
# CONSERVATION ADVISORY SCIENCE NOTES

**No. 95**

## BLACK HEAD : VEGETATION CONDITION AFTER QUARRYING

(Short Answers in Conservation Science)

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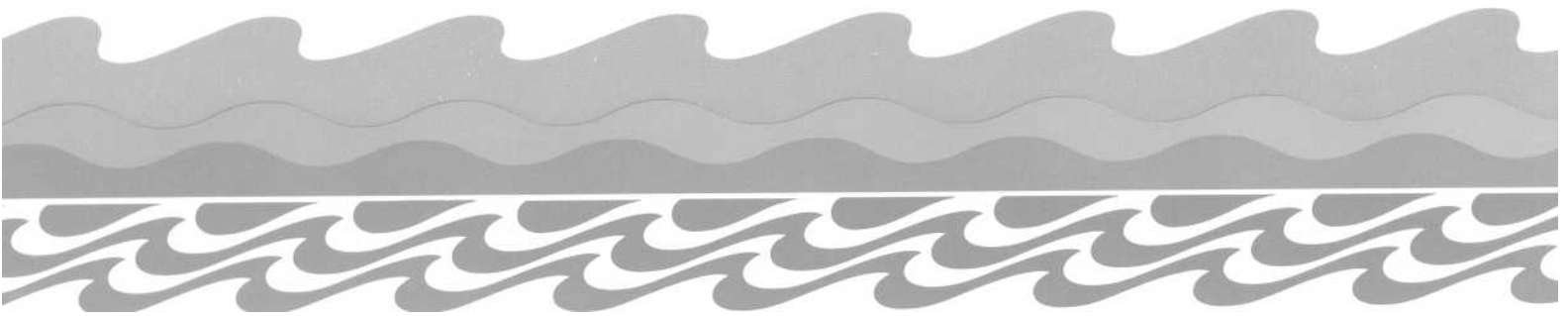

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# Black Head:

# vegetation condition after quarrying

P.N. Johnson

Manaaki Whenua - Landcare Research
Private Bag 1930, Dunedin
New Zealand

Landcare Research Contract Report LC 9394/120

PREPARED FOR:
Department of Conservation
P.O. Box 5244
Dunedin

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## 1. Summary

1.1 Rock fall from quarry activities has eliminated divaricating shrub vegetation and low forest species from the south face talus slopes of Black Head.

1.2 Patches of most other earlier vegetation types are still present. The coastal shrub *Hebe elliptica* is re-establishing well on disturbed talus slopes, and native ice plant is a successful recolonist on many ledges of debris. Orache *(Atriplex prostrata)* has become abundant on lower slope debris of fine soil.

1.3 *Aciphylla subflabellata* and *Pimelea urvilleana* are among native species not recorded from Black Head in this inspection.

1.4 Re-introduction is recommended for the 12 or so shrub and tree species that have been apparently lost from the site. Local spraying of elder is suggested. Gorse and other woody weeds should be prevented from establishing on the coastal slopes.

## 2. Introduction

The coastal headland of Black Head, south of Dunedin, is being quarried for basalt by Black Head Quarries Ltd. A Conservation Covenant has been negotiated between the company and the Department of Conservation to protect rock formations and coastal habitats on the outer and lower faces. Quarrying is continuing to excavate the inland portion of the headland but has now reached the stage where the outer cusp will not be further lowered, thus ending the major phase of induced rock and debris fall down the distal slopes. The Department of Conservation has requested an assessment of the current status of the plant communities and flora.

Earlier botanical reports (Johnson 1982, 1986) provide a baseline against which the present condition of habitats and vegetation is assessed.

## 3. Objectives

3.1 Compared with previous botanical surveys, what communities are still extant after quarrying? Can they recover?

3.2 What communities have completely disappeared, with no hope of recovery?

3.3 Are *Aciphylla subflabellata* and *Pimelea urvilleana* still present?

3.4 Can any remedial action be taken to improve the quality of habitat and viability of the plant communities?

## 4. Methods

My field inspection was carried out on 25 May 1994, in the company of Dave Wilkens (DoC, Dunedin) and, for part of the time, Churchill Walls (Quarry Manager). We walked around the headland from east to west near low tide and traversed the mid and upper slopes on the way. Presence and overall abundance of all vascular plant species was noted, and semi-quantitative descriptions were made of plant communities and habitats. Aerial photos taken the same day have been used to help interpret the patterns of vegetation and disturbance.

## 5. Results

Table 1 compares plant species and their abundance as recorded in 1982-86 and again in 1994. A comparison of generalised vegetation types is shown diagrammatically in Figure 1. Aerial views are shown in Figures 2 and 3, and details of vegetation in Figures 4 to 6.

### 5.1 Impacts of quarrying

Quarrying activities near and behind the crest of the headland have produced several different forms of impact on the vegetation and landforms of the coastal slopes. Much of the dislodged rock material appears to have been as sporadic falls of a few rocks at a time. This type of rock fall has had quite a widespread impact, clearly obvious by the extent to which the crests of basalt columns have been chipped (Fig. 5). This impact is most noticeable on mid-slopes where the chipped surfaces are in marked contrast to the otherwise weathered or lichen-covered rock surfaces. Rock fall of this type also appears to have been responsible for the general reduction in scrub vegetation. Most surviving patches of undamaged hebe scrub are on spurs, or below slight projections, and associated with basalt columns that have escaped bombardment. Some fallen rocks remain on the slopes, and many have accumulated in the Roman Baths, but the sea has removed most detritus from the lower 10-15 m zone above sea level.

A second type of rock fall, apparently the dislodgement and disintegration of a mass of rock at one time, has produced bouldery talus slopes. In Figure 3, just right of centre, an example can be seen that has arisen from the basal bulge of the upper bluffs and produced a talus slope that is almost wholly of rock material. By contrast the talus slopes on the spur above

the Roman Baths (left of centre in Figure 3) are composed of a mixture of rocks, smaller stone fragments, and dislodged soil.

Locally there are small accumulations of stone chips and quarry grit along descent chute lines. Wherever rocks have fallen upon vegetated slopes they have disturbed the soil, resulting in a net movement of soil down slope. This has created ledges of fresh material for colonising plants to establish upon. On the southern slopes (Fig. 4) this is mostly reworked topsoil from the slopes above. Along the south-west faces (Fig. 2) there are thicker debris fans - as well as thin veneers between rock outcrops - of fine materials derived not from old topsoil but from Caversham sandstone.

The vegetation types arising from these different sorts of debris fall and accumulation are discussed below.

### 5.2 Changes in vegetation types

The altitudinal sequence of five main vegetation/ habitat types on the south face (Johnson 1982), shown diagrammatically in Johnson (1986), forms the basis for comparison with the present situation (Fig. 1).

The upper bluffs (item 1 in Fig. 1) comprise steep rounded bulges of solid rock with a fine pattern of columnar jointing. Their vegetation now is similar to that described earlier, with a low cover of *Poa astonii* tussocks, plus ledge and crevice herbs such as *Linum monogynum* and *Luzula banksiana* var. *acra.* This habitat has been reduced somewhat from its previous extent, has been affected slightly by rock fall, and may have lost some of its plant species such as *Pimelea urvilleana* which previously were not very abundant.

Along the base of the upper bluffs is a narrow zone of flax, shrubs of shore koromiko *(Hebe elliptica),* and a ground cover of tetragonia, holy grass, and einadia (Fig. 6). This zone of intact vegetation was not especially noted on earlier visits, but it stands out today, having been protected from rockfall by the overhangs above.

Upper talus slopes formerly of stable rock rubble and with a cover of prostrate scrub have now changed markedly. Most of the divaricating shrub species formerly listed are not now in evidence. Upper talus slopes now have mostly a grass cover of Yorkshire fog (about 30% cover), cocksfoot (20%), sow thistle, Californian thistle, mouse-eared chickweed, and narrow-leaved plantain. The main native plants here are the sub-shrub *Haloragis erecta,* which reaches 30% cover as a pioneer on the more rubbly ground, and hebe, which reaches 15% cover as vigorous re-establishing shrubs to 50 cm tall among the grasses.

Lower talus slopes (item 3 in Fig. 1) once had patches of flax and small trees of ngaio and mahoe among a sward of tall pasture grasses. The grassland cover is still there, but the flax

and woody plants are virtually gone. One dead ngaio stump of 30 cm basal diameter was noted. Three living ngaio seedlings and one young mahoe were recorded. Elder, present as scattered spindly stems just 0.5 m tall, is the only naturalised woody species seen on the coastal slopes.

Outcrops of basalt columns around 30 m above the sea (item 4 in Fig. 1) once had a band of hebe scrub 0.6 m tall, with flax and shore spleenwort, covering 50-90% of the ground. Today the surviving patches of hebe scrub are small and scattered: they show as dark green patches in Fig. 3. Most of this zone is now veneered with accumulations of disturbed soil where the typical cover is mainly orache *(Atriplex prostrata)*, which shows pale brown in Figures 3, 4, and 5 from its browned-off late autumn foliage. Orache covers 30-50% of the ground, with lesser amounts of native celery and native ice plant, both of which are rapid and frequent native pioneers on this sort of site.

The lowermost vegetation zone (item 5 in Fig. 1) is of salt marsh herbs upon moist rock ledges, above the level of storm waves but often drenched by spray. The main species are glasswort, *Crassula moschata, Puccinellia stricta,* and *Leptinella dioica*. Much of this community has survived the quarry impacts, but in places where soil debris has trickled down there has been an apparent downslope movement also of plants from the zone above, especially the orache, native celery, and native ice plant. In the long term continued action of storm waves should again reduce the amount of soil on the lowermost perches.

The above descriptions apply to the south face of Black Head (Fig. 3) which comprises the major part of the conservation covenant and which should not suffer further major rockfalls and debris spillage. Along the south-west faces (Fig. 2) the covenant area includes the lower slopes (below 130 m contour), and these can be expected to receive further debris spillage and vegetation change as the upper faces are quarried. In 1994 the main vegetation/ habitat features of the south-west faces are:

* a lower zone of salt marsh herbs;
* a massive talus slope of boulders with very little vegetation;
* lower faces of basalt columns inclined to the moderately steep slope, capped with a thin mantle of soil/grit/sandstone debris on which native ice plant is extensively dominant;
* tall debris slopes of mainly fine material with a variable component of sandstone, and various stages of plant recolonisation, with native ice plant on the youngest surfaces, and on the older surfaces a grassland with creeping bent, ice plant, *Poa astonii*, native celery, thistles, and scattered young hebe bushes.

### 5.3 Changes in flora

Table 1 compares the flora in 1982-86 with that recorded in 1994. The annotations of abundance ("abundant", "frequent", etc.) are a coarse measure such that not every apparent difference over time is necessarily of real significance. However, several gross changes are apparent.

Twelve native shrub and tree species, including seven divaricating shrubs, appear to be no longer present. These previously formed the very low scrub communities of talus slopes on the south and south-west faces. Their low stature and patchiness was indicative that they held a tenuous foothold anyway on this exposed coastal site.

Native woody plants which have survived but at a lesser abundance are mahoe (one small plant seen), ngaio (three seedlings seen), and muehlenbeckia (once frequent, now rare). The native shrub which has survived best is *Hebe elliptica,* formerly "abundant", now still "frequent", and showing an ability to re-invade disturbed slopes.

Taupata *(Coprosma repens)* was not recorded on earlier visits. Perhaps it was overlooked then, but it might well be a recent arrival on the site, in line with its general increase on the Otago coast in recent decades. This native shrub has increased its geographic range south of its former natural southern limit (about Greymouth and Marlborough), especially around coastal cities and on sea-bird islands. It now grows at Black Head as scattered prostrate shrubs on the upper bluffs, southern talus slopes, and south-west faces.

A few of the native herbs and ferns previously listed were not seen in 1994, but this might be an artefact of the non-intensity of field study. In this regard it is of interest to note that 10 native herbs and 6 naturalised species added to the list in 1994 are very likely to have been present in earlier years.

There has been an apparent increase in abundance of several herbs and grasses as a result of the increase in extent of disturbed ground. Natives which are more common are native celery, haloragis, and *Senecio glaucophyllus.* There has been an increase in the naturalised weedy thistles, sow thistle, and the grass Yorkshire fog. Orache, now so common, was not recorded at all on earlier visits. It is an introduced plant of estuary margins and moist coastal sites. On Black Head it is likely to serve as a pioneer on fresh soil deposits and to decrease in abundance as other plant species establish.

The coastal sub-shrub *Pimelea uroilleana* was recorded as "occasional" on the upper bluffs in 1986, but was not seen in 1994. Several native species previously recorded from Black Head are of particular biogeographic interest. Aciphylla *subflabellata,* a fine-leaved speargrass, was recorded from here many years ago, and this would have been about its southern limit of distribution. It has not been seen at Black Head in recent decades, but was recorded (3 plants, by B. Patrick) on clifftops at Cargills Castle, just to the east, in 1987. There are early records by Dunedin Naturalists Field Club of the southern coastal forget-me-not *Myosotis rakiura* and of Cook's scurvy grass *(Lepidium oleraceum)* from Black Head. Neither has been recorded here in recent decades.

## 6. Discussion

The plant communities which have disappeared as a result of quarry debris fall are the prostrate divaricating shrubs and the patches of low forest trees on the south face talus slopes. *Hebe elliptica* is showing vigour in recolonising these and other habitat types as a possible forerunner to a more diverse woody vegetation that might re-establish unassisted in future. The presence of a few ngaio seedlings is also a hopeful sign. It is unlikely though that all the apparently lost woody species will return, especially as there is no very handy local seed source. I suggest it would be worthwhile to re-introduce at least a few young plants of most of those species, propagated from local material, planting them on talus slope sites where they will have the most chance of avoiding further disturbance. For species such as *Coprosma propinqua*, mahoe, ngaio, matipo, porcupine shrub, and kowhai it would be worthwhile to try broadcasting seed on sites that now have relatively bare and rubbly ground. It should not be difficult to collect seed of these species in relative bulk.

There is probably little point in attempting replanting within other vegetation types. Given time I expect that hebe and flax will again increase in abundance without assistance on the lower columnar slopes, and that both should be able to invade and partly replace the induced grass swards. Native ice plant is showing itself to be a rapid recolonist on ledges mantled with stone chips, sandstone debris, and disturbed soil. So far as the debris slopes now colonised by orache are concerned, it is probably best to allow time for rain to clean some lower ledges, and for a more diverse flora to re-establish naturally.

Bared and disturbed sites in many ecosystems are "windows of opportunity" for weeds. Already the slopes of Black Head have thistles, pasture grasses, sow thistles, the inevitable catsear, plantain, hawkbit, and sow thistles. I see no point in attempting any control of these.

The only naturalised woody plant present is elder which is scarcely a problem, being so low-growing, but it would be relatively easily dispatched from the south face talus slopes by hand-sprayed weedkiller during its leafy season.

Gorse should be kept at bay at all costs. One small clump was noted in the north end of the quarry workings, and any such nearby infestations should be sought out and removed with a view of keeping seed sources well away from the coastal slopes.

## 7. References

Johnson, P.N. 1982: Black Head near Dunedin: botanical notes. Botany Division, DSIR, unpublished report, 4p.

Johnson, P.N. 1986: Black Head near Dunedin: a case for preserving features of scenic, geological and botanical interest. Botany Division, DSIR, unpublished report, 14 p.

**Table 1** Plant species recorded on coastal cliffs at Black Head, south of Dunedin, in 1982-86, compared with after quarrying in 1994.

Key to abbreviations:

* = naturalised (not native)
a = abundant
f = frequent
o = occasional
r = rare
- = not recorded

| | | Abundance 1982-86 | 1994 |
|---|---|---|---|
| **TREES, SHRUBS, AND CREEPERS** | | | |
| *Calystegia tuguriorum* | native bindweed | f | f |
| *Coprosma crassifolia* | | f | - |
| *C. propinqua* | | o | - |
| *C. propinqua* x *robusta* | | r | - |
| *C. repens* | taupata | - | o |
| *Cordyline australis* | cabbage tree | - | r |
| *Haloragis erecta* | haloragis | f | a |
| *Hebe elliptica* | shore koromiko | a | f |
| *Helichrysum aggregatum* | | f | - |
| *Lophomyrtus obcordata* | | r | - |
| *Melicope simplex* | | r | - |
| *Melicytus alpinus* | porcupine shrub | f | - |
| *M. ramiflorus* | mahoe | o | r |
| *Muehlenbeckia australis* | muehlenbeckia | f | r |
| *Myoporum laetum* | ngaio | f | r |
| *Myrsine australis* | matipo | o | - |
| *M. divaricata* | weeping matipo | r | - |
| *Olearia aviceniifolia* | | r | - |
| *Pimelea uruilleana* | | o | - |
| *Pittosporum tenuifolium* | kohuhu | o | - |
| * *Sambucus nigra* | elder | - | r |
| *Scandia geniculata* | | o | - |
| *Sophora microphylla* | kowhai | r | - |

(continued overleaf)

Table 1 continued..

| | | | | |
|---|---|---|---|---|
| **DICOT HERBS** | | | | |
| | *Acaena juvenca* | bush bidibid | - | r |
| | *A. novae-zelandiae* | bidibid | r | r |
| * | *Anagallis arvensis* | scarlet pimpernel | - | r |
| | *Apium prostratum* | native celery | o | a |
| * | *Atriplex prostrata* | orache | - | a |
| * | *Cerastium fontanum* | mouse-ear chickweed | f | f |
| | *Chenopodium glaucum* subsp. *ambiguum* | | - | 0 |
| | *Cirsium arvense* | Californian thistle | r | f |
| * | *C. vulgare* | Scotch thistle | r | o |
| | *Colobanthus muelleri* | | f | o |
| | *Cotula coronopifolia* | bachelors button | - | o |
| | *Crassula moschata* | | o | f |
| | *C. sieberiana* | | r | r |
| | *Disphyma australe* | native ice plant | a | a |
| | *Einadia allanii* | | f | f |
| | *Galium aparine* | cleavers | o | 0 |
| | *Geranium microphyllum* | | 0 | - |
| * | *Hypochoeris radicata* | catsear | a | a |
| * | *Leontodon taraxacoides* | hawkbit | f | o |
| | *Leptinella dioica* | cotula | o | 0 |
| | *Linum monogynum* | native linen flax | f | o |
| * | *Plantago coronopus* | bucks-horn plantain | - | r |
| | *P. lanceolata* | narrow-leaved plantain | a | a |
| * | *Polycarpon tetraphyllum* | allseed | - | r |
| | *Pseudognaphalium luteo-album* | cudweed | o | f |
| | *Sarcocornia quinqueflora* | glasswort | o | f |
| | *Samolus repens* | sea primrose | o | r |
| | *Scleranthus biflorus* | | r | r |
| | *Senecio elegans* | shore groundsel | r | r |
| | *S. glomeratus* | fireweed | - | r |
| | *S. glaucophyllus* subsp. *basinudus* | | o | f |
| | *Sonchus asper* | prickly sow thistle | a | o |
| | *S. kirkii* | puha | - | r |
| | *S. oleraceus* | sow thistle | o | f |
| | *Stellaria media* | chickweed | o | 0 |
| | *S. parviflora* | native chickweed | - | o |
| | *Tetragonia trigyna* | tetragonia | o | f |

(continued overleaf)

Table 1 continued..

| | | | | |
|---|---|---|---|---|
| * | *Trifolium dubium* | suckling clover | o | r |
| * | *T. repens* | white clover | o | r |
| * | *Vicia sativa* | vetch | o | 0 |
| | *Wahlenbergia gracilis* | harebell | o | r |
| **MONOCOTS** | | | | |
| * | *Agrostis stolonifera* | creeping bent | - | o |
| * | *Anthoxanthum odoratum* | sweet vernal | f | o |
| | *Astelia fragrans* | bush lily | - | r |
| * | *Bromus diandrus* | ripgut brome | - | r |
| * | *Dactylis glomerata* | cocksfoot | a | a |
| | *Elymus rectisetus* | blue wheat grass | - | r |
| | *Hierochloe redolens* | holy grass | r | o |
| * | *Holcus lanatus* | Yorkshire fog | - | a |
| | *Isolepis cernuus* | | - | 0 |
| | *Libertia ixioides* | | f | - |
| * | *Lolium perenne* | ryegrass | f | f |
| | *Luzula banksiana* var. *acra* | woodrush | o | 0 |
| | *Phormium tenax* | flax | f | o |
| | *Poa astonii* | | a | a |
| | *Puccinellia stricta* | | o | 0 |
| | *Schoenus concinnus* | | r | r |
| | *Thelymitra longifolia* | | r | - |
| * | *Vulpia bromoides* | vulpia hair grass | r | - |
| **FERNS** | | | | |
| | *Asplenium flabellifolium* | | r | - |
| | *A.lyallii* | | o | r |
| | *A. obtusatum* | coastal spleenwort | f | f |
| | *Phymatosorus diversifolius* | hounds tongue fern | o | r |
| | *Pteridium esculentum* | bracken | - | r |
| | *Pyrrosia eleagnifolia* | leather leaf fern | f | r |

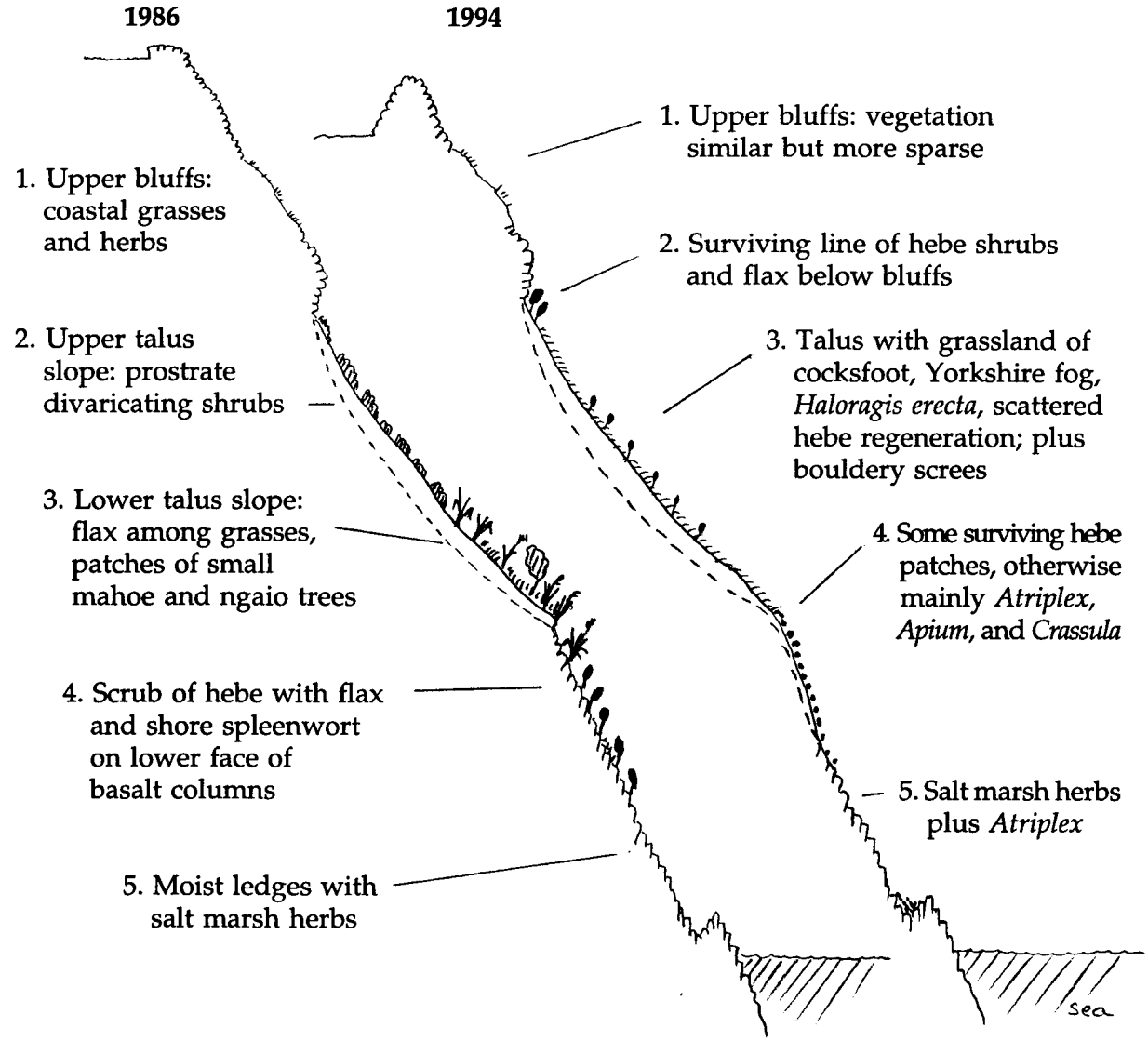


**Fig. 1** Black Head, Dunedin: generalised sequence of vegetation types on south face in 1986 (left) and 1994 (right).

**Fig. 2** Black Head, SW faces, 25.5.1994

**Fig. 3** South end of Black Head with the Roman Baths at bottom left. Dark green patches are surviving *Hebe elliptica* scrub. Talus slopes have browned orache dominant below and cocksfoot/ fog grassland (mid-green) above, dissected by grey rockfalls.

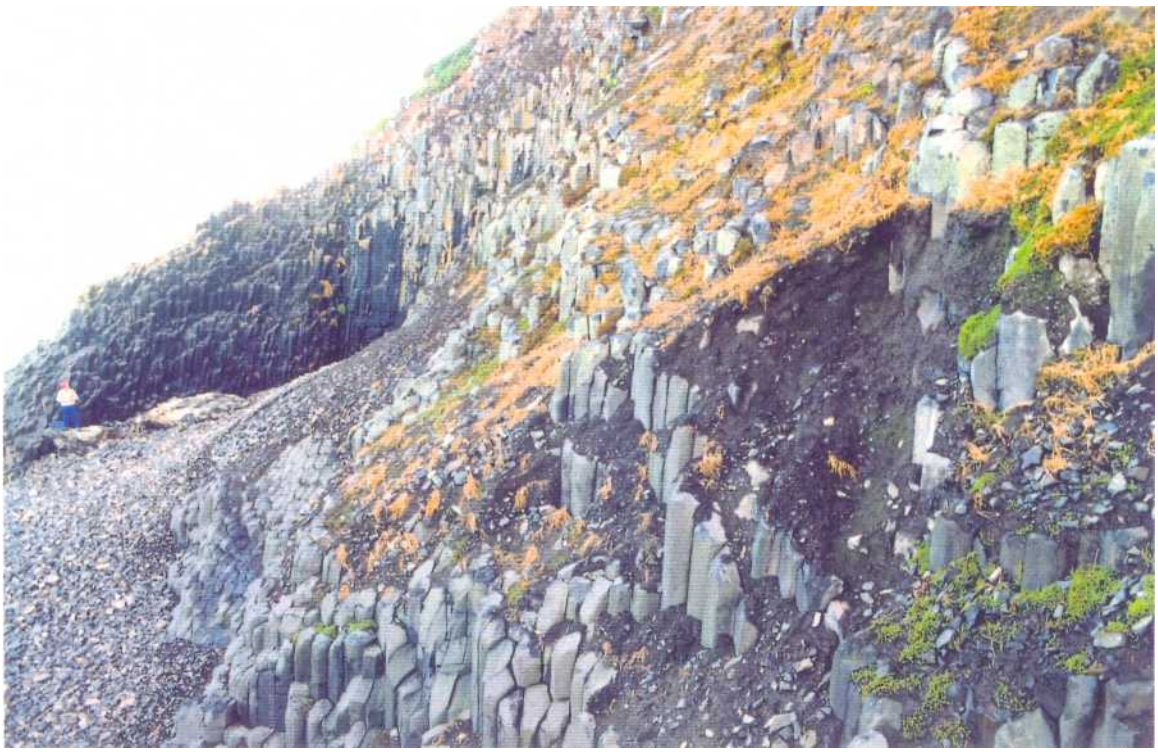

**Fig. 4** Black Head, the Roman Baths with accumulated rock debris and a mantle of soil debris upslope with orache (pale brown) and native ice plant (green).

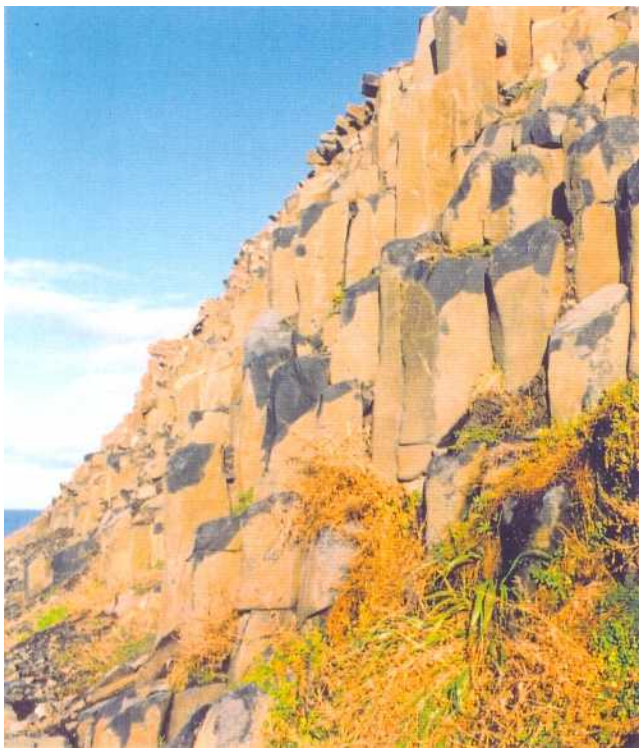

**Fig. 5** Black Head, SE corner, with basalt columns chipped by rock fall; orache and native ice plant on ledge debris.

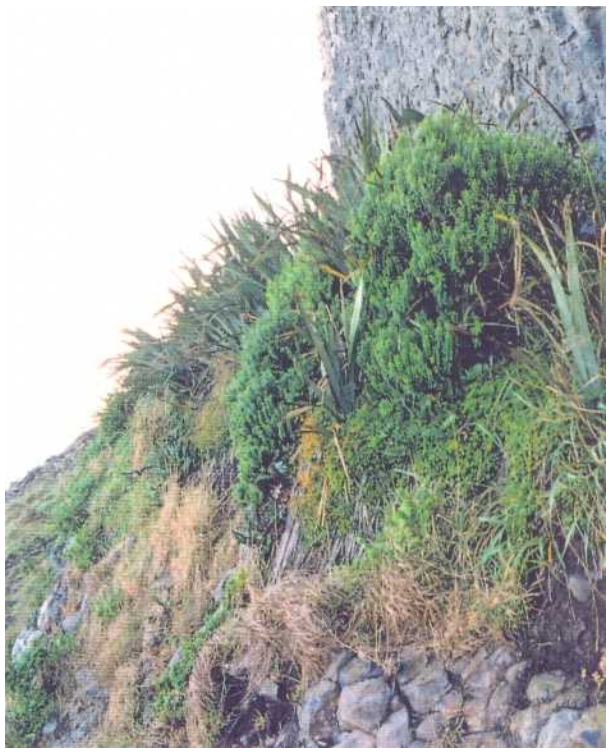

**Fig. 6** Line of *Hebe* scrub with flax, holy grass, and tetragonia below upper bluffs.