Colobanthus quitensis*, associated with mosses such as *Bartramia patens* Brid., *Bryum pseudotriquetrum* (Hedw.) Gaertn., *Encalypta rhaptocarpa* Schwaegr., *Polytrichum juniperinum* Hedw., *Sanionia uncinata* (Hedw.) Loeske and *Syntrichia princeps* (De Not.) Mitt. The lichens are ornithocrophilic, being *Physcia caesia* (Hoffm.) Fűrnr. and *Rhizoplaca aspidophora* (Vainio) Redón the most representative species, along with *Caloplaca* spp. and other crusty lichens.

3. In the coastal plains, next to Mackellar cove (Figure 1.4) there is one of the largest colonies of *Sterna vitata* found in the Keller Peninsula, where there is a community of crusty and leafy lichens formed mainly by *Rhizocarpom geographicum* (L.) DC, but in association to *Rhizoplaca aspidophora* (Vain.) Redón. The remaining parts of that area are covered with a discontinuous formation of carpet mosses composed mainly by *Sanionia uncinata* (Hedw.) Loeske. Part of this moss population is associated to a large colony of cyanobacteria. (Figure 1.3).

4. Close to the beach (Figure 1.5) there is a rocky elevation with a colony of *Larus dominicanus*. The vegetation is composed mainly by ornithocrophilic species, where the largest biomass is represented by populations of *Deschampsia antarctica*, *Colobanthus quitensis*, *Bryum pseudotriquetrum* (Hedw.) Gaertn., *Ceratodon antarcticus* Card., *Sanionia uncinata* (Hedw.) Loeske and *Syntrichia princeps* (De Not.) Mitt. Among the lichens, the most representative species are *Physcia caesia*, *Caloplaca* spp., *Rhizoplaca aspidophora*, *Mastodia tessellata* and *Rhizocarpon* sp.

5. A rocky elevation in the sea, to the West coast of the peninsula (Figure 1.6), there is a *Larus dominicanus* nest. Because it is also a feeding site, the place is well visited by other animals, what contributes to increase the quantity of guano. This fact makes the plant community to be composed by ornithocrophilic species of crusty lichens, mainly *Caloplaca* spp. and *Verrucaria* sp., and by *Prasiola crispa* (Chlorophyta) algae as well as lichenized form, *Mastodia tessellata*.

6. In a rocky elevation in the sea that extends towards the continent (Figure 1.7), there are *Larus dominicanus* nests and the vegetation is typically of bird colonies, where vegetation is dominated by ornithocrophilic species such as *Deschampsia antarctica*, *Colobanthus quitensis*, *Andreaea regularis* C.Muell., *Bartramia patens* Brid., *Encalypta rhaptocarpa* Schwaegr., *Pohlia cruda* (Hedw.) Lindb., *Pohlia drummondii* (C.Muell.) A.L.Andrews., *Polytrichum alpinum* Hedw. and *Sanionia uncinata* (Hedw.) Loeske. The lichens are represented mainly by *Usnea antarctica*, *U. aurantiaco-atra*, *Sphaerophorus globosus*, *Rhizocarpon geographicum*, *Tephromela atra* (Huds.) Hafellner ex Kalb, among others.

7. In a small elevation close to the beach (Figure 1.8), there are two Skuas' nests. The floristic composition is very similar to that above mentioned,

being represented mainly by *Deschampsia antarctica*, *Colobanthus quitensis*, *Polytrichum alpinum* Hedw. and *Sanionia uncinata* (Hedw.) Loeske. The lichens are represented by *Sphaerophorus globosus*, *U. antarctica*, *U. aurantiaco-atra*, *Rhizocarpon geographicum* and *Ochrolechia frigida*, among others.

8. In an elevation with approximately 20 m in diameter (Figure 1.8), many Skua nests occur. This area has dense plant coverage represented by a community of miscellaneous plants in which *Deschampsia antarctica*, *Colobanthus quitensis*, *Polytrichum alpinum* Hedw. and *Sanionia uncinata* (Hedw.) Loeske, presented highest biomass. The most representative lichens are *Usnea antarctica*, *U. aurantiaco-atra*, *Leptogium puberulum*.

9. In a slope covered by rock fragments that are under the influence of the ice movement, causing small landslides water run off, there is typical vegetation growing with some dispersed and discontinuous populations represented mainly by *Placopsis contortuplicata*, *Leptogium puberulum*, *Rhizocarpon geographicum*, *Lecania brialmontii*. Mosses are represented by small tufts of the genus *Schistidium*.

10. To the north of the Keller Peninsula facing Mackellar cove, there is a group of elevations far from the beach (Figure 1.11). Most of that area has Skua nests, making the plant cover and the floristic composition very similar, due to the influence of those birds. In those communities the most representative species are *Deschampsia antarctica*, *Colobanthus quitensis*, *Andreaea gainii* Card., *Bartramia patens* Brid, *Bryum orbiculatifolium* Card. Et Broth., *Pohlia cruda* (Hedw.) Lindb., *Polytrichum alpinum* (Hedw.) G.L.Smith, *Sanionia uncinata* (Hedw.) Loeske and *Syntrichia saxicola* (Card.) Zand. Among the lichens, the dominant species are *Usnea antarctica*, *U. aurantiaco-atra*, *Xanthoria elegans*, *Rhizocarpon geographicum*, several crusty lichens, and others. Among the elevations there are slopes covered by fragmented rocks, with basically no vegetation. In some points there are small snow fields.

11. This area is formed by a group of smooth elevations and most of them are made of fragmented rocks and rocky outcrops (Figure 1.12). In almost all of the elevations there are Skuas' nests and the vegetation shows typical features of those surrounding bird colonies, given that the ornithocoprophilic species are more abundant.

The edges of those elevations are covered by a formation of fruticulous lichens, predominating *Usnea aurantiaco-atra*, *U. antarctica*, *Leptogium cf. menziesii* and some crusty lichens such as *Placopsis contortuplicata*, *Ochrolechia parella*, *Rhizocarpon geographicum* and *Rhizocarpon* sp. Bryophytes are represented mainly by species of the genus *Andreaea*. In the drainage lines, especially in the edges of the elevations, *Sanionia uncinata* is growing associated to *Bryum* spp, where in between the rocks populations of *Pohlia* sp can be found. On the upper parts of the elevations where the Skuas' nests are, dense formations were found, composed mainly by *Deschampsia antarctica*, *Colobanthus quitensis*, *Sanionia uncinata* and *Polytrichum* spp., among others.

12. This is the largest area of the Keller Peninsula (Figure 1.13), and due to being farther from the beach and higher altitude, there is not so much influence of bird colonies, having only small colonies of *Sterna vittata* and no vegetation is found. Its altitude range from 100 to 250 m. In those slopes an exuberant formation of fruticulous lichens is dominant, where *Usnea antarctica* and *U. aurantiaco-atra* have larger biomass. Among the elevations there are small snow fields and slopes formed mainly by fragmented rock, where the vegetation is poor, and represented by small populations of mosses and crusty lichens.

In some points there are formations rich in species as; a small area localized at 62° 04'09,7"S and 58° 24'44,7"W at an altitude of 125 m. Surrounding a Skua's nest there is a plant community with approximately 5 m in diameter, very typical of places with birds' nests. The most representative species of this community are *Deschampsia antarctica*, *Colobanthus quitensis* and *Sanionia uncinata*. In another point there is a small field of carpet mosses composed mainly of *Polytrichum* spp., next to a *Sterna vittata* colony with approximately 20 adults, 62° 04'20,5"S and 58°24'37,7"W and approximately 125 m of altitude. At 62°04'21,4"S and 58°24'40,7"W there is a dense field of *Polytrichastrum alpinum* surrounded by *Sanionia uncinata* with approximately 8m in diameter that is also surrounded by a dense formation of *Usnea antarctica* and *U. aurantiaco-atra*. At 62°04'26,5"S 58°24'21,1"W and approximately 200m high, there is a large formation composed mainly of *Leptogium menziesii*. At 62°04'28,0"S 58°24'20,9"W and 190m high there is a Skua's (*Catharacta lonnbergi*

and *Catharacta maccormicki*) nest surrounded by a dense plant formation composed mainly of *Sanionia uncinata*, *Deschampsia antarctica*, *Colobanthus quitensis* and *Prasiola crispa*.

Towards the entrance of the Admiralty Bay, the vegetation is practically inexistent, where the rocky elevations start to decrease and the slopes with rocky fragments increase.

In the largest elevation of this area, found to the West, there is a dense formation of *Usnea antarctica*, *U. aurantiaco-atra* and *U. trachycarpa*. This last species was known to exist in Antarctica only in Punta Ullman.

Spreaded out over several points in this huge area, the most representative lichens, besides those already quoted above; are: *Placopsis contortuplicata*, *Sphaerophorus globosus*, *Ochrolechia frigida*, *O. parella*, *Rhizocarpon geminatum* and several crusty lichens.

13. This community is characterized by a discontinuous formation of carpet mosses (Figure 1.14), formed mainly by *Sanionia uncinata*, with few and small populations of *Polytrichastrum sp.* and rare turfs of *Deschampsia antarctica* and *Colobanthus quitensis*. In the areas of smooth slopes there are populations of *Rhizocarpon geographicum* and *Rhizoplaca aspidophora*.

14. This is an area in the beach with a smooth elevation formed by smooth gravel of maritime origin (Figure 1.15). In this place there are two Skua's (*Catharacta lonnbergi* and *Catharacta maccormicki*) nests and around those nests, a population of *Rhizocarpon geographicum* is developing, surrounded by fruticulous lichens composed mainly of *Usnea aurantiaco-atra*, *U. antarctica*, *Sphaerophorus globosus* and *Stereocaulon sp.* In some areas there are discontinuous carpet lichen formations growing, in which the species with larger biomass are *Sanionia uncinata* and *Polytrichum spp.* associated to low turfs of *Deschampsia antarctica*.

Towards the center of the Keller Peninsula there is a depression with a small discontinuous formation of carpet mosses composed mainly of *Sanionia uncinata* with a colony of cyanobacteria occurring on the edge.

15. This is an area where a discontinuous formation of carpet mosses occurs in the coastal plains near the beach (Figure 1.16). It is mainly formed of *Sanionia uncinata* and in some points there is also *Bryum pseudotriquetrum* (Hedw.) Schwaegr., *Polytrichum*

*alpinum* (Hedw.) G. L. Smith and *Racomitrium pachydityon* Card. In a small area next to the sea a small population of crusty lichens is growing. Among them we point out *Rhizocarpon geographicum* and *Rhizoplaca aspidophora*. In front of a small rocky formation in the sea there is a dense population of *Deschampsia antarctica*.

16. This area is important for its extended formation of *Leptogium puberulum* that in some points is associated to *Placopsis contortuplicata* and a few populations of mosses (Figure 1.17).

17. In the West side of the peninsula there are several isolated communities (Figures 1.18, 18.1 and 1.18.2) that practically have the same floristic composition. Among the lichens we point out *Usnea antarctica*, *U. aurantiaco-atra*, *Stereocaulon spp.*, *Cladonia spp.* with some populations of *Rhizocarpon geographicum*, *Haematomma erythroma*, *Ochrolechia parella*, *Caloplaca spp.*, *Physcia caesia* and *Rhizoplaca aspidophora*. Several species of mosses are also present, especially *Bartramia patens* Brid, *Bryum amblyodon* C. Muell., *Bryum urbanskyi* Broth., *Pohlia cruda* (Hedw.) Lindb., *Polytrichum alpinum* (Hedw.) G.L.Smith, *Polytrichum piliferum* Hedw. and *Sanionia uncinata* (Hedw.) Loeske. Marked At 62°05'06,3"S 58°25'0,0"W there is a flat area with approximately 30m in diameter where a discontinuous formation exists with carpet mosses of *Sanionia uncinata* (Hedw.) Loeske, *Polytrichum alpinum* (Hedw.) G.L.Smith, and a large population of *Placopsis contortuplicata*.

18. This is a small area formed by fine sediments (Figure 1.19) that are among hills, in which there is a discontinuous formation of carpet mosses, mainly of *Sanionia uncinata*.

19. Next to the South end of Keller Peninsula there is an area of smooth elevations close to the beach (Figure 1.20) that is formed by smooth gravel of maritime origin, in which there is a discontinuous vegetation formed basically by saxicolous or terricolous lichens such as *U. antarctica*, *U. aurantiaco-atra*, *Stereocaulon sp.* and some thin populations of mosses and crusty lichens such as *Placopsis contortuplicata* and *Caloplaca sp.* Among those elevations, there is practically no vegetation.

20. Area found between the Crox Hill and the glacier of the East face of the peninsula (Figure 1.21). In the upper lands there is a big colony of *Sterns* with more than 50 adults. Next to this colony and among

the elevations there is abundance of scaled and leafy lichens, from which we distinguish *Psoroma* spp. e *Leptogium menziesii*. The remaining area is formed by a group of slopes where the top is rich in miscellaneous formations.

21. In an isolated elevation near the glacier (Figure 1.22), where the top has a small community taking an area of approximately 50x8m, there are some populations of *U. antarctica* growing on small fragments of rocks, associated to vigorous populations of *Rhizocarpon geographicum* and *Caloplaca* spp. At the base of this elevation, next to the sea and in the slope formed by large blocks of rocks, there is a feeding place of *Larus dominicanus*, what provides conditions for the development of a rich community formed by ornithocoprophilic species, especially *Prasiola crispa*, *Mastodia tessellata* and several other species of *Caloplaca*. Among them there is also *Sanionia uncinata*.

22. In this area it is growing one of the largest continuous fields of mosses of the Keller Peninsula. This community is formed mainly by population of *Sanionia uncinata*, *Bryum orbiculatifolium*, *Calliergon sarmmentosum* and *Tortula princeps*, associated to *Colobanthus quitensis* and *Deschampsia antarctica*. In this place there is a whale skeleton assembled by Jacques Yves Costeau's crew.

23. This area packs quite a few elevations behind the Commander Ferraz Station (Figure 1.24). The substrate is formed mainly by rocky fragments where *U. antarctica* and *U. aurantiaco-atra* exist associated mainly to *Sanionia uncinata* and *Polytrichastrum alpinum*. Among these smooth elevations there is practically no vegetation.

24. This area is right behind Commander Ferraz Station (Figure 1.25). The vegetation is thin and discontinuous, with small populations of mosses, mainly *Sanionia uncinata* and *Polytrichastrum alpinum*, and only in two points there are dense formations of carpet mosses, marked right at 62°05'07,2"S and 58°23'35,5"W, and 62°05'06,2"S and 58° 23'40,6"W. In some places there are crusty lichens like *Rizhocarpon geographicum*.

25. This plain area with smooth elevations is found right together and above the first rocky elevations in front of Punta La Plaza (Figure 1.26). It is an area that is practically without vegetation, mainly due to the fact that is formed by small fragments of rocks that

are, apparently quite unstable due to the ice and water moving which takes along fine sediments, leaving only rock fragments. The small formations of mosses are discontinuous, with some vegetation in only two points: a small formation of *Sanionia uncinata* found at the coordinates 62°05'18 6''S and 58°24'01,1''W and a small formation of *Polytrichastrum alpinum* with 30x3m, found at 62°05'21,7''S and 58°24'23,2''W.

26. This area corresponds to the edge of the first chain of hills from Punta La Plaza towards the interior of the Keller Peninsula and right after the beach (Figure 1.27). In these places the vegetation is rich, with dense formations of miscellaneous type, formed mainly by *U. antarctica* and *U. aurantiaco-atra*, *Cladonia borealis*, *Sphaerophorus globosus* and *Stereocaulon alpinum*, associated to *Sanionia uncinata*, *Polytrichum* spp and *Polytrichastrum alpinum*.

27. In this place there is a small dam of basalt that outcrops along the sea (Figure 1.29), and it is a feeding place for *Larus dominicanus*, where a nest was found. That gives to this rock the conditions for the formation of ornithocoprophilic lichens that are characteristic of places where bird colonies are found, such as *Xanthoria elegans*, *Caloplaca* spp., *Physcia caesia* and *Haematomma erythroma*.

28. In this area there is a rocky outcrop taken by a colony of large Seagulls (Figure 1.30), that significantly influences the floristic composition of the plant community. The vegetation is basically composed of *Deschampsia antarctica* and *Colobanthus quitensis*, being one of the largest populations of this species in the Keller Peninsula. In this place there is also a significant formation of *Polytrichum juniperinum* Hedw. which is a rare species for the Keller Peninsula.

29. This is a discontinuous formation of carpet mosses found in the coastal plains (Figure 1.31). There is a fine sedimentation occurring due to water from melting ice, what created a large plain area that provides conditions for the development of continuous fields of *Deschampsia antarctica* and *Colobanthus quitensis* mosses.

30. Rocky outcrop with nests of *Larus dominicanus*, surrounded by a developing community of very characteristic ornithocoprophilic fruticulous and crusty lichens (Figure 1.32).

31. This is a very rough area along the Ipanema refugee (Figure 1.33). Among the outcrops and large

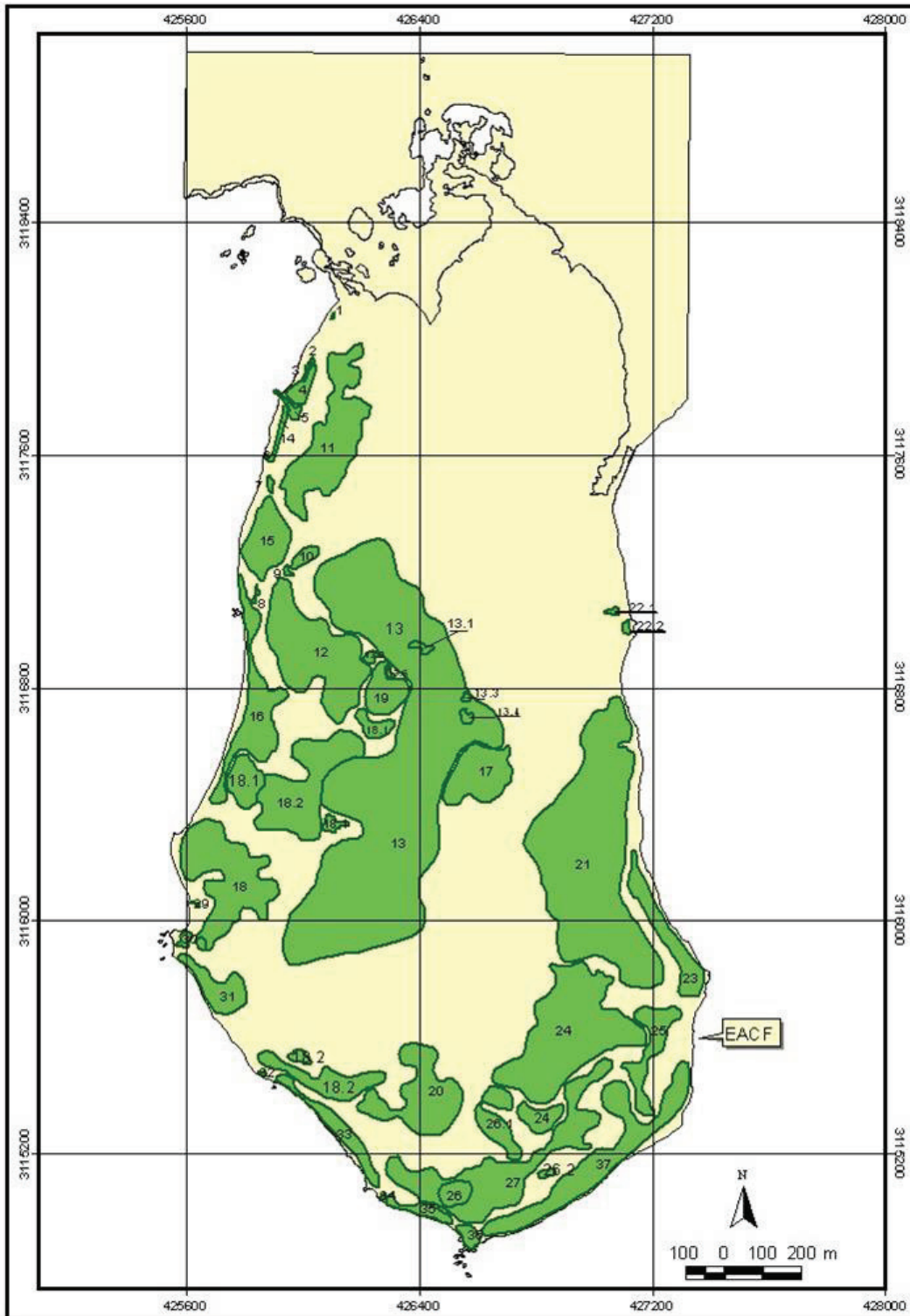


Figure 1. Map of plant communities from Keller Peninsula, Antarctica.

blocks of rocks there is a rich community of carpet mosses where *Sanionia uncinata* is predominant. On the outcrops there is *U. antarctica* and *U. aurantiacolata*, and towards Punta La Plaza, small and scarce populations of *Sanionia uncinata* occur.

32. Rocky outcrop along the sea found between Punta La Plaza and the Ipanema Refugee (Figure 1.34). In this place there are nests of *Larus dominicanus* that are also visited by adults as a feeding place. On the outcrop, crust lichens typically ornithocoprophilic are found, such as *Caloplaca* spp. and *Xanthoria elegans* among others. In the spaces between the rocks a rich community of the miscellaneous type occurs, where *Sanionia uncinata*, *Deschampsia antarctica* and *Colobanthus quitensis* are predominant.

33. This is a small area of the coastal plains next to Punta La Plaza, towards North (Figure 1.35), that suffers strong influence of birds, since it is visited by Seagulls, Antarctic Cormorant and Penguins changing feathers, giving a peculiar characteristic to this plant community, where ornithocoprophilic species predominate, such as *Caloplaca regalis*, *Mastodia tessellata*, *Lecania brialmontii* and *Xanthoria elegans*. There are also discontinuous formations of mosses represented mainly by *Sanionia uncinata*.

34. Punta La Plaza (Figure 1.36) is a group of rocky elevations localized in the extreme South of the Keller Peninsula. This place serves as a feeding place and the visits of Seagulls and Antarctic Cormorants are intense. We also found a nest in there. During February the place receives a generous number of Penguins that stay there during the changing of their feathers. The presence of the birds turns the plant community rich in ornithocoprophilic lichens. Between the rocky elevations there are rich formations of carpet mosses with predominance of *Sanionia uncinata*.

35. In the coastal area between the Commander Ferraz Station and Punta La Plaza (Figure 1.37), there is a community formed mainly by *Bryophytes*, which is characterized by the occurrence of moss species such as *Sanionia uncinata*, *Calliergon sarmentosum*, *Hypnum revolutum*, *Calliergidium austrostramineum*, *Bartramia patens*, *Bryum* spp, *Tortula saxicola*, *Deschampsia antarctica* and *Colobanthus quitensis*.

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