

Distribution and conservation status
of the dune snail *Succinea archeyi*
Powell (Stylommatophora:
Succineidae) in northern
New Zealand

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Abstract

Surveys were carried out from 1994 to 1998 to determine the location, size, habitats and conservation status of extant populations of the endemic dune snail *Succinea archeyi* Powell in northern New Zealand. *Succinea archeyi* was found living in sandfield and prostrate shrubland on fifteen coastal dunefields: ten in northern and eastern Northland; and five on eastern Coromandel Peninsula. Areas occupied by snails at these sites ranged from c. 10–100 ha for the four largest populations (all in Northland), down to less than 0.05 ha for the nine smallest populations. Eight of the known extant populations of *Succinea archeyi* are threatened with extinction. The main threats to their continued survival are habitat loss and degradation resulting from stock damage, weed invasion, land development and erosion.

1. Introduction

Succinea archeyi Powell is a small terrestrial snail endemic to northern New Zealand. It has a thin, fusiform shell up to 12 mm in length, a large aperture, and smooth, strongly convex whorls (Fig. 1). Shells of live individuals have a shiny, uniformly coloured, yellowish-olive to pale orange periostracum. This weathers off after death to expose an underlying white calcareous ostracum. The animal is pale pinkish brown, with darker axial streaks and blotches on the mantle (Powell 1950, 1979; Quick 1951).

Contemporary populations of *S. archeyi* live exclusively in sandfield and prostrate shrubland on coastal dunes. Native plant species characteristic of these dune floras include spinifex (*Spinifex sericeus*), the rush *Isolepis nodosa*,

Figure 1. Growth series of *Succinea archeyi* Powell from Puwheke Beach, Northland.

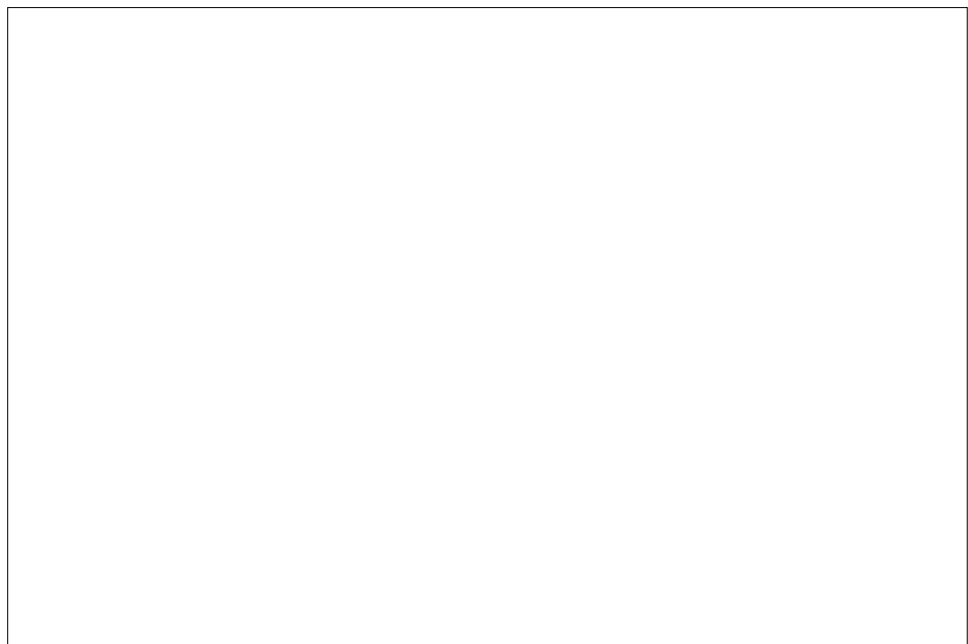




Figure 2. Locations of extant populations of *Succinea archeyi*, and the possibly extinct Omanu Beach and Papamoa Beach populations.

shore bindweed (*Calystegia soldanella*), prostrate shrubs *Coprosma acerosa*, *Muehlenbeckia complexa* and *Pimelia arenaria*, and the erect shrub *Cassinia leptophylla*. *Succinea archeyi* lives under matted spinifex leaves, branches of shrubs lying on the ground, and within clumps of *I. nodosa*. The species is cryptic and sedentary during dry weather, but becomes active in the wet when snails are commonly found crawling out in the open away from vegetative cover. *Succinea archeyi* is herbivorous, and has been observed grazing on blue green algal mats (*Nostoc*), spinifex and *C. acerosa* (Powell 1950; pers. obs.).

The life history of *S. archeyi* is described by Powell (1950), based on observations of some Northland populations. The snail has an annual life cycle. Eggs are present from April to July and hatch from June to August (i.e. during the wet winter months). The snails reach sexual maturity from April the following year, then die off between May and August.

Extant populations of *S. archeyi* are presently known from a total of 15 locations, comprising ten in northern and eastern Northland, and five on eastern Coromandel Peninsula (Fig. 2). However, fossils indicate that the species was formerly much more widely distributed in northern New Zealand (Brook in

press), and at least one historic population (i.e. at Taipa in Northland) is thought to have become extinct within the last 50 years (see below). The common factors linking all of these local extinctions were habitat degradation and loss of native vegetation cover on dunes resulting from stock damage, invasions of exotic plant species, land development and dune erosion (Brook in press).

The present study was undertaken to determine the distribution and conservation status of the remaining extant populations of *S. archeyi* in northern New Zealand. Sites where *S. archeyi* occurred historically were determined from published records (Powell 1950; Thomson 1952, 1959; Thomson & Jones 1954), and from specimens in museum and private collections. Between 1994 and 1998, field visits were made to all of these sites to determine whether the populations were still extant and, if so, to obtain information on their status. Searches were also carried out at a number of other dunefield sites in Northland and eastern Coromandel Peninsula to check for the presence of additional populations of *S. archeyi*. This resulted in the discovery of populations at Motuopao Island, the Cape Maria van Diemen area, Tom Bowling Bay, Whananaki Spit, Horahora River, Opito Bay and Opoutere Beach.

At each site, the distribution area of *S. archeyi* was mapped, a description was made of habitats occupied by the snails, and existing or potential threats to the survival of *S. archeyi* were identified. For threatened populations, future management requirements were identified.

Grid references quoted in this report refer to the 1:50 000 NZMS 260 topographical map series published by the Department of Survey and Land Information.

2. Populations of *Succinea archeyi*

2.1 MOTUOPA O

Motuopao Island, off Cape Maria van Diemen, is a Nature Reserve administered by the Department of Conservation. In 1997, *S. archeyi* was found living on the southern slopes of the central valley on the island (M02/778478; Fig. 3). The population was in an area of unconsolidated slopewash sand occupied by seabird burrows, and extended over c. 400 m². A sparse vegetation cover at the site was dominated by *C. acerosa*, *I. nodosa*, *M. complexa* and spinifex, with less common *C. soldanella*, flax (*Phormium tenax*), *P. arenaria*, *Tetragonia trigyna* and exotic grasses and herbs. Clumps of low sandfield vegetation and flax were interspersed with patches of open sand.

During a subsequent visit to the island in 1998, *S. archeyi* was also found under flax and sandfield vegetation on the sandy northern slopes of the same valley (G.R. Parrish pers. comm. 1998).

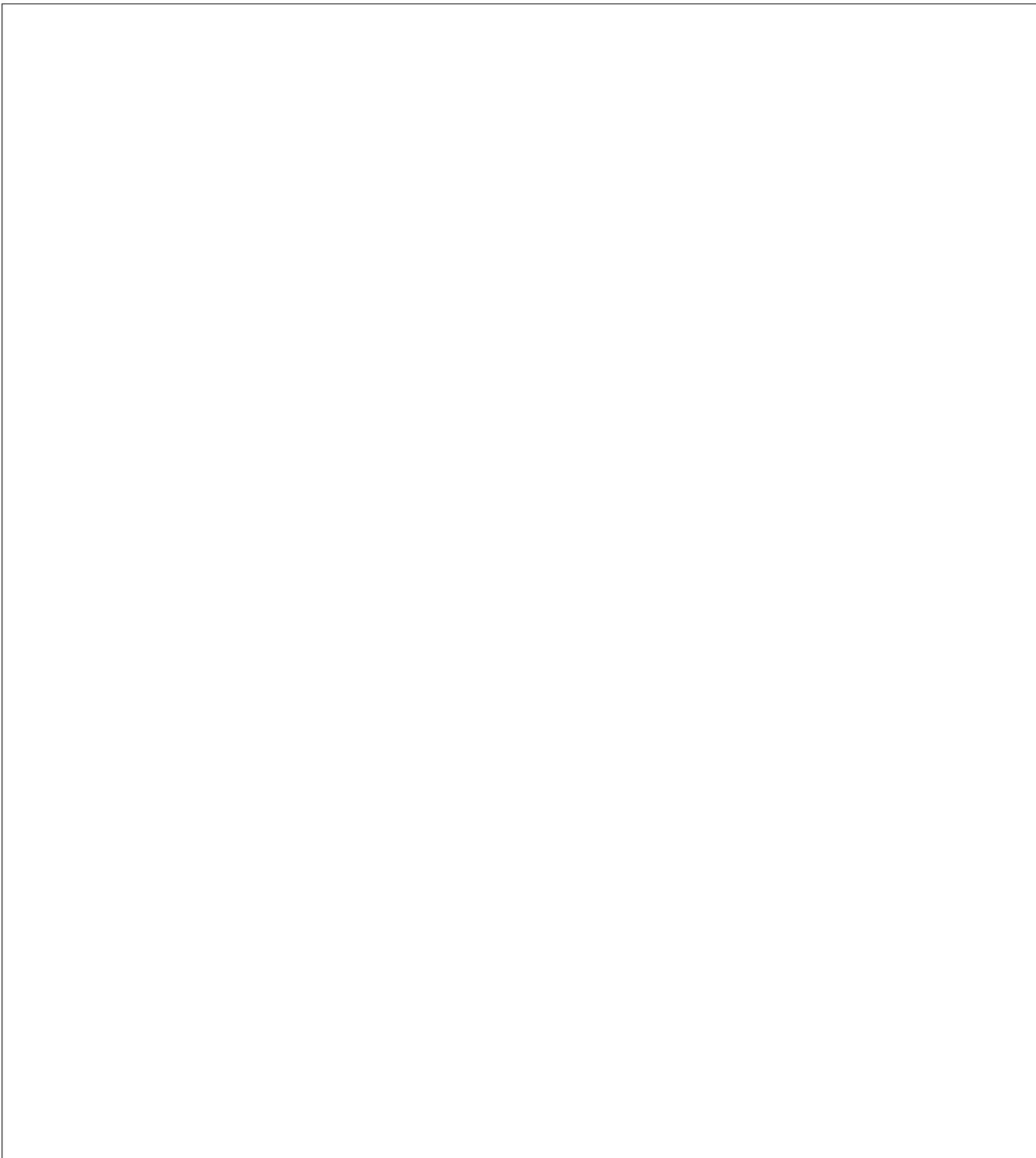


Figure 3. Sites with living *Succinea archeyi* in the Motuopao and Cape Maria van Diemen to Herangi areas.

The population of *S. archeyi* on Motuopao had evidently undergone a marked increase in the period from 1990 to 1997-98. A report on the landsnail fauna of Motuopao by Parrish and Sherley (1993), based on surveys carried out during five visits between 1988 and 1990, made no mention of the existence of *S. archeyi*. That suggests that *S. archeyi* formerly had a much more restricted distribution and/or existed in much lower numbers, compared with the situation in 1997-98. The population increase is probably not attributable to habitat-related factors, as the distribution and composition of the dune flora on Motuopao persisted essentially unchanged from 1988-90 and 1997-98 (pers. obs.). However, it does correlate with the extermination of the kiore (*Rattus*

exulans) on Motuopao in 1990 (McKenzie 1993), suggesting that prior to that time, predation by rats may have suppressed *S. archeyi* abundance on Motuopao.

There are presently no known threats to *S. archeyi* or to its dune habitats on Motuopao. However, regular habitat monitoring should be carried out to check for the presence of aggressively invasive exotic plants such as pampas (*Cortaderia selloana*), already widely present on the nearby mainland, to ensure that they do not establish on Motuopao and modify or replace the existing native plant associations.

2.2 CAPE MARIA VAN DIEMEN TO HERANGI

Five allopatric populations of *S. archeyi* were present between Cape Maria van Diemen and Herangi in 1998 (Fig. 3). This area is within the Te Pahi Farm Park administered by the Department of Conservation. The snail populations were located as follows:

1. Eastern side of Cape Maria van Diemen headland, on the landward margin of an eroded dune belt (M02/784474). In 1998, this population extended over an area of c. 200 m², in patchy sandfield vegetation of *C. soldanella*, *C. leptophylla*, *C. acerosa*, flax, *I. nodosa*, *M. complexa*, spinifex and exotic grasses and herbs.
2. Northern side of Paraspirtus headland at 40 m elevation, on margin of area of unvegetated, mobile sand (M02/797472). In 1998, *S. archeyi* was living in prostrate shrubland remnants that covered an area of c. 60 m². Plant species at this site included *C. soldanella*, *C. leptophylla*, *C. acerosa*, flax, *I. nodosa*, *M. complexa*, spinifex and toetoe (*Cortaderia splendens*).
3. Summit ridge of Herangi at 155 m elevation (M02/802478). In 1998 this population of *S. archeyi* extended over an area of c. 150 m² in patchy sandfield and prostrate shrubland with *C. soldanella*, *C. leptophylla*, *C. acerosa*, *I. nodosa*, *M. complexa*, *P. arenaria*, *Pimelea ?urvilleana*, spinifex and tutu (*Coriaria arborea*), surrounded by dense flax-toetoe stands.
4. Northwest of Herangi at 70 m elevation (M02/798479). This was on a deeply eroded and predominantly unvegetated rocky ridge crest. However, at the extreme northwestern end of the ridge there was a thin capping of sand that supported a small grove of windshorn pohutukawa trees (*Metrosideros excelsa*), and a contiguous patch of prostrate shrubland-sandfield vegetation. The latter included *C. leptophylla*, *C. acerosa*, flax, *I. nodosa*, *M. complexa*, *P. arenaria*, spinifex, *T. trigyna*, toetoe and exotic grasses and herbs. In 1998, this population of *S. archeyi* extended over an area of c. 200 m² within the sandfield-prostrate shrubland patch.
5. Top of Te Kohatu Point, on consolidated sand (M02/796481). In 1998, a population of *S. archeyi* extended over an area of c. 2500 m² in shrubby exotic grassland. Native plant species present at this site included *C. leptophylla*, *C. acerosa*, flax, *I. nodosa*, *M. complexa*, *P. ?urvilleana*, spinifex, *T. trigyna* and toetoe.



Figure 4. Distribution of *Succinea arcbeiy* at Spirits Bay.

The populations of *S. arcbeiy* between Cape Maria van Diemen and Herangi were all confined to small remnant areas with native prostrate shrubs and sandfield vegetation, and had very limited distributions. There is no evidence that any of these populations are threatened at present. However, all are clearly vulnerable to degradation or loss of native vegetation cover from wind erosion, dune encroachment, and invasion by exotic plant species. Rabbits (*Oryctolagus cuniculus*), present at all five sites, could be adversely affecting regeneration of some native plant species in the prostrate shrubland and sandfield communities, but the impact on populations of *S. arcbeiy* is not known (see below).

I recommend that these five sites should be monitored regularly for evidence of habitat deterioration. Further, existing pampas plants between Herangi and Cape Maria van Diemen should be eradicated and that area should then be maintained free of pampas, to prevent the invasion and modification of native dune floras at these sites and elsewhere.

2.3 SPIRITS BAY

A large population of *S. archeyi* was present on the dune belt at Spirits Bay (Fig. 4), within the Te Paki Farm Park administered by the Department of Conservation. From 1994 to 1997, this population occupied an area of c. 75 ha and extended more or less continuously along a 5 km stretch of dunes from near the mouth of Waitahora Lagoon at the western end of the bay, to 2 km southwest of Pananehe Island at the northeastern end (N02/924497-970515). The snails occupied the seaward part of the dune belt between the crest of the coastal foredune and the landward slope of the second dune back from the coast. This part of the dune belt comprised a mosaic of mobile, unvegetated dunes and deflation hollows, interspersed with areas of sparse sandfield vegetation and dense prostrate shrubland. The dune vegetation here was dominated by native species, including *C. soldanella*, *C. leptophylla*, *C. acerosa*, flax, *I. nodosa*, *M. complexa*, spinifex and toetoe. *Succinea archeyi* was restricted to these sandfield and prostrate shrubland habitats, and it was absent from more modified dune vegetation to landward and at the northeastern end of Spirits Bay, where exotic plant species were prevalent.

Uncontrolled browsing and trampling by domestic stock and horses has, in the past, caused extensive damage to dune habitats at Spirits Bay (pers. obs.). This presumably played a key role in the modification and destruction of native flora on landward parts of the dunefield, and on seaward dunes at the northeastern end of the bay. However, the dune belt is now fenced off from adjoining privately-owned land, and this has reduced the level of stock damage, and also damage by off-road vehicles.

Partridge (1992) identified the Spirits Bay dune belt as one of the most ecologically significant dune areas in the North Island on the basis of its botanical values, and preservation of these values is crucial for the population of *S. archeyi* there. Maintenance of fences and co-operation from adjoining landowners to prevent stock and horses gaining access to the dunefield are of key importance. I also recommend that regular monitoring of dune habitats be carried out to check for weed invasion of the native plant associations. Control measures should be undertaken to prevent aggressive weed species such as pampas establishing on the dune belt.

2.4 TOM BOWLING BAY

In 1997, a small population of *S. archeyi* was found on privately-owned land at the western end of the Tom Bowling Bay dune belt, near North Cape (N02/082527; Fig. 5). The snail colony was in a hollow behind the foredune crest, and extended over an area of c. 400 m². The floor of the hollow had a cover of exotic grasses and herbs, with scattered lupins and patches of *C. soldanella*, *C. leptophylla*, flax, *I. nodosa*, *M. complexa* and spinifex. The sides of the hollow had a mosaic of unvegetated sand patches and sandfield vegetation containing the native species listed above.

The dune vegetation at this site showed extensive damage from browsing and trampling by cattle and horses, and rabbits were present in high numbers.



Figure 5. Location of living *Succinea arcbeyi* at Tom Bowling Bay.

Habitat degradation and destruction are significant threats to the continued survival of this population of *S. arcbeyi*, given that the snails are already restricted to a very small area of highly modified habitat. If cattle and horses continue to have access to the site, there is a strong possibility that their cumulative impact on the vegetation will lead to extinction of *S. arcbeyi* at this site. The most effective way of avoiding this would be to build and maintain a stock proof fence around the area occupied by the snail colony. I recommend that discussions be held with the landowners to determine whether they would agree to an enclosure fence being constructed.

2.5 PUWHEKE BEACH

In 1994, *S. archeyi* was present on dunes located within a Marginal Strip Reserve administered by the Department of Conservation, along the eastern half of Puwheke Beach, Karikari Peninsula (Fig. 6). The population occupied an area of c. 10 ha and extended for 1.5 km from O03/395043–410046, on the top and landward slope of the coastal foredune belt. Snails were living in a mosaic of sandfield and prostrate shrubland that had *C. acerosa*, *I. nodosa*, *M. complexa*, *P. arenaria* and spinifex as the main native species.

There are no apparent threats to the population of *S. archeyi* at Puwheke Beach. The dune vegetation lacks some of the exotic weed species that have degraded many dunefield habitats elsewhere in northern New Zealand. Monitoring and, if necessary, weed control should be carried out to ensure that the existing native vegetation at this site is not invaded by weed species capable of replacing or significantly modifying it.

2.6 TOKERAU BEACH

In 1994, *S. archeyi* was present along much of the seaward part of the dune belt behind Tokerau Beach, eastern Karikari Peninsula (Fig. 6). The species was mostly restricted to the seaward foredune ridge within 100 m of the coast, but snails were present locally up to 200 m inland within deflation hollows in the dune belt. The vegetation in areas occupied by *S. archeyi* comprised a mosaic of sandfield dominated by spinifex, *C. soldanella* and *I. nodosa* with *C. leptophylla*, *C. acerosa*, flax and *P. arenaria*, and prostrate shrubland dominated by *C. acerosa*, *I. nodosa* and *M. complexa* with bracken (*Pteridium esculentum*), *C. soldanella*, *C. leptophylla*, flax, *P. arenaria* and spinifex. In 1994, *S. archeyi* was absent from areas of highly modified dune vegetation at the northern end of the beach (i.e. north of O03/450120), in the vicinity of S. Ulrich Road (i.e. O03/446105–448115), and in the picnic area at Tokerau Beach Road (i.e. O04/464945–458955). *Succinea archeyi* was also apparently absent from areas of native sandfield and prostrate shrubland vegetation along a stretch of eroded dunes north of D. Ulrich Road (i.e. O04/447992–448984).

The Tokerau population of *S. archeyi* extended over a total area of c. 100 ha and had the greatest distribution of any extant population. It is not threatened at present. Exotic plant species have largely replaced native vegetation on parts of the Tokerau dune belt, but there are still extensive areas of predominantly native sandfield and prostrate shrubland vegetation along the seaward margin and locally extending inland. Most of these least modified parts of the dune belt, and much of the area occupied by *S. archeyi*, are within Public Conservation Land administered by the Department of Conservation. Preservation of the existing native vegetation cover on crown land is the key to the continued survival of *S. archeyi* at Tokerau. There is existing and ongoing damage to dunefield habitats at Tokerau from stock and offroad vehicles, but the most serious potential threat is posed by the spread of invasive exotic plant species, including iceplant (*Caprobotus* sp.), pampas, gorse (*Ulex europaeus*), *Melanthus major* and kikuyu, which are already established on the dunes. Weed invasion of the Tokerau dunes needs to be monitored, and control measures should be undertaken if native sandfield and prostrate shrubland plant associations become threatened.

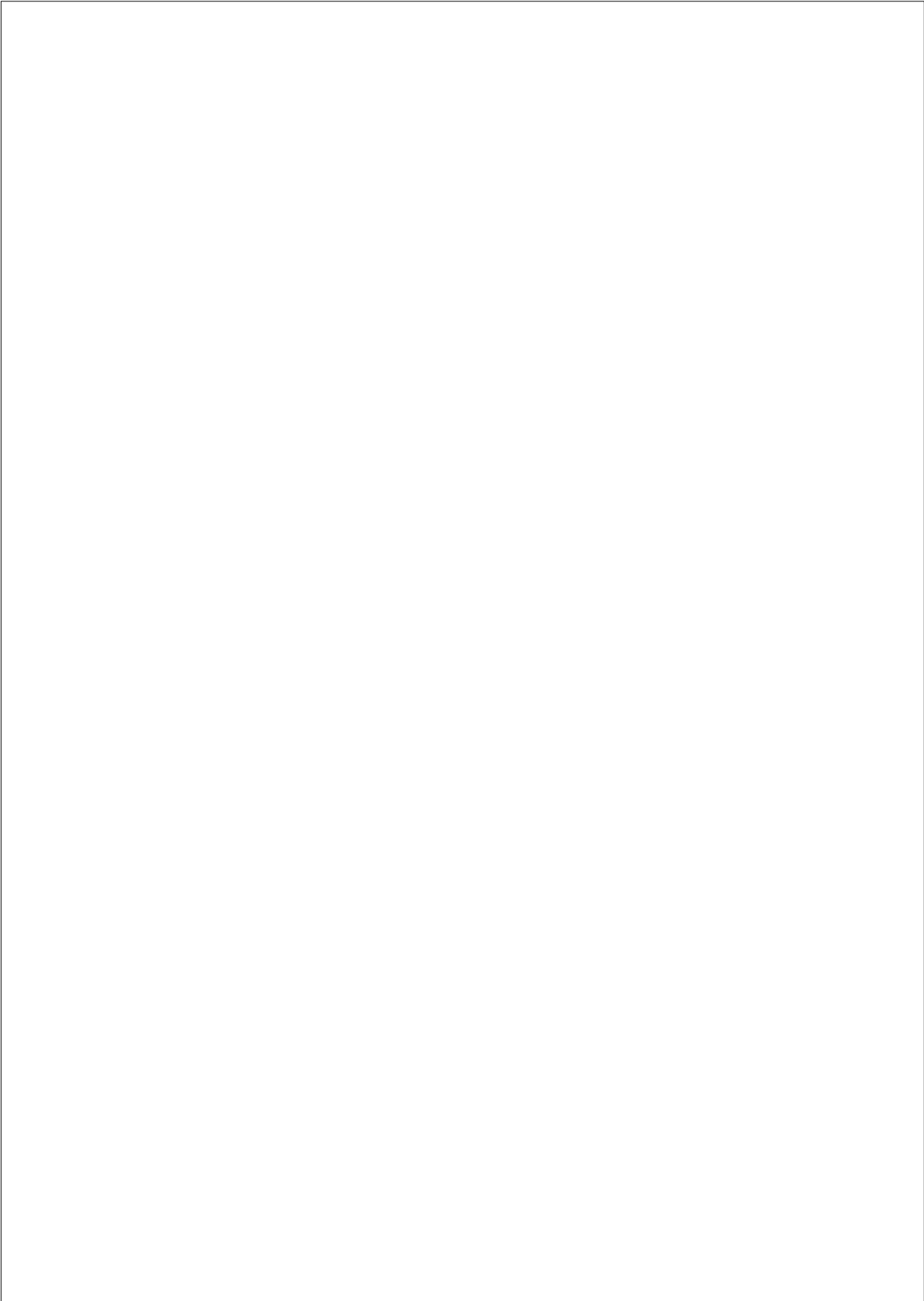


Figure 6. Distribution of living *Succinea archeyi* at Puwheke and Tokerau beaches.

2.7 TE RUATAHI

A small population of *S. archeyi* is present on a foredune at Te Ruatahi, south of Mimiwhangata (Q06/407370; Fig. 7). This is within the Mimiwhangata Coastal Park administered by the Department of Conservation. In 1996, the snail population here extended over an area of c. 1150 m², in sparse sandfield vegetation comprising spinifex, *C. soldanella*, *I. nodosa* and exotic grasses and herbs.

The existence of *S. archeyi* at Te Ruatahi was first documented by Powell (1950, p. 67), based on observations made in 1947. He described the snail population as extending over an area of only a few square metres, under a sparse cover of *C. leptophylla* and dead spinifex, and noted that plant cover on the dune was severely reduced as a result of grazing by stock. Cattle and sheep continued to have access to the dune until the mid 1980s when it was fenced off. *Cassinia leptophylla* had become extinct at the site some time prior to that, and has not re-established. However, since the dune was fenced off, the surviving native flora has regenerated, and the population of *S. archeyi* has increased in size (pers. obs.).

This population of *S. archeyi* is not presently threatened. However, to ensure its continued survival, the site will need to be managed to ensure that stock remain excluded, and that the native flora is not overrun by exotic plant species. Two further conservation measures that could also be undertaken are:

1. Eradication of pasture grasses from the landward part of the Te Ruatahi foredune, and the reintroduction of native sandfield shrub species such as *C. leptophylla*, *C. acerosa* and *P. arenaria* to augment the existing snail habitat.
2. Establishment of a translocated subpopulation of *S. archeyi* at a dune site with suitable habitat elsewhere in Mimiwhangata Farm Park.

2.8 WHANANAKI SPIT

In 1994, a population of *S. archeyi* was found on the eastern side of Whananaki Spit, eastern Northland (Fig. 7). This population extended for 300 m along the coast from Q06/434301-435303, and occupied an area of c. 2 ha on the crest of the seaward foredune and interdune hollow behind it. The snails were living in sandfield vegetation of spinifex, *I. nodosa* and exotic grasses and herbs.

This site was mostly on privately-owned land, but at its northern end it was just inside the Whananaki Recreation Reserve administered by the Whangarei District Council. The area of private land was fenced off from stock and planted with pines. By 1998, the pines on the seaward part of the dune belt were 1-1.5 m high, with many showing extensive salt damage. The adjoining reserve land was unfenced, and in 1994 the vegetation there was badly damaged from trampling and browsing by cattle and horses. Less damage was evident in 1998.

The population of *S. archeyi* on Whananaki Spit is highly threatened and may not survive without management intervention. The most effective remedial measures would be to fence off the existing site along the coastal margin of the



Figure 7. Location of living *Succinea archeyi* at Te Ruatahi and Whananaki Spit.

dunefield and remove all the pines for 30–40 m back from the coast. The possibility of such an approach should be discussed with the landowner. Similarly, the part of the site on District Council land should also be fenced off, along with removal of all young and mature pines from the vicinity. If the Whananaki population cannot be adequately protected in situ, then translocation of snails to some other site(s) would need to be considered.



Figure 8. Distribution of living *Succinea archeyi* at Ngunguru Spit, and location of Horahora River site.

2.9 NGUNGURU SPIT

From 1994 to 1998, *S. archeyi* was present along the seaward side and northern end of Ngunguru Spit, and in deflation hollows in the middle of the spit (Fig. 8). The snails were living in sandfield vegetation comprising spinifex, *C. leptophylla*, *I. nodosa*, *M. complexa* and exotic grasses and herbs. The areas of native dune vegetation showed extensive damage from browsing and trampling by stock, and infestations of pampas, *Polygala myrtifolia*, and brush wattle (*Paraserianthes lophantha*) were locally displacing native plant species.

Ngunguru Spit is entirely in freehold title, and is presently mostly undeveloped. However, the owner is proposing to subdivide the spit for low-density residential development. The population of *S. archeyi* on Ngunguru Spit is one of the most extensive still remaining (i.e. covering c. 40 ha) and is the largest in southern Northland. Its future survival is contingent on preservation of the

native sandfield habitat on the spit. Stock damage and weed invasion are serious existing threats, although grazing cattle may in fact be slowing the spread of pampas. If the proposed subdivision of Ngunguru Spit goes ahead, it could lead to further habitat degradation or loss through land development, introduction of additional invasive plant species, and damage from vehicles and stock.

From a conservation perspective, the ecological value of Ngunguru Spit and the population of *S. archeyi* would be best protected if the spit remained undeveloped, stock were fenced out, and a weed control programme was undertaken to deal with the invasive exotic plant species present. Such an approach would be contingent on landowner support, which is unlikely to be obtained, or on purchase of the spit by the Crown for reserve purposes.

2.10 HORA HORA RIVER

In 1995, a small population of *S. archeyi* was found on a foredune at the northern end of the beach north of Horahora River mouth, on Northland's east coast (Q06/471141; Fig. 8). Snails were very rare at this site, and the total area occupied by the colony was only c. 400 m². *Succinea archeyi* was living under sparse sandfield vegetation of spinifex, *I. nodosa*, *M. complexa* and exotic grasses and herbs, in the vicinity of a solitary pohutukawa tree.

This population of *S. archeyi* is located on a prehistoric Maori burial ground on privately-owned pastoral farmland. Most of the area occupied by the snail colony was fenced off from adjoining paddocks, presumably for cultural reasons. However, at the time of the 1995 visit, and also a subsequent visit in 1998, the fence was damaged and no longer stock proof.

The Horahora population is highly threatened because of its very small size, and the likely prospect of habitat destruction from stock browsing and trampling, and dune erosion. If landowner approval can be obtained, the existing stock enclosure fence should be repaired and a programme of regular fence maintenance undertaken.

2.11 WAIKAWAU BAY

In 1996-97, a population of *S. archeyi* extended for 350 m along the coastal foredunes in the middle part of Waikawau Bay, northeastern Coromandel Peninsula (T10/364082-367079; Fig. 9). Snails were found up to 100 m inland, as far as the second dune ridge back from the coast, extending over c. 4 ha. The vegetation in the area occupied by *S. archeyi* mostly comprised sparse sandfield dominated by spinifex, *C. soldanella* and exotic grasses and herbs, with minor *C. acerosa*, *I. nodosa* and *M. complexa*. Patches of prostrate shrubland dominated by *M. complexa* and *C. soldanella* with *Carex*, *C. acerosa*, flax, *I. nodosa* and spinifex were present locally.

This snail colony is located within the Waikawau Bay Farm Park Recreation Reserve administered by the Department of Conservation. The population is not under any threat. The native dune vegetation is thriving, and the population of *S. archeyi* covers a moderately large area. At the time of the 1996-97 visits, a

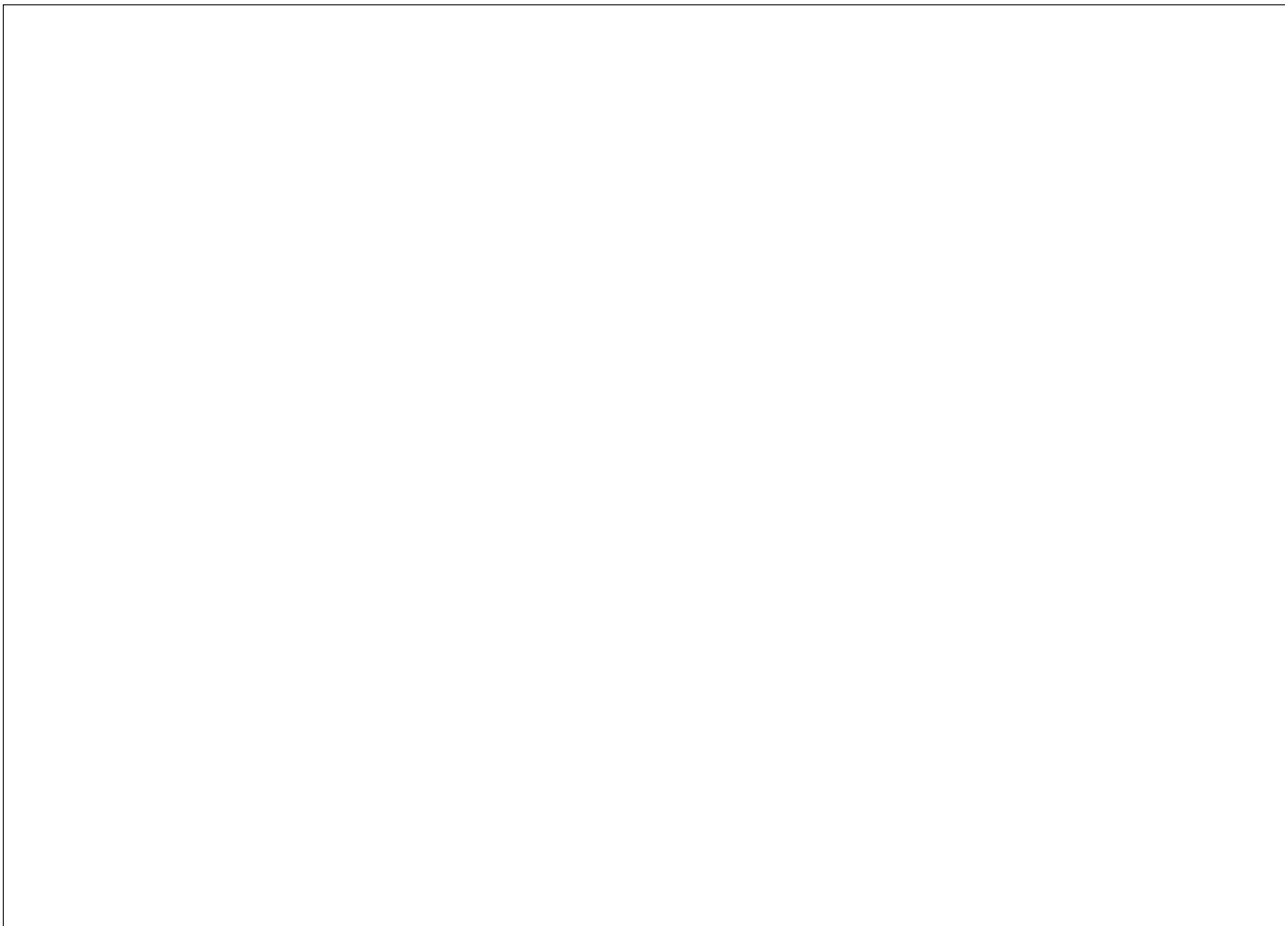


Figure 9. Distribution of living *Succinea archeyi* at Waikawau Bay.

few lupin and pampas plants were present, together with patches of iceplant (*Caprobotus* sp.) and young wilding pines (*Pinus radiata*), on dunes in the vicinity of the *S. archeyi* colony. These weed species should be eradicated from the Waikawau dune belt, if that has not already been done.

2.12 OPITO BAY

In 1996, a small population of *S. archeyi* was found on a foredune at the southeastern end of Opito Bay, on northeastern Coromandel Peninsula (Fig. 10). The population extended for c. 150 m along the upper, seaward dune slope from T10/620938-621939, and occupied an area of c. 1500 m². Snails were most common at the eastern end of the dune in an area of deflated prehistoric Maori shell and hangi stone midden. The sandfield vegetation at this site comprised spinifex and exotic grasses and herbs, with locally common *C. soldanella* and scattered *C. leptophylla*, *I. nodosa* and *M. complexa*.

The Opito Bay population of *S. archeyi* is located on an unformed public road administered by the Thames-Coromandel District Council. In 1996, the dune at this site was fenced off from stock, and the native sandfield flora was thriving. However, patches of iceplant and a small wilding pine were present at the eastern end of the dune, and lupins were scattered along the dune. These pose a future threat to the native flora and should be eradicated. Similarly, small pohutukawa shrubs planted within and adjacent to the area occupied by *S. archeyi* should also be removed, because they have the potential to drastically reduce the area of sandfield habitat available for snails at this site.

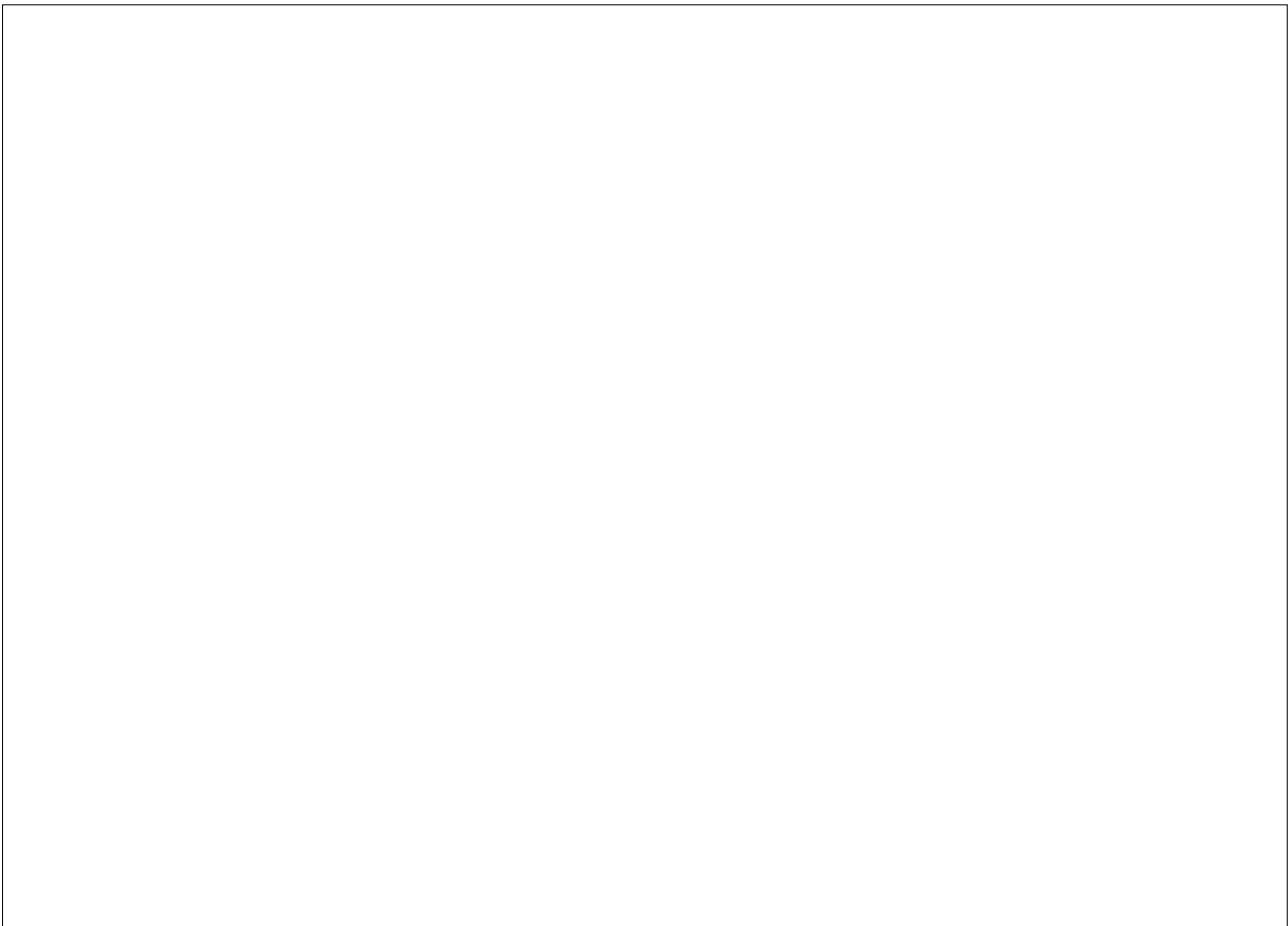


Figure 10. Location of living *Succinea archeyi* at Opito Bay.

I recommend that any planting carried out at this site should be restricted to shrub species typical of sandfield and dune prostrate shrubland associations. For example, *C. acerosa*, common on dune elsewhere in Opito Bay, could be reintroduced to the area occupied by the snail population, to help stabilise the dune and provide greater habitat diversity.

2.13 TAIRUA BEACH

In 1997, two colonies of *S. archeyi* survived on dunes at Tairua Beach (Fig. 11). Both colonies were located within a Local Purpose Reserve (Esplanade) administered by the Thames Coromandel District Council. The larger colony occupied a hollow behind the foredune crest near the middle of the beach at T11/648637, and covered an area of c. 250 m². This site had sparse sandfield vegetation of spinifex, *C. soldanella*, *I. nodosa* and exotic grasses and herbs. Rare plants of *C. leptophylla* and *M. complexa* were also present on the dune crest nearby, and small ngaio (*Myoporum laetum*) shrubs had recently been planted throughout the area. The other colony of *S. archeyi*, located on a small knoll on the seaward edge of the dune crest near the northern end of the beach (T11/646640), was restricted to a total area of only c. 25 m². At that site the snails were living in a patch of sandfield vegetation that included spinifex, *C. soldanella* and *M. complexa*, bordered to landwards by 2 m high planted karo (*Pittosporum crassifolium*) and ngaio shrubs.

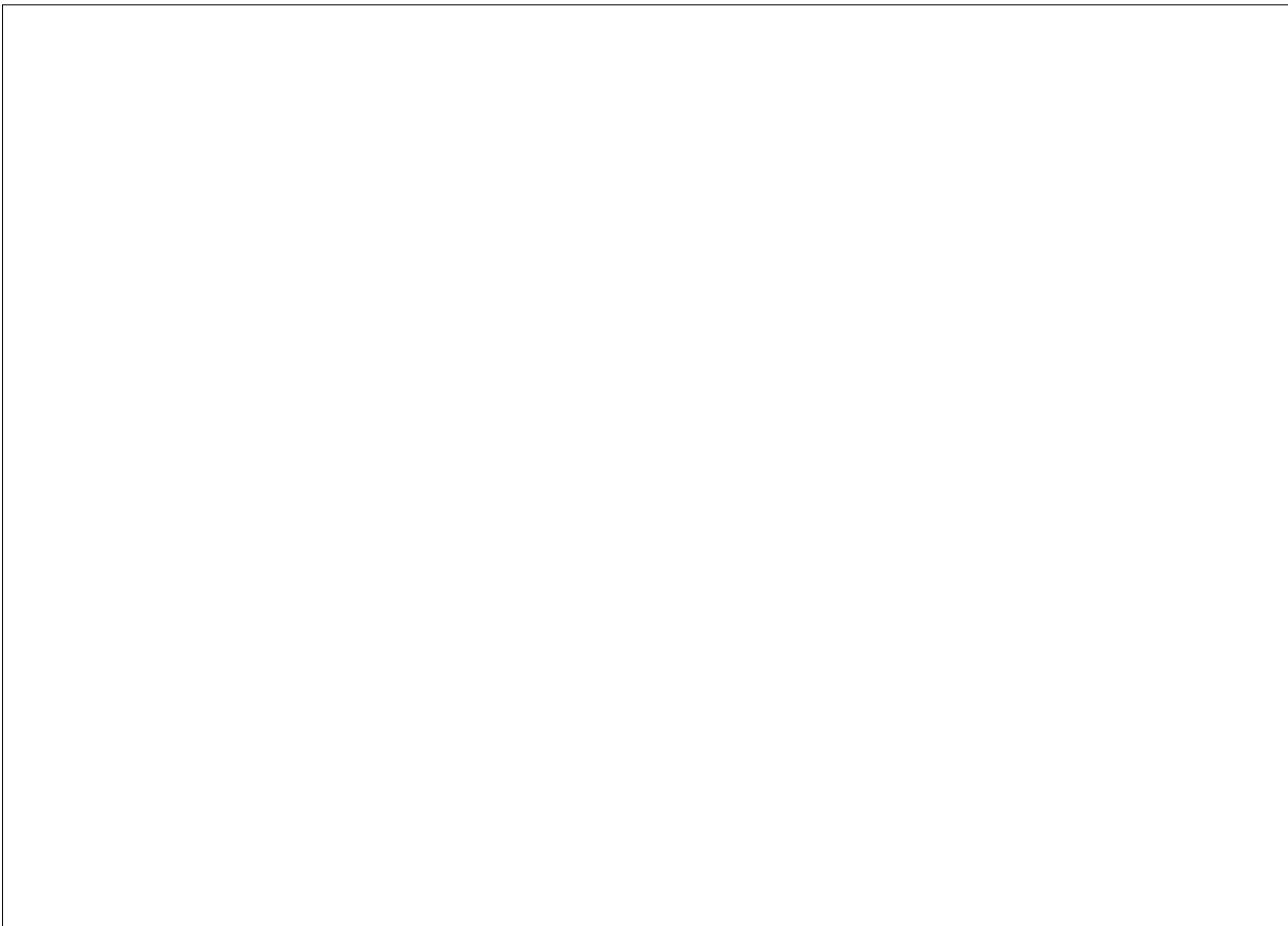


Figure 11. Location of living *Succinea archeyi* at Tairua Beach.

Both colonies of *S. archeyi* at Tairua are highly threatened. The dunefield is extensively eroded, and there have been ongoing attempts to stabilise it by planting a variety of native and exotic shrub and groundcover species. The combination of erosion and establishment of introduced plants has led to fragmentation and modification of the habitats occupied by *S. archeyi*, with the cumulative result that the species is now restricted to two very small habitat remnants, which are likely to be lost if no remedial management is undertaken.

In order to preserve the Tairua population of *S. archeyi*, I recommend that a programme be undertaken to restore native sandfield habitat within the presently open and sparsely vegetated dune area in the vicinity of the southern snail population (i.e. at T11/648637). Such restoration would require existing planted shrubs and exotic groundcover species to be removed and replaced with spinifex, *C. leptophylla*, *C. acerosa* and *I. nodosa*. If a native sandfield vegetation cover could be established here, it would help stabilise the dunes as well as provide habitat for *S. archeyi* to expand into.

2.14 OPOUTERE BEACH

In 1995 a population of *S. archeyi* was found on dunes at the southern end of Opoitere Beach, eastern Coromandel Peninsula (Fig. 12). The population extended for a distance of c. 700 m between T12/668508 and 668514, over c. 3 ha on the seaward face and crest of a high foredune. The vegetation in the area occupied by *S. archeyi* comprised sandfield of *C. soldanella*,

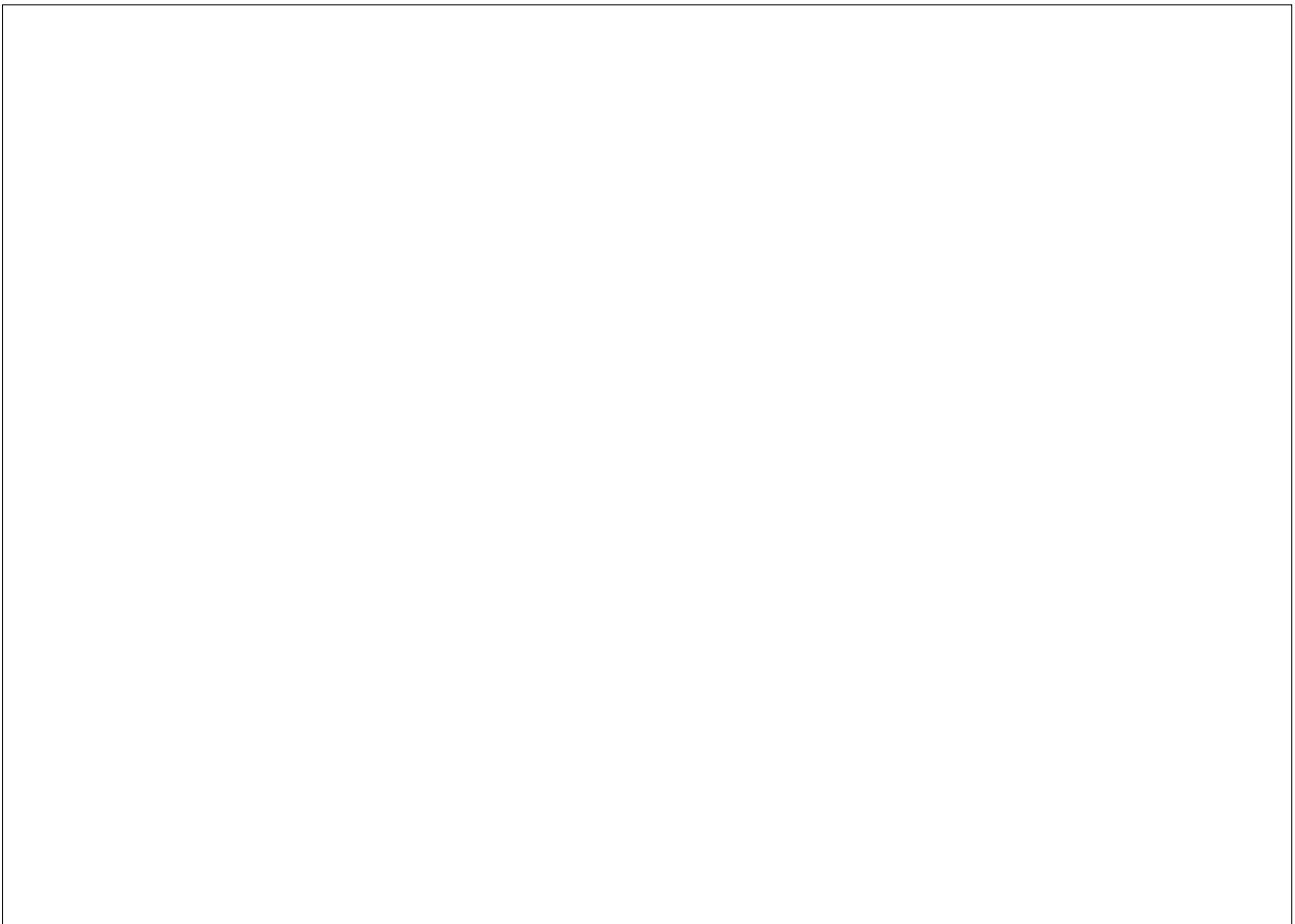


Figure 12. Distribution of living *Succinea archeyi* at Opoutere Beach.

C. leptophylla, *C. acerosa*, *I. nodosa* and spinifex, with exotic grasses, herbs and wilding pines (*Pinus radiata*). The last named species was spreading towards the coast from a plantation of mature pines on the inland part of the dune belt.

The population of *S. archeyi* at Opoutere is located within a Maori Burial Ground Reserve and marginal strip administered by the Department of Conservation. This population and the one at Waikawau Bay are the two largest remaining on Coromandel Peninsula. However, at Opoutere, the spread of wilding pines poses a serious threat to the native sandfield habitat occupied by *S. archeyi*. The establishment of windshorn, shrubby pines on the crest and seaward slope of the foredune here is leading to progressive loss of the native plant cover upon which the snails depend. I recommend that a programme be undertaken to eradicate all pines from the seaward foredune and first interdune hollow back from the coast, south of c. T12/665515, and that regular follow-up control be undertaken to keep this dune area free of pines and any other invasive weeds that could degrade or displace the existing native flora.

2.15 WHANGAMATA BEACH

In 1997, a small population of *S. archeyi* survived on dunes at the northern end of Whangamata Beach, eastern Coromandel Peninsula (Fig. 13). This colony covered an area of c. 2000 m², and was located between the ends of Barrowclough Road and Hunt Street (T12/657403-657404) on an unformed

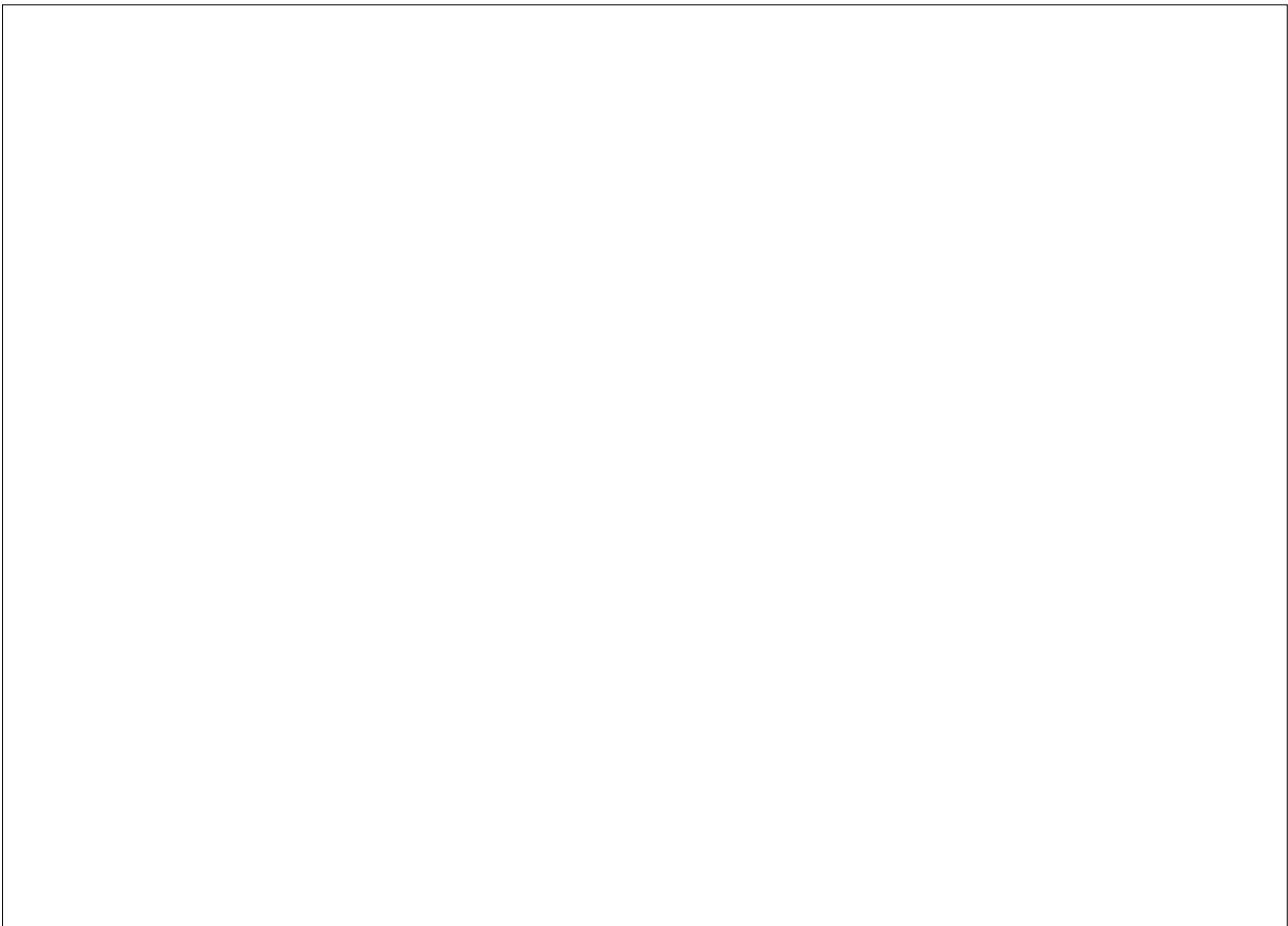


Figure 13. Location of living *Succinea archbeyi* site at Whangamata Beach.

public road administered by the District Council. The snails here were living in a mosaic of sandfield vegetation and prostrate shrubland comprising *C. soldanella*, *C. acerosa*, *I. nodosa*, *M. complexa*, *P. arenaria*, spinifex, and exotic grasses and herbs. Planted and invasive exotic species were also present, including three small pohutukawa trees, *Acacia longifolia* and *Cotoneaster glaucophyllus* shrubs, *Agapanthus*, and *Arctotis* daisies. In addition, pampas (*Cortaderia ?seloana*) was present in a dune deflation hollow immediately to the south.

In order to preserve the native sandfield flora and habitat for *S. archbeyi* at this site, I recommend that the invasive exotic plant species noted above be eradicated from the dunes in this area, and that the small pohutukawa trees also be removed. The site is subjected to heavy foot traffic from people getting to and from the beach, with resultant damage to the dune vegetation and an increased risk of sand erosion. Ideally this dune area should be fenced off, and public beach access be restricted to managed pathways from the ends of Barrowclough Road and Hunt Street.

3. Conservation status

3.1 DISTRIBUTION

Estimated areas occupied by the various extant populations of *S. archeyi* are listed in Table 1. The four largest populations are in Northland, and range between 10 ha and 100 ha in area (i.e. Spirits Bay, Puwheke, Tokerau, Ngunguru Spit). Three populations cover between 2 ha and 4 ha; one is in Northland (Whananaki Spit) and two are on Coromandel Peninsula (Waikawau Bay, Opoutere Beach). All other populations of *S. archeyi* occupy less than 0.25 ha, and nine of these smaller populations occupy less than 0.05 ha each.

S. archeyi is still quite widely distributed in northern Northland, and the population at Tom Bowling Bay is the only one threatened. *Succinea archeyi* is much rarer in eastern Northland, where only four populations are known and three of these are threatened (i.e. Whananaki Spit, Ngunguru Spit, Horahora River). On eastern Coromandel Peninsula, *S. archeyi* is known from five locations but it is threatened at four of those (i.e. Opito Bay, Tairua Beach, Opoutere Beach, Whangamata Beach).

TABLE 1. AREAL EXTENT AND EXISTING THREATS TO POPULATIONS OF *Succinea archeyi*.

SITE	APPROX. AREAL EXTENT	EXISTING THREATS			
		WEED INVASION	STOCK DAMAGE	LAND DEVELOPMENT	DUNE EROSION
Motuopao	400 m ²	-	-	-	-
Cape Maria van Diemen	200 m ²	-	-	-	-
Paraspiritus headland	60 m ²	-	-	-	-
Herangi summit	150 m ²	-	-	-	-
NW Herangi	200 m ²	-	-	-	-
Te Kohatu Point	2500 m ²	-	-	-	-
Spirits Bay	75 ha	-	-	-	-
Tom Bowling Bay	400 m ²	-	yes	-	-
Puwheke Beach	10 ha	-	-	-	-
Tokerau Beach	100 ha	-	-	-	-
Te Ruatahi	1150 m ²	-	-	-	-
Whananaki Spit	2 ha	yes	yes	yes	-
Ngunguru Spit	40 ha	yes	yes	yes	-
Horahora River	400 m ²	-	yes	-	-
Waikawau Bay	4 ha	-	-	-	-
Opito Bay	1500 m ²	yes	-	yes	-
Tairua Beach north	25 m ²	yes	-	yes	yes
Tairua Beach south	250 m ²	yes	-	yes	yes
Opoutere Beach	3 ha	yes	-	-	-
Whangamata Beach	2000 m ²	yes	-	yes	yes

Succinea archeyi was also recorded historically from dunes at Omanu and Papamoa beaches, Bay of Plenty (Thomson & Jones 1954), but no live snails were found there during a cursory search in March 1996. There is a possibility that *S. archeyi* still survives in that area.

Succinea archeyi was described by Powell (1950) as flourishing during 1949–50 on dunes on the western half of Taipa Beach, northern Northland, but is now extinct there. The extensive native sandfield habitat that formerly existed at this site (see photograph in Powell 1950) was almost completely destroyed as a result of foreshore development and invasion by exotic plant species.

3.2 THREATS

Categories of threat affecting *S. archeyi* are listed in Table 1. Weed invasion threatens the dune habitats at Ngunguru Spit, Opito Bay, Tairua Beach, Opoutere Beach and Whangamata Beach, and it potentially could become a serious threat at other *S. archeyi* sites as well. The spread of pampas (*Cortaderia selloana*) onto dunefields is of particular concern as it poses a major threat to native dune floras.

Damage to dune habitats from browsing and trampling by stock is threatening *S. archeyi* at Tom Bowling Bay, Whananaki Spit, Ngunguru Spit and Horahora River. If stock continue to have access to the Tom Bowling and Horahora dunes, they will almost certainly destroy the tiny remaining areas of snail habitat and cause the extinction of those populations of *S. archeyi*. Stock damage is not presently of such critical concern at Whananaki and Ngunguru Spits, given that larger areas of native sandfield vegetation exist at those sites.

Land development is threatening *S. archeyi* at Whananaki Spit, Ngunguru Spit, Opito Bay, Tairua Beach and Whangamata Beach. Three different kinds of development are involved, namely residential subdivision, plantation forestry and planting for amenity or erosion control purposes. *Succinea archeyi* at Ngunguru Spit is under threat from a proposed low density residential subdivision that would inevitably have attendant adverse impacts on existing native sandfield habitats. Establishment of a pine plantation over much of the dune area occupied by the Whananaki Spit population of *S. archeyi* poses a serious threat to the future survival of that population. Similarly, plantings of pohutukawa at Opito Bay and Whangamata Beach, and of ngaio at Tairua Beach, threaten the existing native sandfield and prostrate shrubland habitats occupied by *S. archeyi* there.

Wind erosion of dunes is a serious threat at Tairua Beach, because parts of the foredune there are unvegetated or very sparsely vegetated. As a consequence, *S. archeyi* at Tairua is vulnerable to habitat destruction from erosion or burial by sand. At Whangamata Beach, there is a risk that continued uncontrolled pedestrian access will result in erosion and loss of snail habitat there as well.

Other ecological factors that could be adversely affecting *S. archeyi* in Northland and Coromandel Peninsula include predation by introduced mammals and invertebrates, and the impact of rabbits on native dune vegetation. No data are available on whether small predatory mammals such as mice (*Mus musculus*), rats (*Rattus* spp.), hedgehogs (*Erinaceus europaeus*),

weasels (*Mustela nivalis vulgaris*) and possums (*Trichosurus vulpecula*) eat *S. archeyi*, or whether they have a significant adverse effect on any of the snail populations. However, the fact that *S. archeyi* increased in abundance on Motuopao following extermination of kiore there, provides circumstantial evidence that rat predation was probably a key factor limiting snail population size at that site.

The introduced European snail *Oxychilus alliarius* Miller, a known predator of snails and snail eggs (Barker 1999), is present at many of the Northland and Coromandel sites of *S. archeyi* populations (pers. obs.), but its effect on populations of the latter species is unknown.

The ecological impact of rabbits on *S. archeyi* populations is also largely unknown. Rabbits are present in relatively high numbers at many of the snail population sites (as indicated by browse, scrapes and droppings), and they clearly have an important adverse effect on plant growth and recruitment in native dune floras. However, it is not known if grazing by rabbits has an entirely negative impact on *S. archeyi* through habitat attrition, or whether it can have a beneficial effect in some situations by creating or maintaining mosaics of vegetation and open sand patches favoured by *S. archeyi*. Whichever is the case, the impact of rabbits is presumably most significant for those *S. archeyi* populations restricted to small habitat remnants, such as those between Cape Maria van Diemen and Herangi, and at Tom Bowling Bay, Te Ruatahi, Horahora and Opito. There was no evidence of rabbit presence at the Tairua and Whangamata sites.

4. Future action required

Management requirements for *S. archeyi* are listed in Table 2. They are based on the philosophy that threatened populations should be managed in situ where possible. However, translocation may be necessary in the future for the Whananaki Spit population, if existing habitat at that site is lost to pine forest.

The populations of *S. archeyi* on private land at Tom Bowling Bay, Ngunguru Spit and Horahora River would benefit considerably from being fenced off from stock. The respective landowners should be approached to determine whether they would agree to this.

The populations of *S. archeyi* at Te Ruatahi, Opito Bay and Tairua Beach require habitat improvement through planting native dune species such as *C. leptophylla*, *C. acerosa*, *P. arenaria* and spinifex (i.e. to increase vegetation cover and habitat diversity at these sites).

Weed control is required in areas occupied by *S. archeyi* at Ngunguru Spit, Waikawau Bay, Opito Bay, Tairua Beach, Opoutere Beach and Whangamata Beach. In addition, the planted pohutukawa at the Opito and Whangamata sites, and ngaio at the Tairua Beach (south) site, should be removed.

Regular weed monitoring is required at all sites with *S. archeyi*, to enable early detection and control of invasive species that have the potential to significantly modify or replace existing native vegetation.

To summarise, I recommend the following management actions:

Northern Northland

- Build a stock-proof fence around Tom Bowling Bay site (dependent on landowner agreement).

Eastern Northland

- Improve habitat at Te Ruatahi site by plantings of *C. leptophylla*, *C. acerosa* and *P. arenaria*.
- Remove pines from vicinity of Whananaki Spit site and build a stock enclosure fence around the snail colony (dependent on landowner agreement).
- Protect Ngunguru Spit from development (e.g. through District Plan provisions or Crown purchase), exclude stock and undertake weed control (dependent on landowner agreement).
- Repair and maintain the stock enclosure fence at Horahora River site (dependent on landowner agreement).

Coromandel Peninsula

- Eradicate iceplant, lupins, pampas and pines from Waikawau Bay site (if that has not been done already).
- Remove young pohutukawa from the Opito Bay site, and replace them with *C. acerosa*.
- Improve habitat at the Tairua (south) site by planting spinifex, *C. leptophylla*, *C. acerosa* and *I. nodosa*. Remove the planted ngaio shrubs in this area.

TABLE 2. FUTURE ACTION REQUIRED FOR SITES WITH EXTANT *Succinea archbeyi*.

	LAND TENURE	FENCING	HABITAT PLANTING	WEED CONTROL	WEED MONITORING
Motuopao	DOC	-	-	-	yes
Cape Maria van Diemen	DOC	-	-	-	yes
Paraspiritus headland	DOC	-	-	-	yes
Herangi summit	DOC	-	-	-	yes
NW Herangi	DOC	-	-	-	yes
Te Kohatu Point	DOC	-	-	-	yes
Spirits Bay	DOC	-	-	-	yes
Tom Bowling Bay	Private	yes	-	-	yes
Puwheke Beach	DOC	-	-	-	yes
Tokerau Beach	DOC, Private	-	-	-	yes
Te Ruatahi	DOC	-	yes	-	yes
Whananaki Spit	Private, District Council	yes	-	yes	yes
Ngunguru Spit	Private	yes	-	yes	yes
Horahora River	Private	yes	-	-	yes
Waikawau Bay	DOC	-	-	yes	yes
Opito Bay	District Council	-	yes	yes	yes
Tairua Beach north	District Council	-	yes	yes	yes
Tairua Beach south	District Council	-	yes	yes	yes
Opoutere Beach	DOC	-	-	yes	yes
Whangamata Beach	District Council	yes	-	yes	yes

- At Opoutere Beach, eradicate wilding pines from the seaward foredune and first interdune hollow, south of T12/665515.
- At the Whangamata site, fence off dunes and provide beach access along managed paths from the ends of Barrowclough Road and Hunt Street. Eradicate acacia, agapanthus, arctotis and cotoneaster plants, and remove the three small pohutukawas.

5. Further survey and research

Further survey of the dunes between Omanu and Papamoa beaches, Bay of Plenty, is required to determine whether live *S. archeyi* still exist there (see Thomson 1952; Thomson & Jones 1954).

There is also a strong possibility that undiscovered populations of *S. archeyi* are present in Northland and eastern Coromandel-Bay of Plenty. Dunefields in Northland that were surveyed cursorily or not at all during the present study include those between Great Exhibition Bay and Karikari Bay (excluding Puwheke Beach), Taemaro, Waimahana and Motukahakaha bays northwest of Whangaroa, and Bream and Pakiri bays south of Whangarei. Most of the eastern Coromandel-Bay of Plenty dunefields, including those on Matakana Island, also remain unsurveyed, as do dunefields on Great Barrier Island.

Aspects of dunefield ecology that are relevant to the conservation of *S. archeyi*, and which require investigation, are the impacts of introduced predatory mammals and invertebrates on native dunefield invertebrate faunas, and the impact of rabbits on composition and structure of dune vegetation.

Finally, a taxonomic study is needed to determine whether morphologic and/or genetic variation exists between any of the northern Northland, eastern Northland and Coromandel populations of *S. archeyi* and, if so, whether additional conservation measures are required to preserve variation within the taxon.

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