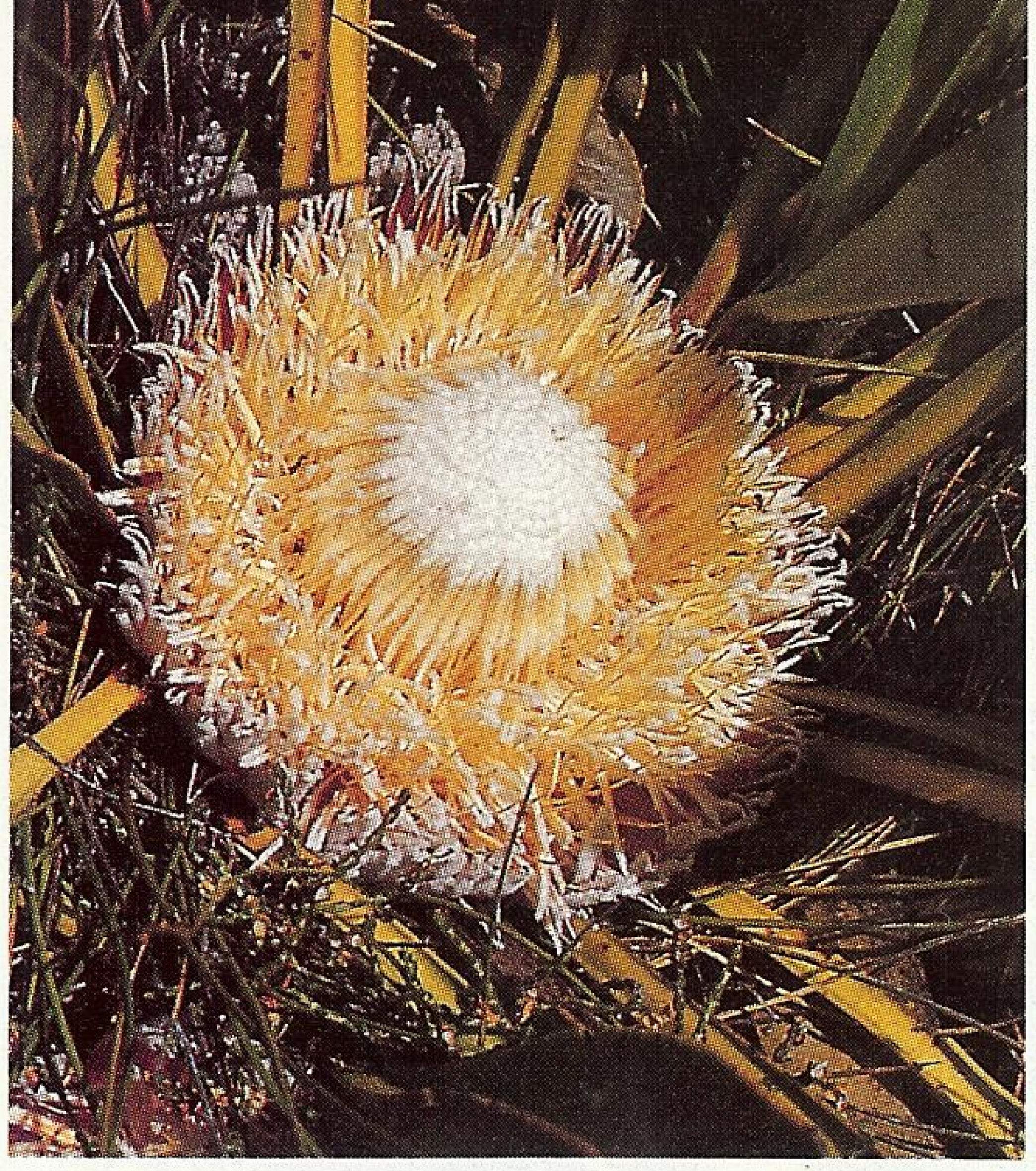
THE PLIGHT OF *PROTEA PRUINOSA*

Adaptations to survive the challenging conditions of its natural habitat might have led to the rarity of this alpine species.

by Jan Vlok, Cape Nature Conservation, De Rust



The fully open flowers of *Protea pruinosa* emit a yeasty scent to attract their pollinators: rodents. *Photo: J.Vlok.*

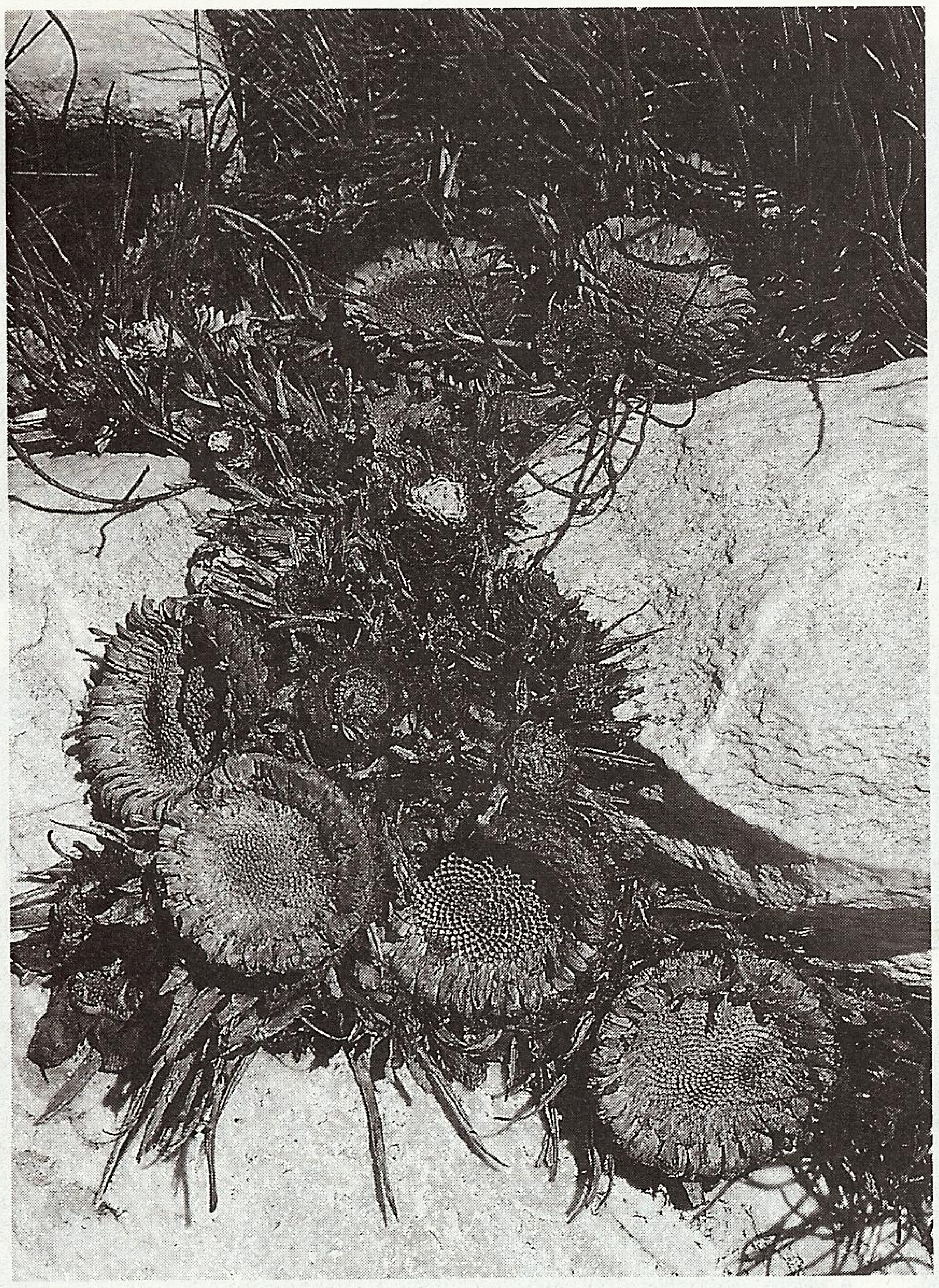
In its natural habitat, *Protea pruinosa* has a good view of the Little Karoo. Despite its compact growth form, a mature *Protea pruinosa* plant can produce up to seventeen flowers per year. *Photo: J.Vlok*

Not only does the lure of high mountain peaks give the reward of spectacular scenery, but also of fascinating plants to be found. On the highest mountain peaks of the fynbos world grows such a plant: *Protea pruinosa*. It only occurs on the Swartberg mountains, on the northern flanks of the Little Karoo. Five of its six known population occur on the Klein Swartberg, just north of Ladismith. Here they are limited to peaks and ridges which exceed 2 000 m in altitude. These high Cape mountains might recall romantic memories of snow-clad mountain tops, but to its permanent inhabitants, it is a tough environment.

The apt specific name, *pruinosa*, refers to the frosted appearance of the flowers. It does, however, also hint of the blizzard conditions that these plants frequently experience. Up there I have seen the topsoil remaining frozen from July to October, with the wind so strong during spring that it is impossible to stand upright. To plants, the harshness of this environment is worsened by the lack of soil nutrients. Plants growing under these extreme environmental conditions require special adaptations to survive. They cannot grow tall, as they will blow down or break under the weight of the snow and damage to these plants is a serious loss, as the long remaining cold conditions and lack of soil nutrients retard their growth. Species growing on these mountain crests are thus usually compact, cushion-shaped plants as is *Protea pruinosa.* Its slow growing, short stems remain flat on the ground.

The prostrate, compact growth of *P. pruinosa* might prevent wind and snow damage, but causes another problem. The flowers remain hidden between the leaves, where the usual *Protea* pollinators, birds and insects, cannot see them. So rodents, plentiful in the fynbos, are used to facilitate cross-pollination. To attract rodents, the flowers emit a pleasant, yeasty scent. The rodent-pollinated *Protea* species which grow together on the summit of the Swartberg have sequential flowering periods. One species, *Protea scolopendriifolia,* flowers during early summer (November-January), thereafter *P. pruinosa* flowers from late January to February and the flowering season is ended with *P. montana* (February to June). Hybridization between the species is thus prevented, while continued attraction to the rodents is ensured. *P. pruinosa* might well be dependent on the presence of other rodent-pollinated species, as its small populations might not have adequate flowers to ensure discovery by the rodents.

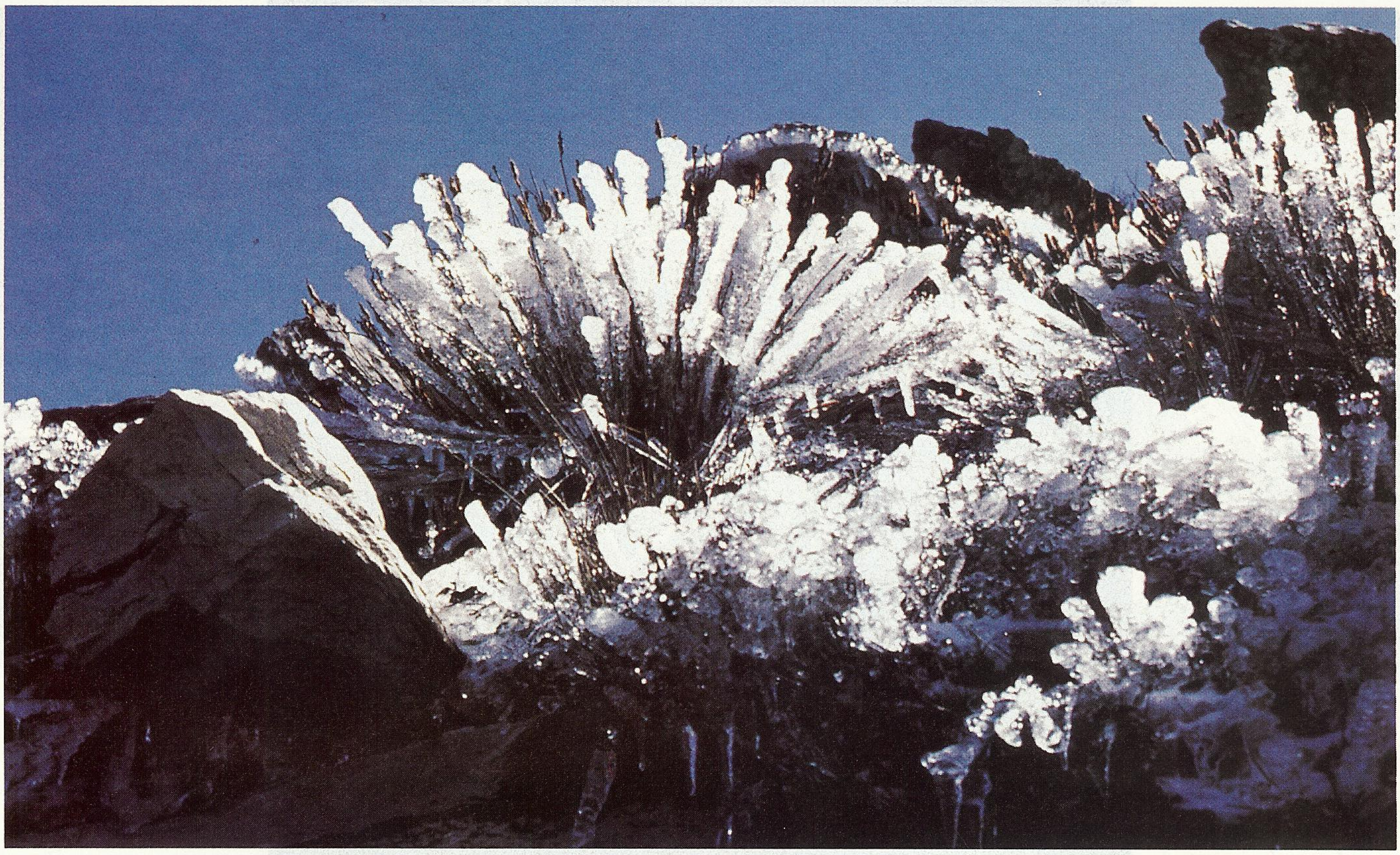
The mountain peaks where *P. pruinosa* grows are often struck by lightning. Fires tend to occur on an average of once a decade on these high peaks. These regular fires appear to be a problem as species like *P. pruinosa,* which can only re-establish after fire by means of seed, need more time to produce seed than what the fire frequency of the area allows. I investigated this problem in some of the *P. pruinosa* populations. Initially, we thought that *P. pruinosa* plants were able to re-sprout after being lightly scorched in a fire. However, of the investigated 239 burnt plants, only a single plant remained alive. The other scorched plants died, even though a few initially attempted to sprout after the fire. This species thus only regenerates after fire by means of seeds which are retained in the old flower heads. These old flower heads can last for five to eight years on the plants. The seed is released from the old flowers soon after the parent plant is killed, which usually happens only after a fire. Most seeds germinate during the first winter, but some only germinate in the second winter after a fire. *P. pruinosa* seed needs freezing temperatures to germinate and grow. (I attempted to grow this species and only had success after freezing the seed and packing ice blocks around seedlings during winter. My plants did, however, not last many years, as diurnal lowland temperatures did not seem to suit them.) On average they flower for the first time once a plant has reached a diameter of 30 cm, when they are approximately fifteen years old. Thereafter they seem to need another three years before they flower for the second time. At about eighteen to twenty years of age, they may flower every year.



The old flower bases of burned *Protea pruinosa* plants remain intact for many years after a fire. *Photo: J.Vlok.*

Unlike most other proteas, some plants in a *Protea pruinosa* population will survive each fire. The rockiness of its natural habitat prevents all the plants from burning down during a fire. Between 2 - 27% of the population survive a fire, depending on the intensity of the fire and the rockiness of the habitat. One would thus expect to find the biggest *P. pruinosa* populations in areas that are well protected from fires, but this is not the case. Best seedling establishment of this species only occurs after a high-intensity fire has removed the competing vegetation. Some seed-bearing plants must be killed in each fire to ensure seedling establishment in a cleanly burnt environment.

Presently, the *P. pruinosa* populations are coping reasonably well with the current fire regime. The number of seedlings that appeared after a fire was therefore about equal to the losses of plants in a fire. To ensure adequate seedlings after a fire, the average plant in a population must have about six old flowers before the population can burn again. Thus, as these plants need about fifteen years to produce the first flower and thereafter have, on average, 1.17 flowers per year, they need approximately twenty years to produce the six flowers needed to ensure adequate seedlings after a fire. A population must therefore be at least twenty years old, or the plants in a population have a mean minimum age of twenty years, before



This is what *Protea pruinosa* has to survive. The adjacent-growing restios were turned into lollipops during blizzard winter conditions.
Photo: T.Marshall.

they can produce replacement levels of seedlings after fire. It is thus impossible to prescribe a general fire frequency for *P. pruinosa* populations, as an acceptable fire frequency will depend on the age structure of each population.

There are probably less than 1 000 mature plants of *Protea pruinosa* remaining in the wild. The limited distribution and rarity of this species may be partly due to its inability to re-sprout after fire. A closely related species, *Protea scolopendriifolia*, which is able to re-sprout after fire is a much more widespread and common plant. This re-sprouting species is also more common and widespread than its other two re-seeding relatives, *Protea cryophila* and *Protea scabriuscula*, which are also relatively rare and have limited altitudinal and geographical distributions. It thus seems unlikely that there is any advantage to being a re-seeding species, as the re-sprouter in this species group is much more common and widespread. *P. scolopendriifolia* occasionally grows next to *P. pruinosa*, which indicates that it is equally able to grow in this habitat.

It would be quixotic to ask why *P. pruinosa* is a re-seeding species when its re-sprouting relative is doing much better, but is interesting to contemplate the consequences of its re-seeding nature. We now know that the re-seeding nature of this species restricts it to fire-protected areas. Such fire-protected areas are limited to harsh environments where all plants grow slowly and fuel for fire thus accumulates slowly. These unfavourable conditions act as strong selecting forces to only allow those plants which are best suited to their specific habitat to survive. These selecting forces result in specialization and isolation of these plants to their specific habitats. Specialization to suit specific habitats leads to isolation of these populations, which prevents interbreeding between the populations. The plants in these isolated populations eventually acquire new morphological characteristics, which enable them to survive best in their habitat. These morphological differences enable us to recognize these plant populations as distinct species. Thus we can see how the re-seeding habit of *Protea pruinosa* could have survived, but how it probably caused this plant to remain rare and restricted to a specialized habitat, eventually becoming a distinct species.

The present custodians of this species are keen to conserve its exquisite beauty for future generations. They will, however, have to keep an eye on its populations as its numbers remain precariously low.

Acknowledgments
This project was sponsored in part by the Foundation for Research Development and S.A.Breweries.
I thank Cape Nature Conservation for permission to publish these results, Dr John Rourke and Dr Peter Linder for information on some populations and T. Hoekstra who helped in various ways.

Further reading

McDonald, D.J. *et al* (1993). Is there alpine vegetation on the mountains of the south-western Cape? *Veld & Flora* **79**(1),17-19.
Rourke, J.P. (1980). *The proteas of southern Africa*. Purnell, Cape Town.
Rourke, J.P. (1980). Rodents as pollinators of dwarf proteas. *Veld & Flora* **66**(2), 54-56.