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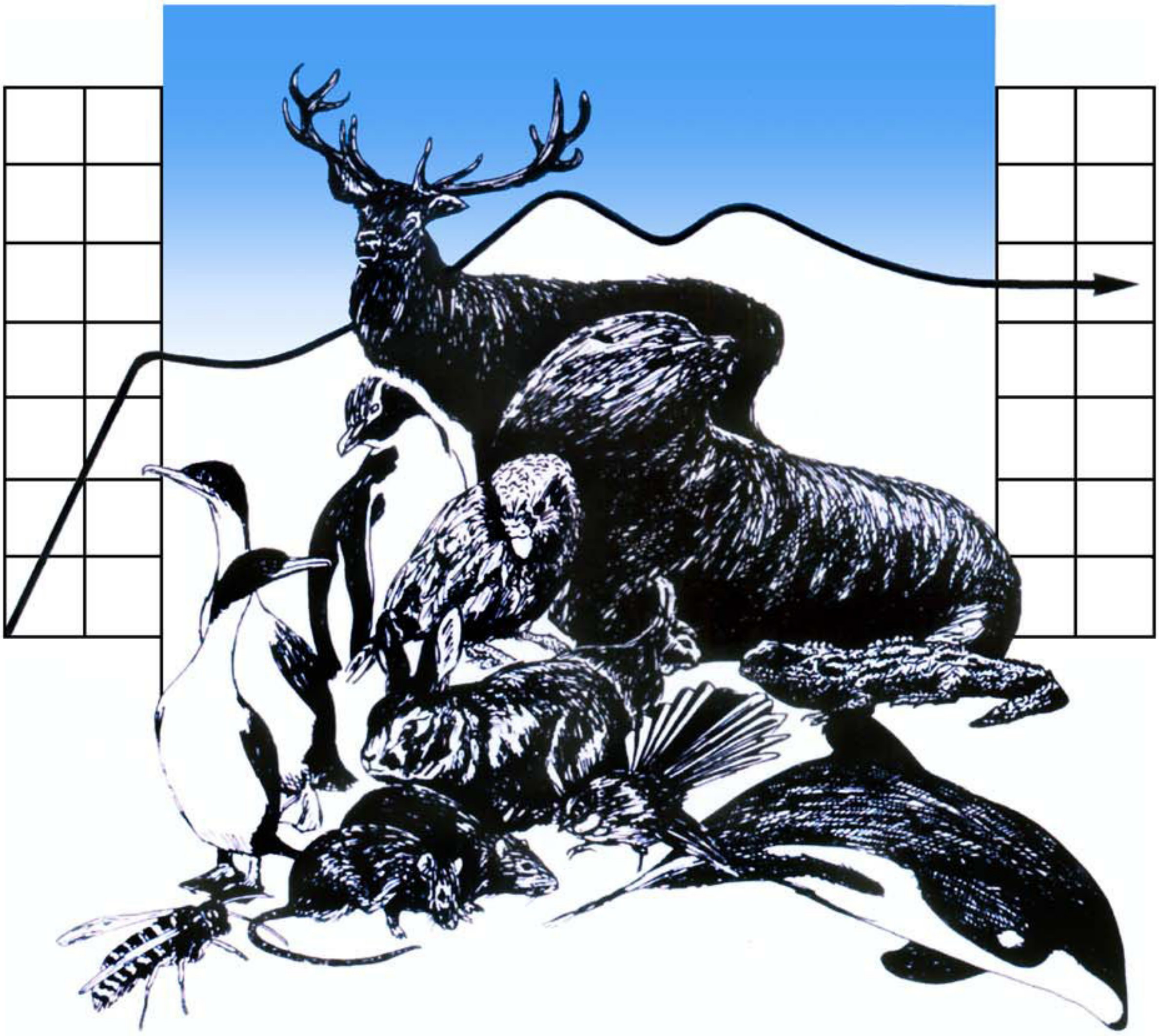

WILDLIFE MANAGEMENT

Seabird fauna of Long Point: a historical perspective

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By Jens Andre Weller

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"What is a scientist after all? It is a curious man looking through a keyhole, the keyhole of nature, trying to know what's going on."

— Jacques Yves Cousteau

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1.0 Summary

The Long Point Reserve today

The Long Point/ Irahuka Reserve at the South Islands Catlins coastline was purchased by the Yellow-Eyed Penguin Trust (YEP Trust) in 2009. The Long Point Reserve has a total area of ~ 75 ha, and is recently protected under the Reserves Act (1997) mainly due to breeding colonies of Yellow-eyed Penguins (*Megadyptes Antipodes*). The YEP Trust plans the reintroduction of historical abundant seabirds of this region as significant step in Long Points habitat restoration.

The urgency of seabird conservation

The historical extinction rate of large ranging seabird species appears to be much lower than the one of forest bird species. This assumption however, should not hide the fact that today 16 from 77 in New Zealand endemic seabird species have the conservation status of being threatened, and 47 of these 77 are considered at risk.

Local seabird species extirpation is caused by anthropogenic factors

Natural occurring climatic changes played always an important role in the natural succession of Long Points and the Catlins vegetation. Clearing fires, the introduction of mammalian predators and bird hunting mainly by early Polynesian land occupiers were the first significant anthropogenic changes of the Catlins environment that commenced about 1000 years ago. Changes in land use due to logging, dairy and sheep farming by European settlers in the last two centuries in combination with an increase of introduced mammalian predator species in New Zealand and on Pacific Islands increased significantly the anthropogenic pressure on all seabird species breeding habitats and their population sizes.

The reintroduction proposal for seabirds and their need for advocacy

At Long Point, the recovering of recently abundant remnant populations from Yellow-eyed Penguins, Fiordland-crested Penguin (*Eudyptes pachyrhynchus)*, Spotted Shags (*Phalacrocorax punctatus*) and Sooty shearwater (*Puffinus griseus*) should have highest priority.

In the near future, more historically abundant seabird species should be reintroduced at Long Point. Some experts share the opinion that seabird ecosystem services are an underestimated contribution, or are even ignored by many scientists and the public. Guano, food scraps, eggs, feathers, and bodies of dead chicks and adults of seabirds are organic material and substantial nutrients for many aquatic and terrestrial ecosystems. Seabirds function as the “mobile link” that connects those habitats in space and time.

The fascinating lifestyle of seabirds is hard to observe for humans nowadays due to the retreat of breeding colonies to predator free and remote offshore Islands. The Long Point Reserve has the potential to bring a few former traditionally abundant seabird species home.

2.0 Long Points/ Irahukas location and legal status

Long Point / Irahuka, situated between Tahakopa Bay and Purakaunui Bay in the Catlins, South Otago, 15km south-east of Owaka. Long Point (-46.574911S, 169.579468E) is part of the Catlins core, which belongs to the Forty one Special places of significant conservation value (Long Point and Chasm Island; Site No: 13-37; DOC) in the Otago region (DOC, 1994; see below).The conservation values of this area include Maori Cultural values and are significant to Ngai Tahu iwi (DOC, 1994).

A part of Long Point is considered as a Scenic Reserve (see below), mainly due to colonies of Yellow-eyed Penguins *(Megadyptes Antipodes*; DOC, 1994; 1998); IUCN red list: endangered; nationally vulnerable. Breeding colonies of New Zealand fur seals *(Arctocephalus forsteri)* are found on the east side of the point; IUCN: least concern; Population trend: increasing.

In 2009 the Department of Conservation reclassified the area of 25ha at the tip of Long Point as a scenic reserve. In the same year the Yellow-eyed Penguin Trust (YEP) purchased the waist area of the reserve as part of an overall land purchase together with the Nature Heritage Fund (NHF). Two blocks are held in freehold title by the Trust and two by the Crown, with the Trust appointed as the administering body of the crown blocks. In addition, a fifth block of Crown land was vested in the Trust for management.

As the administering body, the Yellow-eyed penguin Trust has legal obligations following paragraph 40 of the Reserves Act from 1977. The duty of the Trust is the managing and controlling of the reserve and to ensure that its use, enjoyment, development, maintenance and preservation are adhering to the Reserves Act (Draft Long Point Management Plan, 2011).

"The Trust (YEP) has formal Protected Private Land agreements with the Crown, signed on 3rd May 2010, that the Long Point freehold block held by the Trust is to be managed in the interests of both biodiversity and public recreation, while Cosgrove Creek, classified as Scientific Reserve, will be managed in the interest of biodiversity with no public access." (Draft Long Point Management Plan, 2011).

The total land owned by the Yellow-eyed Penguin Trust is ~38.5 hectares.
The total land owned by the Crown is ~12.75 hectares, plus 25.0ha in existing reserve at the tip of Long Point.

Both blocks owned by the Yellow-eyed Penguin Trust are designated as Scenic Reserves. One block holds an area of ~28.2 hectares (Lot 1-2; Figure 1); the second block holds ~10.3 hectares (Lot 1-3; Figure 1).

The two Crown land blocks that are administered by YEP hold an area of ~9ha (Section 29 Block XI; Figure 1) and ~3.8 ha (Section 28 Block XI; Figure 1). Both blocks are designated as Scenic Reserves.

Section 27 Block XI (Figure 1), designated as Scenic Reserve is vested in the Yellow-eyed Penguin Trust since October 2010 and holds an area of ~25.0 hectares (Draft Long Point Management Plan, 2011).

The Yellow-eyed Penguin Trust plans the reintroduction of historically abundant seabird species at Long Point as part of a long-term habitat restoration project.

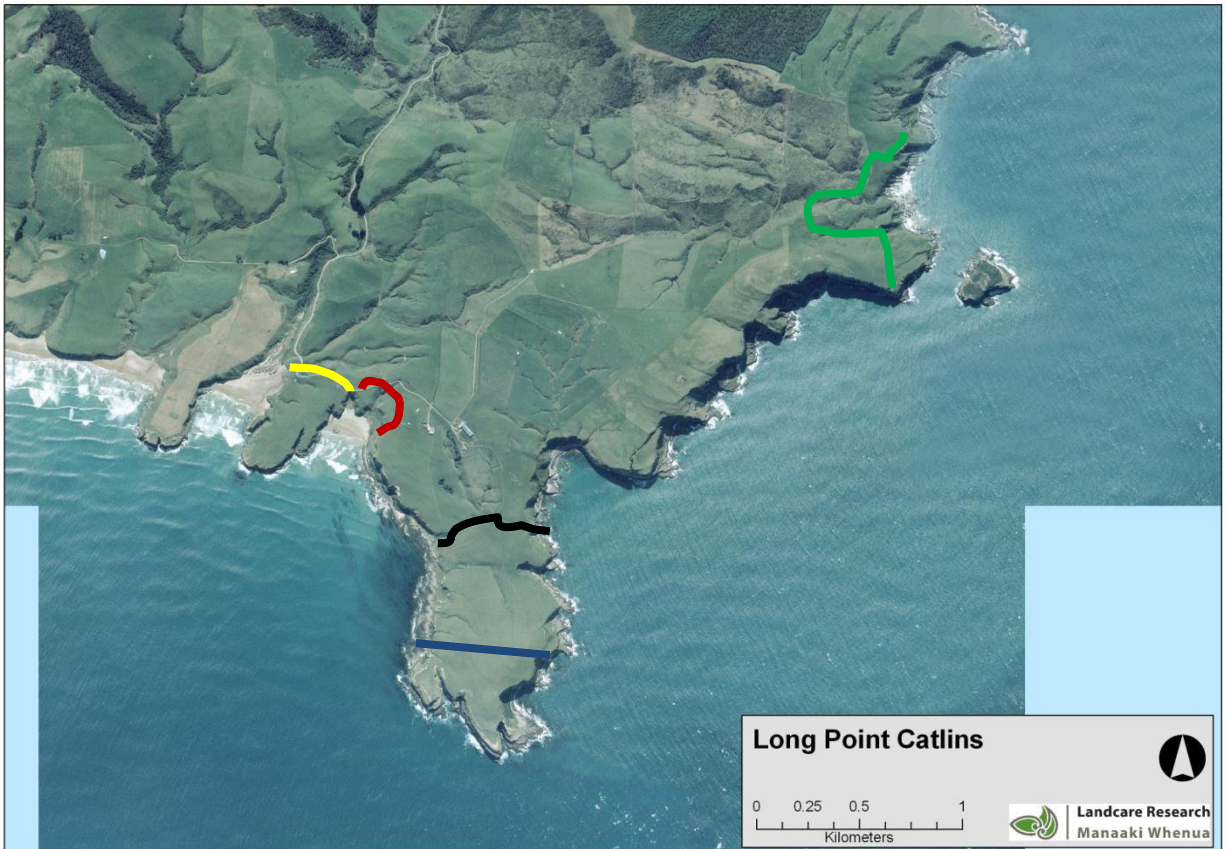

Figure 1: Sections of the Long Point/ Irahuka Reserve administered by YEP and DOC. The Sections start below the coloured lines.

- Lot 1-2
- Lot 1-3
- Section 29 Block XI
- Section 28 Block XI
- Section 27 Block XI

2.2 Geological history of the Catlins

Today, parts of the Southland Syncline strike from South East to North West in the Catlins region as a result of major earth movements that occurred in the late Jurassic about 140 million years ago (see Figure 3 below; Buckingham,1987). The land surface of the Catlins mostly consists of freshwater, shallow-water marine and estuarine sediments, which were transported from the mainly submerged New Zealand continent (Figure 3; Hamel, 1976). The rock units of the Southland Syncline in the Catlins region are mainly thin and consist of bedded sandstones, siltstones and mudstones, which are interbedded with occasional coarser-grained sandstones and conglomerates (Figure 3). Most rock units contain feldspar fragments with characteristically little quartz components (Buckingham, 1987).

The strike ridges of the syncline are thicker and consist of more coarsely grained sandstone. The fold structure is complicated and "depending upon the location of particular ridges in relation to the fold structure, these generally feature a steep escarpment on one face with more gentle slopes on the other" (Figure 2-3; Buckingham, 1987).

The Catlin's ranges are separated from the ranges of the Maclennan and Beresford Valley by flat topped ridges and the axis of folds that form these broad tablelands (Buckingham 1987). Linear Valleys and depressions such as the Tahakopa Valley can be found as a result of outcrops from fine grained and more readily eroded beds (Figure 2; Buckingham 1987). Streams can be generally associated with faults or joints. Gorges are often steep, feature a waterfall and adjoin often to a forest (Buckingham, 1987).

Towards the inland, at the head of the Mclennans River, Mount Pye is the highest point with 720m. Further inland from here the Mataura floodplain and various tributaries of the Clutha River show clearly how the ranges decreased in height (Buckingham, 1987).
At the coast the extremities of the strike ridge can be observed as High cliffs, which are characteristic for the Catlins coast (Buckingham, 1987).

The strongly indented 65 km long Catlins coastline extends from Nugget Point to approximately Waikawa. Peninsulas and Headlands like Long Point protect sandy beaches on the Catlins coast, which is exposed on regular basis to extreme southern and south-westerly winds (Figure 2; Hamel, 1976).Further has to be considered that erosions and vertical movements of the Synclines landmasses in the last 1000 years at the east coast of Otago have created variances in the coastal high tide mark (Hamel, 1976). The consequence might be that the composition of shellfish changed in the estuaries. Erosions and vertical landmass movements in the Catlins region make it also hard to determine its prehistoric vegetations (Hamel, 1976, Anderson 1992; see below).

2.3 Climate in the Catlins

In the Catlins, half of the annual precipitation (1500mm at the lowest elevations) is brought by south westerly winds. The climate can be described by cool humid, moist and equable conditions (Buckingham, 1987). Hamel (1976) refers to a comment of Garnier (1946) who states that, "being expressed particularly plentiful and reliable rainfall and relatively small mean annual ranges of temperature… Antarctic influences are particularly marked in the area from time to time a generally homogeneous climatic unit."

The higher hill country of the Tuatuku and Mclennan state forests face the heaviest precipitation exceeding 2500mm annually, while the rainfall is relatively less (1400-1000mm) for the inland northern and north eastern parts of the Catlins due to rain shadow effects (Buckingham, 1987). The moderate temperatures occurring in summer can drop rapid and frequently by the onset of south westerly winds. Hamel (1976) concludes that the maximum and minimum temperatures cannot be summarised in any standardised way due to an intra-regional variation that might occur even in the same valley. Further was investigated that the coldest months of the year are between June and November where brief snow falls can occur down to the valley floors (mean: 4° Celsius), while the temperature highs appear between the summer months of December to February (mean: 17° Celsius). Even during the summer months there is a chance of screen frosts during night which might have an effect on plant growth. November is the main period of shoot extension in trees and can be easily killed by frost (Hamel, 1976). Buckingham, 1987 describes that during summer on the east coast the south westerly winds are commonly modified or replaced by easterly sea breezes during the day time. The windiest months occur in spring and autumn, while less frequently occurring north westerly winds bring warm and dry weather in spring and summer.

The closest temperature measurements recorded that might give an understanding of Long Point weather patterns were recorded at Papatowai. During the hottest part of the day easterly sea breezes funnel along the hillside up to the Tahakopa Valley with a cooling function. The mean temperatures recorded at Papatowai showed that "the hillsides were the warmest, the river valley sites intermediate, and the coastal terrace side opposite to the Papatowai Moa-hunters side the coolest" (Hamel, 1976).

These findings about microclimate changes including dampness and evaporation have to be considered for the investigations of vegetation patterns at Long Point (Hamel, 1976; see below). The installation of at least one weather station is recommended for future research.

Anderson (1992) assumes that there must have been 4 dramatic events of climate change with a temperature deficit from ± 0.7° C during the last 1000 years on the South Island. Cooler episodes are expected to be about AD 1050-1100, 1250-1400, 1600-1770, and around 1850, with warmer phases between.

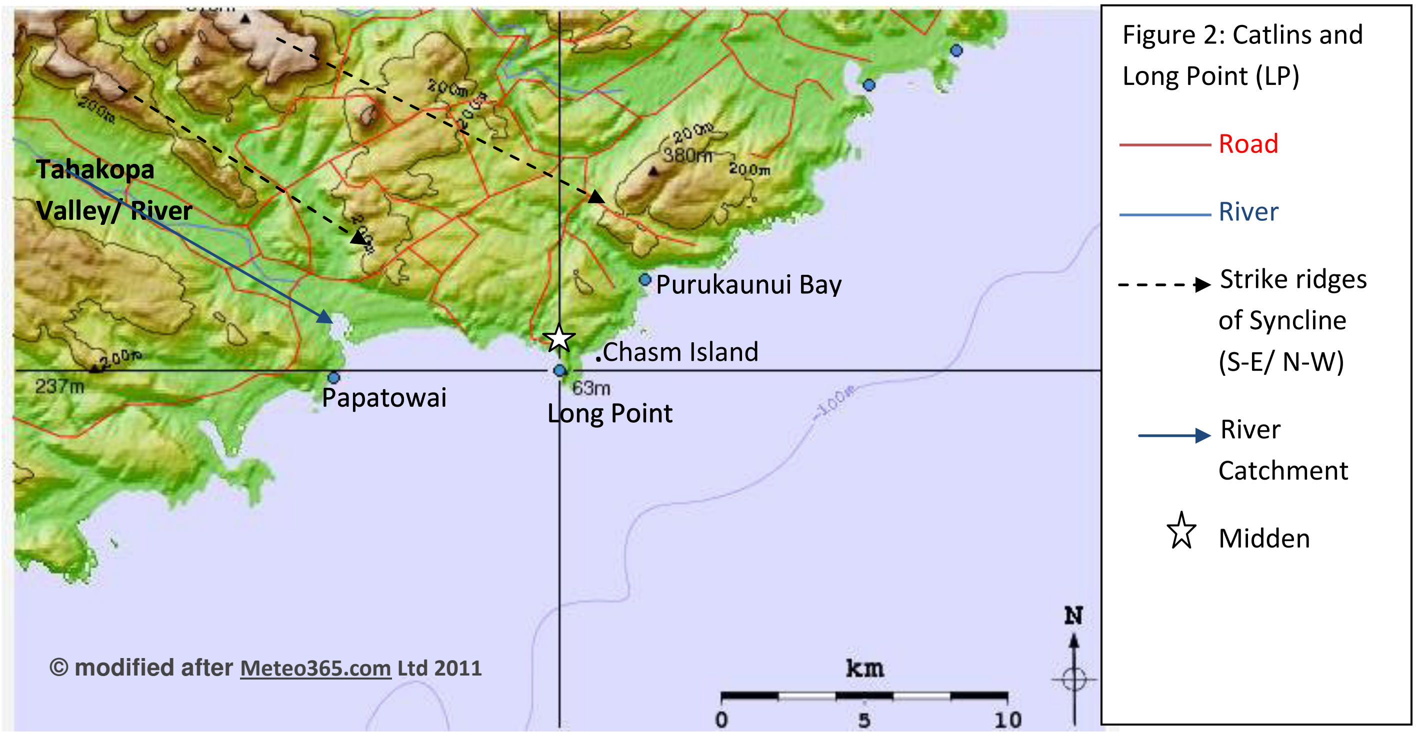

Figure 2: Geographical and geological details from Long Point/ Catlins

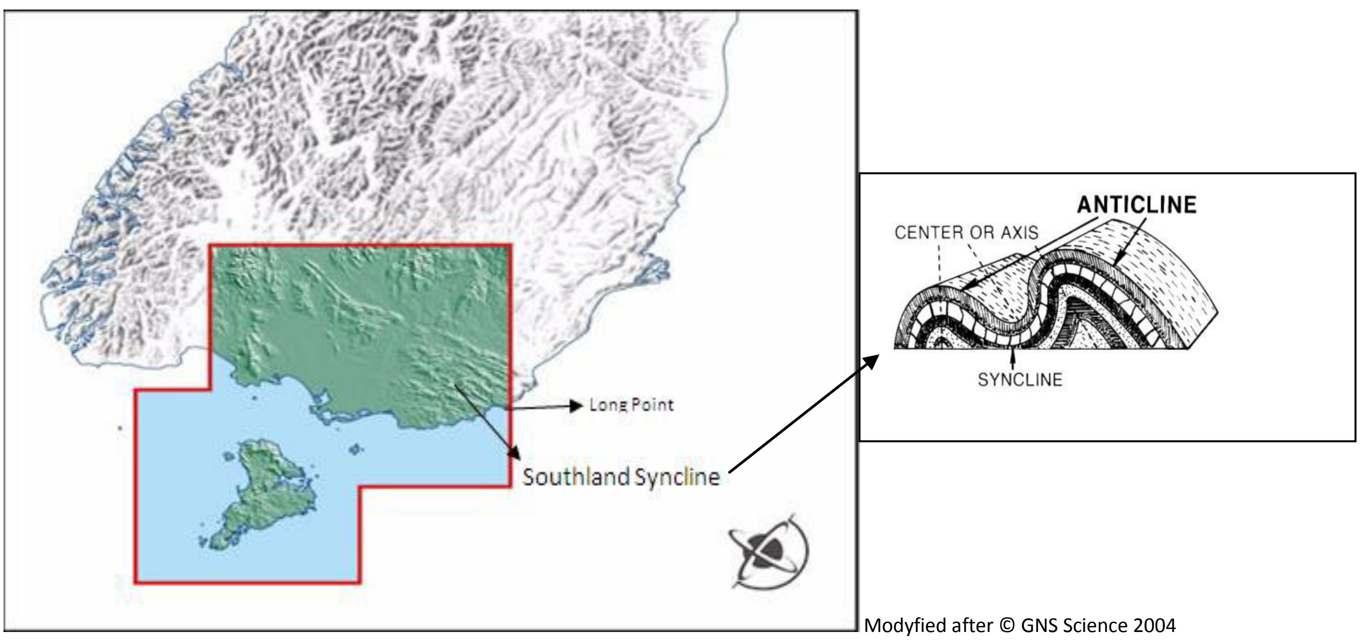

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Figure 3: Southland Syncline overview

3.0 The Catlins flora before human arrival

Nowadays the Catlins region is still the largest area of indigenous forest on the east coast of the South Island (DOC, 1998). Most of the Catlins forest park and ecological places of interest are protected by the Conservation Act of 1987 as several Conservation units (DOC, 1998). Scientific, scenic, natural and recreational reserves are protected areas of interest after the Reserves Act from 1977 (DOC, 1998). However, the prehistoric landscape changed dramatically with the arrival of humans in the area (Hamel, 1976; Anderson 1983, 1992, see below).

The detailed composition of the prehistoric flora in certain areas of the Catlins is hard to investigate, due to natural occurring and manmade fires, and the succession of different native plants as a result of microclimate changes. The prehistoric flora is also affected by erosions and vertical landmass movements in some areas (Hamel, 1976). The difficulty to determine the original vegetation in a certain habitat becomes obvious in Andersons (1992) findings. His excavations at Papatowai Point were only 8 metres away from Hamels (1976) site. Anderson found that the different soil layers represented various percentages (younger soil: 55% and older: 90%) of charcoal from Hall's totara (*Podocarpus totara hallii*), while Hamel assumed that all layers contain the same percentage (90%). The stratigraphic order of the organic midden material can vary enormously in between short geographical distances depending how the land was used by the human occupants (Anderson, 1992). Again, this makes it hard to determine the exact histological time of occurring vegetation in a Catlins area (Anderson, 1992).

Prehistoric vegetation in the lowland Catlins

Hamel (1976) assumes that the prehistoric forest- grassland ecotones in the lower valleys of the Catlins (Tahakopa Valley)represented an open bog with *Sphagnum Sp.* (wire rush) and *Gleichenia circinnata* (umbrella fern) that was set in an open shrub land of *Leptospermum scoparium* (manuka), *Pteridium aquilinum* (bracken), *Phormium tenax* (flax) and *Chionochloa rubra* (lowland red tussock). The adjacent terraces presented a forest of kamahi and podocarps (Hamel, 1976). Temperature patterns occur in the valleys through microclimatic changes (Hamel, 1976; see above). Wardle (1971) suggests that some tree roots in the valley were unable to compensate evapotranspiration from the leaves. The poorly drained soils and its varying temperature could have caused physiological stress for tree seedlings and might have created a succession of an inverted timberline against valley floors.

Hamel refers to a personal comment of McGlone from 1974 (Botany division; Department of Scientific and Industrial research),who suggests after his excavations at Stott's bog (Tahakopa Valley; Figure 1) that low and relatively open shrub lands with patches of wire rush (*Calorophus sp.*) were present throughout the prehistoric period. Further was investigated that during the same time large amounts of the insect- pollinated species *Rubus* (Bramble), *Pennantia*and *Muehlenbeckia* (flowering shrub; *Muehlenbeckia astonii*) were abundant. Hamel further cites McGlone: "There is no radio carbon dating available from Stott's bog, but a dated

6000 Before Present (B.P.) excavation on Swampy Summit (Dunedin) reveals that the findings at Stott's bog can be interpreted as a standard sequence" (personal comment; McGlone, 1974).

Hamel (1976) further suggests that 6000 B.P. podocarp pollens of mostly miro (*Podocarpus ferrugineus*) and matai (*P. spicatus*) slightly decreased in numbers, while rimu (*Dacrydium cupressinum*) pollens increased. Interestingly there is no recording of silver beech (*Nothofagus menziesii*) pollens from that time period. Silver beech pollens can be found at a depth of 4 meters, which suggests a later "successional invasion" of this plant in the Catlins region. Nowadays the Catlins contain the most southern beech forest in New Zealand (Buckingham, 1987).

3.1 Relative sea-bird abundance and distribution in pre-human times

Available data about the bird fauna and its abundance in prehistoric times must be mainly extracted from excavation findings, which can cause difficulties by the composition of the midden soil layers (Anderson, 1998; Table 4.3.1 see below). Seabird remains in the Catlins however are found mainly in layers were Polynesians already occupied the land. It has to be assumed that some seabird bones might have been transported to sites with cooking ovens (Hamel, 1976; see below).

Miskelly et al (2008) reports, that in New Zealand waters 5% of oceanic birds went extinct in prehistoric times (Table 3.1.2). Interestingly the recorded extinct seabirds are mainly penguins, which are known to be long-lived species such as albatross with a relative slow reproduction rate (Miskelly et al, 2008). Penguins occupy a small habitat niche compared to seabird species like albatrosses and petrels, which have relative far foraging distances. Changes in oceanic productivity can be triggered by (natural) climate change (Miskelly et al, 2008; see below).

However, information about the factors causing seabird species extinction is sparse for prehistoric times. Investigations by Pimm et al (2006) show that catastrophic events in prehistoric times like periodical tsunamis had a significant impact on island seabird breeding sites in the Pacific Ocean.

Pimm et al (2006) further assume that local extinctions of small seabird colonies on certain Pacific Islands have occurred during prehistoric and early Polynesian occupied times. Recent excavations reveal the findings of further extinct bird species. Pimm et al (2006) argue that for every species known from its remains, the remains of another await discovery. If this is true, we would expect enormous extinction rates for prehistoric bird species, but there is no significant data available at this stage. Further investigations are needed. Climatic catastrophes and changes might have been the main drivers for extinctions in prehistoric times.

Historical findings and modern research

Hamel (1976) collected the data from all main historic excavations sites in the Catlins region. Interestingly, all seabird species found in several soil layers of the middens in the Catlins still exist nowadays (Table 4.3.1). This assumption finds support by Miskelly et al (2008) investigations. It was shown that from 77 recorded oceanic bird species from New Zealand, four went extinct in pre 1800 (included in Table 3.1.2). Holdaway et al (2001) created a working list of breeding bird species in the New Zealand area. The original data set is a compilation of reports from earlier conducted research and gathers information about prehistoric breeding sites from 245 bird species. Holdaway et al (2001) explain that information about potential breeding sites of seabirds before the arrival of mankind are mainly found as beach-wrecked sea birds in dune deposits. Further is assumed (Holdaway et al, 2001) that the bird fauna composition was stable for the past 100,000 years until the arrival of mankind 2000 years ago. Holdaway et al (2001) research found that by human induced extinctions of terrestrial and forest species have resulted in a strong bias towards marine and coastal taxa in the present avifauna, which supports the investigations of Miskelly et al (2008). Holdaway et al (2001) findings about the historic breeding distribution of seabirds on the South Island are shown in Table 3.1.1. Holdaway et al (2001) could not proof, if there was a prehistoric albatross sp. breeding site on the New Zealand mainland and recommends further research.

Many other bird species, especially small forest birds and terrestrial moa species had to face significant anthropogenic impacts, which ended in their extinction (Buckingham, 1987; Anderson, 1983; see below).

Most seabirds today however, have a cryptic lifecycle and spend most of their live time on the open ocean. Many seabirds only come to the mainland and offshore islands for breeding purposes. Some oceanic species breed under climatic harsh conditions, or places like high cliffs at the coastline that are difficult for humans to access (Robertson et al, 2003). Further research that investigates on the historical baseline and abundance of seabird species on the New Zealand mainland is strongly recommended (see below).

Table 3.1.1: Historical baseline of breeding seabirds on the South Island New Zealand after Holdaway et al (2001); The taxonomy of the species is after IUCN Red list 2011; Note: Order and Family will stay the same until new name occurs in column.

Order	**Family**	**Species**	**Common name**
Procellariiformes	Diomedeidae	NA*	Albatross sp.*
Procellariiformes	Procellariidae	*Puffinus griseus*	Sooty Shearwater
		Puffinus gavia	Fluttering shearwater
		Puffinus huttoni	Hutton’s shearwater

Table 3.1.1 Continued			
		Puffinus spelaeus	*Extinct
Procellariiformes	Procellariidae	*Procellaria parkinsoni*	Parkinson’s Petrel
		Procellaria westlandica	Westland Petrel
		Pachyptila turtur	Fairy Prion
		Pachyptila vittata	Broad-billed Prion
		Pterodroma inexpectata	Mottled Petrel
		Pterodroma cookii	Cook’s Petrel
Procellariiformes	Hydrobatidae	*Pelagodroma marina*	White-faced petrel
Procellariiformes	Hydrobatidae	*Garrodia nereis*	Grey-backed storm petrel
Procellariiformes	Hydrobatidae	*Oceanites maorianus*	New Zealand storm petrel
Procellariiformes	Pelecanoididae	*Pelecanoides urinatrix*	Common diving petrel
Pelecaniformes	Phalacrocoracidae	*Leucocarbo carunculatus*	King Shag
		Phalacrocorax punctatus	Spotted Shag
		Phalacrocorax carbo	Great shag
		Phalacrocorax varius	Large pied shag
		Phalacrocorax melanoleucos	Little pied shag
Sphenisciformes	Spheniscidae	*Megadyptes Antipodes*	Yellow-eyed Penguin
		Eudyptula minor	Little (Blue) Penguin
		Eudyptes pachyrhynchus	Fiordland crested Penguin
Ciconiiformes	Ardeidae	*Egretta sacra*	Pacific Reef heron
Ciconiiformes	Ardeidae	*Casmerodius albus*	White heron

Table 3.1.2: Extinct oceanic birds of New Zealand in prehistoric times; (after museum of New Zealand; Te Papa)

<u>Extinct oceanic Birds before human arrival in NZ</u>
Albatross (unnamed) *Manu antiquus*
Narrow flippered penguin *Palaeeudyptes antarcticus*
Marples' penguin *Palaeeudyptes marplesi*
New Zealand giant penguin *Pachydyptes ponderosus*
Wide-flippered penguin *Platydyptes novaezealandiae*
Amies' penguin *Platydyptes amiesi*
Lowe's penguin *Archaeospheniscus lowei*
Lopdell's penguin *Archaeospheniscus lopdelli*
Duntroon penguin *Duntroonornis parvus*
Oliver's penguin *Korora oliveri*
Harris' penguin *Marplesornis novaezealandiae*
Moisley's penguin *Tereingaornis moisleyi*
Ridgen's penguin *Aptenodytes ridgeni*
Tyree's penguin *Pygoscelis tyreei*
Miocene False-toothed Pelican *Pelagornis miocaenus*
Stirton's False-toothed Pelican *Pseudodontornis stirtoni*
Miocene diving petrel *Pelecanoides miokuaka*

4.0 The Catlins flora under anthropogenic influence

Townsend (2008) explains that fire is an essential feature for many successions. "A succession is the relatively predictable sequence of change in community composition that occurs after a disturbance." Townsend (2008) states that the phenomenon of succession is always influenced by the natural occurring fire regime. Fire intensity and frequency can manipulate the germination of seeds that are able to survive the fire. The secondary succession of the Catlins was significantly induced by human fires (Anderson, 1983; Figure 4). The dilemma is that the early Polynesian land occupiers had the tendency to convert small, patchy fires into raging infernos (Anderson, 1983). The consequence is that this disturbance caused a misbalance in the shift from natural pioneer to mid- to late-successional plant communities, which makes it extremely hard nowadays to reconstruct the prehistoric Catlins vegetation (Hamel, 1976).

From the 1860's onwards the wood logging and export from the Catlins region by European settlers, as well as cattle and sheep farming had a major impact (see below). The vegetation was partially removed, but left well developed soil and seeds behind (Hamel, 1976; Buckingham, 1987). Townsends (2008) appeal managing successions for restoration of natural plant communities is depending on spatial and temporal scale of disturbance, which has occurred widely for the last 1000 years in the Catlins region (Hamel, 1976; Anderson, 1983; see below). Further has to be considered the timetable of natural recovery. Hamel (1976) estimated the forest succession time in the Catlins lowland area on fertile, and well- drained sites from second growth on cut- over areas of farms and forestry land (Table 4.1.1).The significant contribution of seabirds in the recovery process of natural forest is discussed below (5.0).

Table 4.1.1: Relative succession times of vascular plant species on fertile and drained sites in the lowland Catlins after Hamel, 1977; *trees and shrubs also found at Long Point (LP) by Lloyd (2006)

Plant species	Succession time in years
Podocarpus halli(Hall's totara)	1
Podocarpus totara (True totara)	1
*Griselinia littoralis** (Broadleaf)	1
*Aristotelia serrata** (Wineberry)	1
*Fuchsia exorticata** (Fuchsia)	1
Nothofagus menziesii (Silver beech)	5
Metrosiderosumbellate(Rata); ***M. Diffusa*****at LP**	5
*Melicytus ramiflorus** (Mahoe)	10
*Weinemannia racemosa** (Kamahi)	30-50
Podocarpus spicatus (Matai)	50
Podocarpus ferrugineus (Miro)	50
*Dacrydium cupressinum** (Rimu)	50

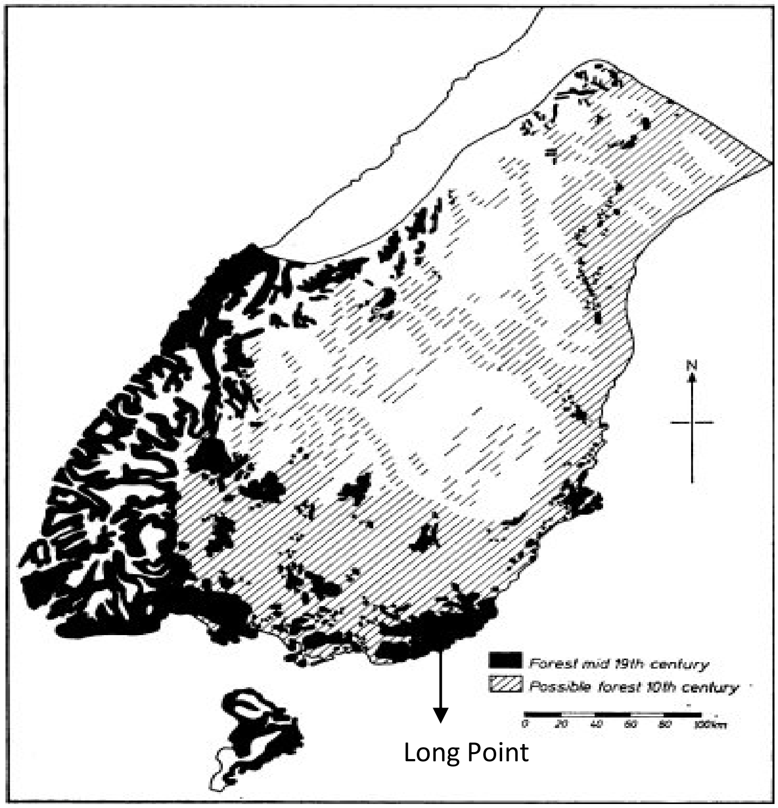

Figure 4: Modified after Anderson, (1983): The possible deforestation after human occupation (burn offs) of the South Island in the last millennium until the mid 19th century.

Vegetation patterns reveal the abundance of early land occupiers

The first signs of Polynesian occupation in southern New Zealand are dated back about 1000 years ago (Anderson, 1983).Hunting and fishing were mainly the tools for food gathering. The reason here for was that the land lay far south (44°- 47° South) and the traditional food plants could not be cultivated. Only bracken fern (*Pteridium esculentum*) and ti (*Cordyline australis*) was available (Anderson, 1983). However, southern New Zealand suffered heavily deforestation in the last millennium (Anderson, 1983; Figure 4).

The impact of natural fires and land clearing fires by Polynesians were not the only reason for the drastic changes in the landscape (Hamel, 1976).However the (fire) clearings detected by pioneer researchers indicate patterns of Polynesian occupation (Hocken, 1892; Figure 4).

Anderson (1983) revealed that already in the 1500's the moa hunting slowed down at the occupied coastal sites due to its exploitation (see below). During this time period the Polynesian tribes started focusing on fishing (mainly barracouta*, Thyrsitis Atun* and sealing; mainly *Arctocephalus* forsteri and *Phocarctus hookeri,* Hamel, 1976; Anderson, 1992) at the coast, while more evidence of inland manmade fires are found (Anderson, 1983). Hamel (1976) suggests that more sites in the Catlins should to be surveyed, particularly around the Catlins coastline where in the prehistoric period forest- grassland ecotones existed. After interviews with local inhabitants and site surveying Hamel (1976) located and recorded70 sites, but interestingly all sites were in areas that are not covered by pre- European forests anymore.

4.1: Recent vegetation patterns at Long Point

Pasture is the main vegetation cover of Long Point, and occurs on cultivated land. The pasture is dominated by exotic plant species of perennial ryegrass (*Lolium perenne**), white clover (*Trifolium repens**), California thistle (*Cirsium arvense**), crested dogs tail (*Cynosurus cristatus**) and mouse-ear chickweed (*Cerastium fontanum**); (Lloyd, 2006). Further research is needed, addressing how pasture land needs to be restored into former native vegetation. Townsend et al (2008) describe an attempt in England as a "slow and unreliable" process. However, seabirds will play important roles in habitat restoration as seed dispersers and with the providing of guano fertilizer (Polis et al, 1997; see below).

Kamahi, Coastal, Riparian and kowhai forest

Investigations about the flora at Long Point by Lloyd (2006) showed that the forest remnants in gullies, higher elevation parts and on hill slopes can be associated with kamahi (*Weinmannia racemosa*) as its major canopy species. Further was assumed that the current remnants of the once in the Catlins widely abundant podocarp/ broadleaved forest in forms of rimu (*Dacrydium cupressinum)* and rata (*Metrosideros* umbellate) must have been prominent in earlier times. Stock has access to the remnants, which results in sparse understory vegetation. The areas with no livestock occupation show more substantial understory vegetation with a greater range of canopy species (putaputaweta, *Carpodetus serratus;* tarata, *Pittosporum eugenioides;* broadleaf, *Griselinia littoralis* and mahoe, *Melicytus ramiflorus*). Water fern (*Histiopteris incisa*), kiwakiwa (*Blechnum fluviatile*), prickly shield fern (*Polystichum vestitum*) and chicken fern (*Asplenium bulbiferum*) are the most common ground cover species in this forest type.

Lloyd further assumes that lower elevations on drier coastal slopes historically must have represented a mahoe forest, which nowadays is sparse due to the impact of stock browsing and the exposure to south westerly winds.

A common component of the forest in the Purakaunui Valley is the lowland ribbonwood (*Plagianthus regius*). Further can be found a wide variety of broadleaved species (fuchsia, *Coprosoma rotundifolia*; kaikomako, *Pennantia corymbosa*; mapou, *Myrsine australis*; kohuhu, *Pittosporum tenuifolium*) and rare species of matai (*Prumnopiys taxifolia*); (Lloyd, 2006).

One kilometre from the coast, the steep and boulder slopes of the sunny knoll in the Purakaunui Valley have a stand of kowhai forest (*Sophora microphylla*). This forest benefits from dry conditions as it receives no drainage from adjacent land. The shady slopes show a transition to mahoe forest (Lloyd, 2006).The groundcover is distinctive by dry forest ferns and herbs (*Pellaea rotundifolia, Asplenium flabellatum, A. Hookerianum, Polystichum novae-zelandiae and Scheizelema trifoliolatum).*

Mingimingi, Coprosoma/purei, and coastal shrubland (incl. Flaxland)

Llyod (2006) reports on the first stages of forest regeneration from grassland. It can be observed on the grassy hillsides of the Purakaunui Valley, where mingimingi (*Coprosoma propinqua*) often surround small stands of broadleaved forest. The main components of the Purakaunui Valley floor wetland shrublands are mingimingi and *Coprosoma tayloriae*. Directly above the wetlands occur tall purei tussocks (*Carex secta*) and stands of *Carex lessoniana*. The vegetation in one part of the upper valley site shows lancewood (*Pseudopanax crassifollius*) and weeping mapou (*Myrsine divaricata*), but exotic species are prominent in forms of blackberry (*Rubus fruticosus**), birds foot trefoil (*Lotus pedunculatus**), creeping buttercup (*Ranunculus repens**) and tall fescue (*Schedonorus phoenix**); (Lloyd, 2006).

The coastal shrublands at lower elevations where salt spray is more frequent are dominated by shore hebe (*Hebe elliptica*), *Anisotome lyalii*, *Poa astonii*, coastal spleenwort (*Asplenium obtusatum*) and *Blechnum blechnoides* (Lloyd, 2006). At higher elevations Lloyd found shrubs of mahoe, tree nettle and kohuhu (*Pittosporum tenuifolium*) along with harakeke (*Phomium tenax*), bush flax (*Astelia fragrans*), toetoe (*Cortaderia richardii*) and New Zealand spinach (*Tetragonia trgyna*). The native liane *Calystegia turguriorum* and pohuehue (*Muehlenbeckia australis*) are also present in these shrublands (Lloyd, 2006).

Lloyd (2006) assumes that the present feature of a remnant population of inaka (*Dacrophyllum longifollium*) on a cliff top between Chasm Island and Cosgrove Island was once the former forest-edge shrub present prior to forest clearance.

Tall and dry grassland

Tall grassland is found on well drained sites with low recent grazing pressure in the Purakaunui Valley as well as in places where the forest converts to pasture land. It occurs on steep coastal slopes and on the sides of forest cleared gullies where no cultivation of the land has been observed (Lloyd, 2006). Yorkshire fog (*Holcus lanatus**), sweet vernal (*Anthoxanthum odoratum**), and cocksfoot (*Dactylis glomerata**) are the dominant tall grassland species. The exotic tall herb species of foxglove (*Digitalis purpurea**), ragwort (*Senecio jacobaea**) and hawksbeard (*Crepis capillaries**) are becoming locally dominant in some sites (Lloyd, 2006).

Dry grassland vegetation is very restricted at Long Point. The native grasses of plume grass (*Dichelachne crinita*) and *Rytidosperma gracile*, two native orchids (*Microtis unifolia* and *Thelymitra longifolia*) and the native daisy *Helichrysum filicaule*are found mainly on the dry lip of the chasm at Chasm Island (Lloyd, 2006).

Coastal turf; coastal ledges, beaches and sand dunes

The only turf vegetations on the New Zealand mainland are concentrated along the deeply indented Catlins coastline and the Otago Peninsula. Limitation of turfs to the eastern shoreline is initiated by a natural occurring southwesterly wind channel. This unique feature is enabled by the wind funnel functioning south-east coast of Foveaux Straight. The abundance of turfs reduces northwards. Turfs are depending on the height of coastal cliffs, the salt-depositing capacity and strength of southwesterly winds (Rogers, 1999). Rogers (1999) explains that the influence of the oblique shoreline winds can be demonstrated under the aspect of an average 76° offset between the turf and the strata. Interestingly the turfs grow in suboptimal soil conditions. The Southland syncline features a sandstone basement lithology, with interbedded conglomerate seams that commonly fails to provide stable uplifted terraces for turf formation (Rogers, 1999). The extent and composition of coastal turf on the Long Point property varies according to exposure and distance from the coast (Lloyd, 2006). Rogers (1999) explains that turfs have a ground smothering function, and occupy coastal promontories which are exposed to the maritime influences of persistent wind and heavy salt deposition. Rogers (1999) assumes that grazing of stock is the main threat for the abundance turf vegetation. Turfs on pasture land are known to recover when the grazing pressure is significantly reduced.

Long Point represents unique features of turf vegetation. Small turfs occur at Long Points seal point. Rogers (1999) found that "the turfs within a fur seal haul-out zone on a low coastal platform at Long Point providing the only clear-cut mainland association between turfs and marine mammals." Further was observed (Rogers, 1999) that the Long Point Headland margins and the feature of seaward exposed coastal paddocks represent the most extensive turfs. The southern side of Long Point shows also a rare example of a turf developed on coastal peat around an isolated crib.

Lloyd (2006) states that the composition of turf at Long Point is diverse. They may be dominated by grasses of the*Nertera depressa*, *Epilobium komarovianum*, *Langenifera pumila*, *Leptinella squalida*, *Gunnera dioica*, *Plantago raoulii*, *P. triandra* and *Uncinia aucklandica*. This creates a diverse turf vegetation mixture on steep, exposed, shady banks and beneath overhangs on cliff tops. Dominant turf plants on the tips of coastal headlands are the native *Leptinella dioica*, *L. squalida* and *Crassula moschata* along with the exotic grass creeping bent (*Agrostis stolonifera**); (Lloyd, 2006).However, the composition and recovering of turfs can be a significant aspect of reintroducing seabird colonies at Long Point (see below).

Damp and sandy coastal ledges close to the spray zone provide habitat for two native daisies, shore puha (*Sonchus kirkii*) and *Senecio carnosulus*, while the sheltered boulder beaches present a sparse vegetation of orache (*Atriplex prostrate**), cleaver (*Galium aparine**) and holy grass (*Hierochloe redolens*). Above the strand line a mixture of the native species *Carex trifida*, harakeke (*Phorium tenax*), tree nettle (*Urtica ferox*), poroporo (*Solanum laciniatum*) and ring fern (*Paesia scaberula*)can be found along with the exotic species of tall fescue (*Schedonorus phoenix**), Californian thistle (*Cirsium arvense**) and Yorkshire fog (*Holcus lanatus**); (Lloyd, 2006). The native *Carex pumila* can be found on the seaward margins of some dunes, which are usually dominated by the exotic marram grass (*Ammophila arenaria**).

Composition of native and exotic vascular plant species

Lloyd (2006) concludes that the majority of his recorded vascular plant species were native (154 plants; 71%), which reflects the diversity of habitats at the Long Point site. Further was investigated that four native occurring plant species on coastal ledges or turfs were either considered as threatened or uncommon. The Shore puha (*Sonchus kirkii)* and *Ranunculus recens* are in “gradual decline” (not found in Lloyd’s survey 2006); *Senecio carnosulus* and *Atriplex buchananii* are both classified as “sparse” (de Lange et al, 2004). The majority of the exotic plant species (64; 29%) were herbaceous and found on pasture, rough grassland and in disturbed areas.

*****_exotic vascular plant species at Long Point_

4.2: Investigations from Hamel at the Long Point midden

Destruction by infiltration and erosion has made it difficult to classify Long Point either into a midden or occupation site. This uncertainty has the consequence that it is not possible to clearly identify if Polynesians have permanently lived in the area. Occupation sites are big middens with traditional burial sites, ovens and several artefacts (Hamel, 1976). The abundance of seals (see above), shellfish (Paua, *Haliotis isris* and Mussels, N.A.) and blue cod (*Parapercis colias*)indicates that man came during different seasons of the year for hunting purposes in many centuries. However, Hamel (1976) considered Long Point as a smaller coastal site that is adjacent to fewer resource zones (Figure 2).

The “midden” at Long Point is located on a small grassy flat behind the fore dune of a sheltered bay (Figure 2). The mainly exposed position of Long Point makes it hard to assume nowadays, that man lived there permanently, especially during the cold and wet winter months. However, bones of small birds (not clearly identified by Teviotdale; 1938), Polynesian dog, kiore and moa were found, as well as three human burial sites with several adzes. The Polynesian burial sites are radiocarbon dated into the period between the 14th and 16th century (Hamel, 1976).

4.3 Changes in the Catlins sea- bird fauna following human arrival and settlement

At the beginning of the land occupation were moa

The exploitation of Moa species plays an important role in the deforestation of the Catlins region. About 1000 B.P., the early Polynesians started occupying the land in the Catlins area. Today they are described as moa hunters who exploited these species significantly (Anderson, 1983). Findings of Hamel (1976) reveal that all extinct moa species (Table 4.4.1) had a significant contribution to the forest- grassland ecotone of the Catlins. The herbivorous Moa species were abundant all over the region and responsible for the distribution of podocarp seeds, matai fruit, *coprosoma* fruit, seeds and capsules (Hamel, 1976). The solitary ground nesting moa, which laid its eggs in small clutches, did not only face the pressure of fires and human exploitation, but also the predation of the introduced mammals; kiore (Polynesian rat) and kuri (Polynesian dogs). A natural occurring predator was the now extinct Haast eagle. The chicks had to fear the New Zealand falcon, Black backed gulls and wekas. The latter two might also have predated on moa eggs (Hamel, 1976).

Uncertainties about the historical sea-bird species richness

Pimm et al (2006) found that the bird extinction rate increased significantly in 1500 A.D. with human occupation of the Pacific Islands. From a low estimated 26 species per million/year in early Polynesian occupation times, more recent research assumes that the real extinction rate up to 1800 A.D. must have been about 100 species per million/year. The reason for this dramatic increase in extinction figures is based on the fact that most bird species were only scientifically described after 1850 A.D. and taxonomists still describe a significant amount of new species from skeletal remains found in middens (Pimm et al, 2006). Kaaren Mitcalfe (Personal comment) from the Owaka museum states that: “Currently we are part way through cataloguing the pre-Maori first settlement people material. The bone material is yet to be catalogued and sorted and identified and highly likely to be moa in biggest proportion.”

This comment supports Pimm et al (2006) findings. Further investigations should aim on the dramatic and significant impacts for the Catlins ecosystem that were triggered by the extinction from moa along with the exploitation of seed dispersing land bird species and seabirds (Sekercioglu, 2006; see below). Pimm et al (2006) assumes that in the last two decades the bird species extinction rate can be reduced to >50 species per million/year due to recent conservation effort, does not solve the dilemma in recent times that land and seabirds are facing serious anthropogenic threats (see below).

Anderson’s (1992) excavation reports from the Papatowai midden show explicitly the bird exploitation by Polynesians. Parakeet (*Cynaroramphus sp.*), New Zealand pigeon

(*Hemiphaga novaseelandiae*) and tui (*Prosthemadra novaseelandiae*) bones reveal that those forest habitat bird species were caught in significant figures in the area. Bones of seabirds such as Sooty shearwater (*Puffinus griseus)* and shags (*Phalocrocorax sp.)* can be numerously found in the midden as well. Bone remnants of Erect-crested penguins (*Eudyptes sclateri*) and 137 Fiordland-crested penguins (*Eudyptes pachyrhynchus*) were found in one observed midden layer. This reveals that around 570 B.P. many seabird species were under enormous hunting pressure (see below).

Seabirds as traditional and urgent food

The traditional harvest of small procellariids, mainly petrels, prions and shearwaters (*Puffinus griseus*; titi; muttonbirding) is widely recorded for early historical times on the South Island (Anderson, 1998). Anderson (1998) estimated the number of traditionally harvested titi in good years to be around 250,000 birdson southern coasts of the mainland, on sub Antarctic Islands and on 30 small "Muttonbird Islands" in Foveaux Strait (see below).

Not only Polynesians used procellariids as a food source. In the late 18th century, small islands like Lord Howe and Norfolk Island hosted small colonies of weakly migratory procellariids, which were locally extirpated by European settlers, who could only avoid starvation by eating Providence petrel (*Pterodroma solandri*). In 1800, within 10 years after arrival of the European settlers the *Pterodroma sp.* colony on Norfolk Island was extinct. Recordings from this time show that in the first winter 171,362 birds were harvested (Anderson, 1998).

Pimm et al (2006) explain that the exploitation of birds by Polynesians on Pacific Islands in combination with habitat modification and the introduction of non-native mammalian predators is a good example for showing that anthropogenic extinction rates are significantly higher than the figures of natural occurring extinctions, which are thought to be one species per million/year.

Table 4.3.1: Table of relative seabird abundance from excavation reports in the Catlins Modified after Hamel, 1977: All shore and seabird species that were found in Catlins middens. All completely identified species still exist nowadays.

Midden Site	***Seabird species found/ Scientific name***	***IUCN Red list status***	***Extinct***
Papatowai point	Albatros sp. * / (*Phoebetria sp*.?)	NA*	NA*
	Shag (large) sp*. / (*Phalacrocorax sp*.?)	NA*	NA*
	Heron sp. */ (*Ardea sp.*?)	NA*	NA*
	"Hybrid" Penguin*	NA*	NA*
	Fiordland- Crested Penguin/ *Eudyptes pachyrhynchus*	Vulnerable	No
	(Southern) Rockhopper Penguin/ *Eudyptes chrysocome*	Vulnerable	No
	Erect Crested Penguin/ *Eudyptes sclateri*	Endangered	No

Table 4.3.1 continued	Sooty Shearwater/ *Puffinus griseus*	Near Threatened	No
Tautuku Point	Diving Petrel / *Pelecanoides ulinatrix*	Least Concern	No
	Black-backed Gull / *Larus marinus*	Least Concern	No
	Heron (large) sp. * / (*Ardea sp.*?)	NA*	NA*
	Oystercatcher sp. */ *Haematopus sp.*	NA*	NA*
	Blue Penguin / *Eudyptula minor*	Least Concern	No
	Erect Crested Penguin/ *Eudyptes sclateri*	Endangered	No
	Fiordland- Crested Penguin/ *Eudyptes pachyrhynchus*	Vulnerable	No
	(Southern) Rockhopper Penguin/ *Eudyptes chrysocome*	Vulnerable	No
	Little Pied Cormorant / *Phalacrocorax melanoneucos*	Least Concern	No
	Spotted Shag / *Phalacrocorax punctatus*	Least Concern	No
	Steward Island Shag / *Phalacrocorax* chalconotus	Vulnerable	No
	Fluttering Shearwater / *Puffinus gavia*	Least Concern	No
	Short- tailed Shearwater / *Puffinus tenuirostris*	Least Concern	No
	Sooty Shearwater/ *Puffinus griseus*	Near Threatened	No
Waitangi Stream East	Blue Penguin/ *Eudyptula minor*	Least Concern	No
	Spotted Shag / *Phalacrocorax punctatus*	Least Concern	No
Long Point South	Oystercatcher sp. */ *Haematopus sp.*	NA*	NA*
	Fiordland- Crested Penguin/ *Eudyptes pachyrhynchus*	Vulnerable	No
	"Hybrid" Penguin*	NA*	NA*
	(Southern) Rockhopper Penguin/ *Eudyptes chrysocome*	Vulnerable	No
Cannibal bay	2 Shag species*/ *Phalacrocorax spp.*	NA*	NA*
	Mollymawk*/ (*Thalassarche sp.?)*	NA*	NA*
Hinahina	Spotted Shag / *Phalacrocorax punctatus*	Least Concern	No
Pounawea	White-Capped Albatross/ *Thalassarche steadi*	Near threatened	No
Kings Rock	Sooty Shearwater/ *Puffinus griseus*	Near Threatened	No
	Penguin spp.*/ *(Eudyptes spp.?)*	NA*	NA*

*species not clearly identified after excavation

4.4: The impact of European settlers in the Catlins region

The history of rats (*Rattus spp.*) in the Catlins region

Buckingham (1987) reports that soon after the arrival of European settlers kiore (*Rattus exulans*) and kuri (Polynesian dogs) disappeared in the Catlins district. Whalers probably accidently imported European rat species at the beginning of the 19th Century (Buckingham, 1987). Smith (2002) research found that the Polynesian rat could not compete with the introduction of two European rat species (*Rattus Rattus; Rattus norvegicus*) and went extinct on the New Zealand mainland. Further was found that kiore only survived on a few remote offshore Islands. However, all rat species (*Rattus spp.)*are expected to prey on several seabird species eggs and chicks (Mulder et al, 2009).

Interestingly is that found remains of *Rattus exulans* in natural predator deposits on both the North and South Island date to around 1800 B.P. which is about 1000 years earlier than the oldest archaeological investigated settlement sitesin New Zealand. The kiore is a non-native species to New Zealand. Distances between the Pacific Islands and the New Zealand mainland are expected to be too far for kiore to swim and leads to the assumption that it must have been introduced by humans. If this is true, human occupation of New Zealand must have occurred at least 1800 B.P. (Smith, 2002).Further investigations are recommended.

Further habitat modification and pressure on native birds by ungulates and possums

Pigs and cattle were purposely introduced by European settlers into the Catlins forest which caused further browsing damage. Swampland was drained for gaining farmland and plant regeneration could not sustain with the farming pressure (Buckingham, 1987). Surveyors and a few conservation minded settlers recognized the issue of forest exploitation, but it took until 1926 until larger areas were protected in form of a State Forest or as Scenic reserves (Buckingham, 1987).At the beginning of the 19th century, early pioneers and settlers brought cats (*Felis catus)* and dogs (*Canis lupus*) to the Catlins region, which became feral to varying degrees (Buckingham, 1987). The Australian brush tailed possum *(Trichosurus Vulpecula)* was introduced into New Zealand in 1837 to establish a fur trade and was soon dispersed over both main islands (DOC, 2011). Batcheler (1983) reports that in New Zealand possums cause major damage through defoliation on native hardwood rata *(Metrosideros spp.)* and kamahi *(Weinmannia racemosa)*forest. Batcheler (1983) found that compared with the similar Westland forest the rata and kamahi species in the south eastern Catlins forest are not that heavily affected by possum browsing. A four year long research conducted by Landcare Research (Innes, 2011) revealed that omnivorous possums not only feed on eggs and kill chicks of native bird species (kokako and kukupa), but also on native invertebrates (weta).

Morphological distinctive adaption to browse tolerance of indigenous plants

Batcheler (1983) assumes that the forest in south east New Zealand was not only significantly influenced by geological and climatic changes, but also by indigenous thorny, divaricating and astringent tasting shrub species (e.g. *Hedycarya arborea, Brachyglottisrepanda, Melicytus*ramiflorus). Those woody plant species were abundant as natural adaption against moa browsing. Greenwood et al (1977) found that New Zealand's flora contains 54 spineless, small leaved divaricating plants, which is expected to be about 10% of all woody flora. Archeological findings of moa remains on forest edges, open country, river banks, swampy ground, and coastal dunes define also the habitat in which browse tolerant or browse-resistant species are more common (Batcheler, 1983).Interestingly is the fact that divaricating plants occur significantly less frequent on the mainland comparable to offshore and outlying Islands, which were not or hardly occupied by moa spp. (Greenwood et al, 1977). Greenwood et al (1977) found that "One or two species of plants, often or always divaricating on the mainland, have related non-divaricating populations on islands. These include a non-divaricating relative of *Myrsine divuricata* on the Poor Knights, the non-divaricating juvenile forms of *Plagianthusbetulinus* and *Sophora microphylla* on the ChathamIslands and a non-divaricating form (var. *martini)* of *Coprosma propinqua* also on the Chatham Islands."

The browsing tolerant dicotylous, low-statured shrubs of *Fuchsia, Aristotelia, Muehlenbeckia, Discaria, Plagianthus, Carmichaelia* and *Hoheria* are now the preferred foods of introduced mammals. The only exception seems to be in early forest successions the often found red-colored form of *Fuchsia excorticate* (Batcheler, 1983).

Hedgehogs and mustelids are chick, egg and sea-bird predators

Hedgehogs were introduced to New Zealand in the late 19th century. Their main food is considered to be mainly invertebrates. However, a monitoring program from 1994-1999 by Moss (1999) revealed that this species is responsible for the predation of eggs from the ground nesting birds such as banded dotterel (*Charadrius bicinctus bicinctus*; NZ threat ranking: nationally vulnerable) and black-fronted tern (*Chlidonias albostritatus*; NZ threat ranking: nationally endangered) in a braided riverbed system of the Mackenzie Basin.
In the 1880's, stoats (*Mustela erminea*), ferrets (*Mustela putorius furo*) and weasels (*Mustela nivalis*) were liberated to New Zealand and many offshore Islands for the control of rabbits (*Oryctolagus cuniculus*) in the 1830's by European settlers for food and sport purposes (Fitzgerald, 1964). Mustelids are expected to do major harm by predation on native bird species (Buckingham, 1987; White et al, 2006). White et al's (2006) research focused on predator-prey interactions and found that in beech forests abundant mice (*Mus musculus*) can significantly buffer the predation of native birds by stoats only over a short time period. White et al (2006) assume that after the regular occurring 3-5 year event of a beech (*Nothofagus sp.*) mast seeding, very high numbers of mice last for a shorter time period than stoats. The

consequence is that the increasing stoat population is most likely to prey on native birds.

Forest clearing by European settler in the Catlins

Forest clearing had a major impact on the Catlins habitat. The forest cover in South east New Zealand was nearly complete until 1,200-1,400 AD (Hall et al, 2001). Trees of the native kahikatea (*Podocarpus dacrydioides*), rimu and totara were heavily exploited from the late 18 hundreds onwards (Buckingham, 1987). Buckingham (1987) found that with the arrival of European settler in the mid 19th century the first major reduction of the Catlins forest commenced. The history of logging in the Catlins region can be observed due the building of the Catlins River Branch railway (Tyrrell, 1996). Tyrrell found that before the building of the railway, logging in the dense Catlins forest was only possible by approaching it from the sea. The difficulties that occurred to build the railroad through the dense bush become obvious by looking at the timeline of the station construction. The first contract for the railroad construction was signed in 1879, but building the first 12.8 km of tracks from Balclutha to Romahapa took until the end of 1885. The whole distance of 68.44 km to the last station at Tahakopa was not finished until 1915 (Tyrrell, 1996). The 18 stations between Baclutha and Tahakopa were all located at sawmills. Bush tramways lead from many stations further into the native forest. The logging industry in the Catlins forest reached its climax in the 1930's and slowed down after this. The railroad was finally closed in 1971. Only the first 4 km to Finegand remained open as an industrial siding tofreezing works of Silver Fern Farms Limited;(Tyrrell, 1996).

"The Catlins originally had 131,400 ha of indigenous forest, 68,200 ha (52 %) of which was opened for settlement in the late nineteenth century. In 130 years, farmers cleared 55,000 ha, and in 1991 only 13,200 ha of indigenous forest remained on farms"(Wilson, 1993).

At the beginning of the 1990's, the structure and composition of the forest was altered again by the replacement of indigenous forest and the replanting of farmland with exotic tree species of *Eucalyptus delegatensis* and *Pinus radiata* (Wilson, 1994).

Nowadys the Catlins forest park represents with 420km² a big forest remnant with diverse landscapes in some parts unbroken sequences of native vegetation from the coast to the subalpine zone (Hogan, 2010). However, deforestation from European settlers had a big impact on the ecosystem by losing at least half of the native historical abundant forest biomass.

Modern Land modification and its impact on sea- bird colonies and their dynamics

While most moa species went extinct already before European settlement in the Catlins area (Table 4.5), the commencing of land modification in the mid 19th century by Europeans was the cause for further land bird extinctions on the South Island and Catlins region (Buckingham, 1987; Table 4.5).

Pimm et al (2006) found that range restricted bird species with a skewed geographically range (<50000km) are worldwide overwhelmingly the most threatened species (35% threatened compared to 4% of larger-ranging species).

Dunn et al (2005) found that recent bird species breeding in clearings of 6 neotropical forests have the largest average latitudinal range. When these clearings experience their secondary succession and the habitat matures, more small range bird species occur and a shift towards those species can be observed. Further is assumed that the conservation of a forest only with its secondary succession is not sufficient enough to protect species with a high risk of extinction (Dunn et al, 2005). Duncan et al (1999) showed that in New Zealand exotic bird species benefitted from forest fragmentation and early succession habitat. Generally non-native species have a faster reproduction rate and disperse well in patchy habitat (Duncan et al, 1999).Buckingham (1987) observed the colonisation of the Catlins region by Australian species. The Australian magpie (*Gymnorhina tibicen*), white faced heron (*Egretta novaehollandiae*), spur-winged plover (*Vanellus spinosus)* and Cattle egrets (*Bubulcus ibis*) became resident in the area. The impact of those exotic invasions on the native bird community in the Catlins needs further investigations. There might be a direct impact for seabirds from deforestation (Mulder et al, 2009, see below). Warne (2008) observed during a survey on the Snares that a stronghold colony of Sooty Shearwater (*Puffinus griseus*) is located in a dense forest and the floor leaf litter is dragged into the burrows by the birds for nesting material (see below). Further research is needed.

Table 4.4.1: Extinct terrestrial and forest avifauna of Southern New Zealand; data combined from Miskelly, 2008; Buckingham, 1987; Anderson, 1983)

Extinct terrestrial and forest avifauna in Southern New Zealand		**Family**
Anomalopteryx sp.	(Little bush moa)	*Anomalopterygidae*
Megalapteryx sp.	(Upland moa)	*Dinornithidae* (genus *Megalapteryx*)
Pachyornis elephantopus	(Heavy footed moa)	*Dinornithidae* (genus *Pachyronis*)
Euryapteryx gravis	(Stout legged moa)	*Dinornithidae* (genus *Euryapteryx*)
Emeus crassus	(Eastern moa)	*Emeidae*
Emeus huttoni	(moa sp. Identified by Dr. Benham)	*Emeidae*
Dinornis torosus	(Slender moa)	*Dinornithidae* (genus *Dinoris*)
Dinornis robustus	(South Island giant moa)	*Dinornithidae* (genus *Dinoris*)
Dinornis maximus	(Giant moa)	*Dinornithidae* (genus *Dinoris*)
Cygnus sumnerensis	(swan)	*Anatidae*
Cnemiornis calcitrans	(goose)	*Anatidae*

Euryanas finschi	(Finsch's duck)	*Anatidae*
Harpagornis moorei	(Haast Eagle)	*Accipitridae*
Accipiter eylesi	(goshawk)	extant genus *Accipitridae*
Aptornis defossor	(giant rail)	*Aptornithidae*
(Gallirallus minor / australis?	(small weka; not clear if same species!)	*Rallidae*
Nesophalaris (Fulica?) chathamensis	(coot)	*Rallidae*
(Nesto rsp.)	(small kaka)ˣNot clearly identified	*Strigopidae*
Palaeocorax moriorum	(NZ grow)	*Corvidae*
Cotornix novazealandiae	(NZ Quail)	*Phasianidae*
Sceloglaux albifacies albifacies	(Laughing owl)	*Strigidae*
Xenicus longipes	(South Island bush wren)	*Acanthisittidae*
Turnagra capensis capensis	(South Island thrush; Piopio)	*Turnagridae*
Bowdleria rufescens	(Chatham Island fernbird)	*Sylviidae*
Cabalus modestus	(Chatham rail)	*Rallidae*
Callaeas cinerea	(South Island kokako)	*Callaeidae*
Anthornis melanocephala	(Chatham Island bellbird)	*Meliphagidae*
Coenocorypha iredalei	(Stewart Island snipe)	*Scolopacidae*
Ixobrychus novaezelandiae	(New Zealand little bittern)	*Ardeidae*

5.0 The importance of seabirds in ecosystems

Seabirds keep the nutrient energy cascade in equilibrium

The reason to be concerned about the quantity of fish stocks around New Zealand coasts is not only a question about a wrong estimated fish catching quota. It is the stop of the energy flow that Polis et al (1997) describe as the “river continuum concept”. It is based on the flow of detritus and nutrients (organic biomass) in different aquatic systems that are directly (space) or indirectly combined (food chain nutrient-exchange). Polis et al (1997) explain that nutrient energy cascades are complex networks between physical characteristics of the ecosystem (e.g. fresh and salt water; “turnover” between nutrients of richer and poorer water) and the variety of organisms and species abundant in the ecosystem and their contribution and productivity to the “continuum”.

Polis et al (1997) found that salmons bring essential nutrients (Phosphorus and Nitrogen) via reproductive products, excretion and death up-stream to the headwaters. Organic material from trees and the “fish-nutrients” feeds aquatic micro organisms. These get eaten by insects, insectivorous birds eat insects, fish eat insects, and smaller aquatic life feeds on the “baseline” again. Fish and sea-birds as consumers of seeds, organic material, micro organisms, and smaller fish etc. transport this material among aquatic habitats in either way.

Polis et al (1997) describe the whole trophic cascade between benthic and pelagic water coupling in fresh and salt water systems as a “nutrient pump mechanism”. It is assumed that “The rainforest, in its floodplain manifestation, has come to the trophic rescue of these aquatic ecosystems” (Goulding, p. 252). Polis et al (1997) argue on this behalf that “an estimated 75% of market fish receive substantial input (50–90% of diet) from terrestrial origin (fruit, seeds, insects, small vertebrates).”

Guano, food scraps, eggs, feathers, and bodies of dead chicks and adults of seabirds are organic material and substantial nutrients which are brought by the birds to land (Polis et al, 1997). The amount of guano brought to land is estimated to be 10^4-10^5 tons a year (Murphy, 1981). Sekercioglu (2006) reports that crop fertilisation as a part of a seabird ecosystem service can occur thousands of kilometres away from the nutrients place of origin. Sekercioglu (2006) describe seabirds as “the mobile link that connects habitats in space and time”. It is further assumed (Sekercioglu, 2006) that guano cascading directly or indirectly effects populations of plants, invertebrates and rodents. Sekercioglu (2006) explain that the 60 fold reduction of seabirds on the Aleutian Islands by arctic foxes (*Alopex lagopus*) was responsible for triggering a switch from grassland to marine tundra.

A study by Hawke et al (2009) on the Auckland Islands showed that Bellbirds (*Anthornis melanura melanura*) and Parakeets (*Cyanoramphus novaezelandiae novaezelandiae*) feed within petrel colonies, undisturbed by humans, on marine invertebrates which were provided by the seabirds. This leads to the assumption that seabirds offer foraging opportunities for forest birds.

Soil chemistry studies by Hawke (2010) revealed that added nutrients by petrel colonies (N, P, see above) are only poorly retained by the soil. The recorded low levels of nutrient retention suggest dispersion to the wider environments that might affect nutrient dynamics in waterways (Hawke, 2010).

Daughtery et al (1990) further found that the primary terrestrial productivity of nutrients is 13.6 times higher on seabird Islands than on Islands that are unaffected by these birds.

All piscivorous seabird species are known to be mobile linkers according to their transport of aquatic nutrients to terrestrial environments (Sekercioglu, 2006). Burrow building seabird species like the Sooty Shearwater are functioning as ecosystem engineers. The soil nutrients (guano, feathers, dead chicks) are actively brought into the burrows by the bird and act as nitrogen (N) and phosphorus (P) fertilizer deposits. Some seeds from the forest floor are adhesive to the birds and get dragged underground as well (Sekercioglu, 2006).

Seabirds act as predator and experience predation by native animals

On New Zealand Islands natural occurring seabird predators like the tuatara (*Sphenodon punctatus)* lived always in a dependant predator-prey relationship that was naturally balanced (Daughtery et al, 1990). Daughtery et al (1990) assume that when tuatara lost its native prey to invasive rat species the equilibrium was shifted in an unbalanced state and both native species became threatened by the exotic species.

Future investigations on the impact of commercial fisheries towards seabird mortality

Baird et al (2010) prepared a risk assessment for fishing related seabird mortality. It was showed that the endemic, at risk and declining White-capped albatross (*Thalassarche steadi*) is a regular bycatch of several fishing methods (trawling, bottom longline and surface longline). This causes a high mortality rate for the species. Miskelly et al (2008) predicted a serious population decline for the species, which was once abundant at the Catlins coast in prehistoric times. In addition a study of the White-capped albatross is underway (MCS, 2009). As for many seabirds, there is limited information on White-capped albatross ecology. Population parameter and at sea distribution of *Thalassarche steadi* will be investigated on the Auckland Islands (MCS, 2009). Findings of this study might contribute to the successful establishment of a White-capped albatross colony at Long Point (Table 5.3.1; see below).

The fishing for blue cod *(Parapercis colias;* Raawaru*)* is a big industry in New Zealands Southern Sea waters (Ministry of fisheries; Mfish, 2011). Statistical reports from the 1989-2010 time period in southern sea fishing zone BCO 5 showed that the catch of blue cod remained relatively stable (Mfish, 2011). Interestingly is that the most significant amount of fish was caught around Foveaux Strait and eastern Stewart Island (Mfish, 2011). Those Islands appear to be partially forested with significant amounts of seabirds. The oceanic life refuge of the Snares is not far away from those Islands. This might lead to the assumption that the stable cod catching quota is ascribable to the ecosystem services of seabirds?! However, Marine

Conservation Services (MCS, 2009) will conduct several investigations on the ecology of seabirds and their impact on the commercial fishing industry. The at-sea distribution of naturally vulnerable and range restricted black petrels (*Procellaria parkinsoni*) will be investigated. Black petrels (populationsize~1000-5000 mature individuals) occur rarely on the coasts of the North Island. The petrel's population performance on Great Barrier Island will be monitored (MCS, 2009). Parkinson (2006) assumes that this species might benefit from reintroduction programs to former breeding sites.

Mainland and Chatham Island shag species are in the focus of the research. Shag species are known to interact with mainly inshore commercial fisheries (MCS, 2009). The data collection will provide information about the foraging distribution of shag species and their overlapping with the fisheries (MCS, 2009). The research will include estimates about relevant life history parameters and the establishment of population levels and trends, which are recently poorly investigated (MCS, 2009; Table 5.3.1).

Yellow-eyed penguins (*Megadyptes antipodes*) are affected by the inshore fisheries (MCS, 2009). It is assumed that the foraging distribution of this oceanic bird is partially overlapping with the commercial fishing effort and the mortality of this species at sea is very poorly understood (MCS, 2009).Nationally vulnerable Yellow-eyed penguins are quite well studied on land, but questions about the foraging diet of this species still remain (MCS, 2009; Table 5.3.1).

5.1 Seabird advocacy potential at Long Point

Forest and Bird (Brooks, 2011) investigated on Important Bird Areas (IBA) as part of an international research project that highlights places where conservation actions for seabirds can be best targeted. To qualify for international IBA standards at least one out of three criteria must apply: threatened seabirds must regularly use the proposed area; have more than one per cent of the world's population of the species; more than 20,000 individuals are found there. It was revealed (Brooks, 2011) that New Zealand provides eight significant areas along its coasts and offshore islands. Brooks (2011) states that from worldwide 344 seabird species, 84 breed in New Zealand's exclusive economic zone (EEZ) and therefore is considered as the world wide richest EEZ for seabirds. It has to be recognized that a third of the world's species of penguins and shags bred on and around New Zealand along with 12 (from 22) albatross species as well as a few petrels and other seabird species (Brooks, 2011). Long Point and the Catlins are a part of the Marine IBA from the Southern Shelf. The recently abundant breeding populations of vulnerable yellow eyed penguins at Long Point play an important role for qualifying after IBA standards (see below).

A restoration project for seabirds must include the awareness that New Zealand is the world centre of seabird activity (Parkinson, 2006). However, Miskelly et al (2008) explains that seabirds might have thousands or even millions of breeding pairs, but their threat classification of range restriction is caused by breeding ranges of less than 100,000 ha. Most seabirds breed on offshore islands usually inaccessible for humans. The fact that some seabird species (Erect-crested Penguin; Snares Island snipe; Buller's Shearwater) only bred in one or a few locations (mostly Islands) makes them "Naturally uncommon" (Miskelly et al, 2008).

Some seabirds that are regular visitors on the New Zealand mainland and show increasing numbers might be assessed as relict for their conservation status. Research on those species (e.g. Cook's petrel; fairy prion; fluttering shearwater) found that their original breeding range had decreased by more than 90% following the anthropogenic introduction of predatory mammals on the New Zealand mainland and offshore Islands (Miskelly et al, 2008).

Miskelly et al (2008) found that before the beginning of the 19th century, four from 77 indigenous New Zealand breeding oceanic birds went extinct.

16 from 77 seabirds are classed threatened in the conservation status (six nationally critical; three nationally endangered; seven nationally vulnerable).

47 from 77 seabirds are at risk (nine declining; two recovering; 13 relict; 23 naturally uncommon). Six species have the conservation status not threatened and four have the status coloniser (Miskelly et al, 2008).

More recent estimates by Forest and Bird are even more alarming. It is assumed that about half of the 84 in New Zealand waters breeding seabird species are threatened with extinction and 90% of the 30 to New Zealand endemic species are threatened (Brooks, 2011).

These figures show that seabird conservation is an urgent issue and needs national consideration. However, Long Point can be considered as a future potential for seabird restoration on the New Zealand mainland (see below).

Access to seabird colonies on the mainland

Mainland seabird colonies at Long Point of cryptic (sooty shearwater), migrating seabirds (albatross, petrels) and flightless aquatic species (Yellow-eyed penguin, Fiordland-crested Penguin), will or are already established and provide hereby optimal conditions for long term academic studies on their physiology, social behaviour and contribution to the ecosystem. The studies can be conducted without extensive travels to offshore Islands. The monitoring of species can be accomplished in any season. Conservation of endangered species on offshore islands must not always be an advantage. Mulder et al (2009) found that when an offshore Island had to be eradicated from predators like rats, novel plant communities are still likely to suppress the native vegetation. This might be induced by seabirds that bring new seeds to the Island. Mulder et al (2009) assume that the recovery of natural vegetation and the composition of plant species on offshore Islands might be an extremely hard to monitor and involves a long-term project with a significantly low chance of success. It is strongly recommended that if urgent "hands on" wildlife management techniques for endangered species have to occur, it might be easier to conduct it on the mainland with an easier access to resources.

Involvement of heritage interested groups

Projects from other scientific fields could be integrated in the Long Point restoration project. There is still a large amount of gaps in the reconstruction of prehistoric and early settlement times (Hamel, 1976, see above). Such a project might find interest by the local community independently of any ethnic ancestry.

Integration of school projects

Certain communal establishments such as schools might directly benefit from the seabird restoration project. Either weekly afternoon workshops supervised by adults, or integrated in the school system as an environmental-local history and geography class could provide a practical approach to investigate supra-regional ecological issues. The practical tasks can be suitable for children and pupils of any age class. For example, the monitoring of invertebrates of the Long Point region away from the cliffs could be conducted safely by smaller children. Combined with an integrated seabird and/or seal observing it could be a form of interactive learning. Mature students should get tasks that inspire their contribution to the local environment in the future. Some pupils might like to act as volunteers in the pest control application and the checking of artificial burrows (see above), while others could enjoy monitoring penguins or seabirds. Mature students might also get involved in data entries of recent surveys and observations and hereby have the opportunity to gain the knowledge of "real life" data processing as a part of a computer laboratory class.

Modification of the YEP website

The Yellow-eyed Penguin Trust website (*www.yellow-eyedpenguin.org.nz)* might be extended by an online training course about seabird knowledge in the style of Department of Conservation online course (http://www.doc.govt.nz/getting-involved/get-trained/). In cooperation with the Department of Conservation a national "seabird knowledge" course could be developed to encourage the community more to actively participate in conservation work.

Integration in the Otago coast Seabird restoration Project

Forest and Bird (2008) reported that Long Point has a high potential for reintroducing seabird colonies on the mainland. After the eradication of introduced predators to a minimum level the Long Point headland with its suitable slopes (see pictures in appendix) is able to provide sufficient and qualitative breeding locations for a few target species (Table 5.3.1; see below). Forest and Bird (2008) argues that the downside of Long Point is its remoteness. It can be seen as an opportunity as well. Warne's (2008) notebook entries from a survey to the Snares explain how incredibly loud the noise, in a 1982 estimated 2.75 million pair stronghold of sooty shearwater must be during its nocturnal activities:

11.05 pm: "...There are a lot of birds (sooty shearwater) on the forest floor...They sound terrible, like a squeezebox being played by a madman."

03.55 am: "...For the past hour the noise has been building up until it's now deafening. It seems that every muttonbird is out on the surface..."

To my knowledge concerns about anthropogenic noise and light pollution around the potential breeding sites for nocturnal petrels such as the sooty shearwater are no issue at Long Point. The Purakaunui Bay conservation campsite on the edge of the Long Point reserve gains more popularity by ecological interested tourists especially during the summer months (Personal observation). Future information leaflets about the seabird restoration project could reach international tourists and might involve the opportunity for fundraising resources.

5.2 Integration of Long Point seabird advocacy on a national level

Gaskin (2007) investigated extensively on advocacy proposals for New Zealand seabirds. His discussion paper reveals that the dilemma in seabird conservation is the lack of awareness by the public. The key for successful seabird conservation will be the networking of all New Zealand Seabird groups. The data gathering and maintenance should be equally administered by DOC, NIWA, Universities and the Ornithological Society of New Zealand (Gaskin, 2007). The results will occur uniformly on a nationwide database that is accessible for all interest groups. From the already existing website (*www.nzseabirds.com*) links to all interest groups of seabird conservation sorted by geographical region and participation of stakeholders should be provided (Universities; Museums; Government and other agencies: DOC, NIWA, Ministry of fisheries; Landcare research; Iwi Groups; NZ Trusts or commercial operators; NGO's and Overseas Agencies). The data bases should be divided in following subcategories:

Historical data entry by region

Museums and excavation reports about the traditional abundance of seabirds should be accessible and electronically sorted by historical regional appearance of the seabird species (Gaskin, 2007).

Seabird monitoring on the mainland NZ

This includes the participation of volunteers and professional conservation workers. The website should provide a map of "hotspots" were seabirds can be observed from the shore under the supervision of professional staff (DOC and Trust ranger). Data about and seabird interactions might play an important role (see above) and sightings of inter-species behaviour should be recorded (Gaskin, 2007).

Satellite Tracking data

All data of former satellite tracking of any seabird species that is available should be sorted in an online archive, helping scientists to find out more about population dynamics (Gaskin, 2007).

Data from fisheries observers and conservation surveys

Baird and Gilbert (2010), collected seabird capture data from 1989 onwards to gain spatial and temporal distribution of the seabird species which are involved in interactions with the commercial fishing industry in New Zealand waters. All official fishery observers should be trained and use the same practice during the data collection. In standardising the observer methodology, Gaskin (2007) assumes that the forward quadrant method (90° single observer- or 180° two observers) obtains the most consistent and high quality data. A data logger should be used for information of sighting conditions, effort and sightings. It has to be investigated how far ecotourism "surveys" can be involved in the qualitative data gathering.

Data about the seabird physiology and ecology

DOC, NIWA and Universities need their own category on the proposed website when it comes to physiological and ecological research. Further subdivisions of both of these categories are probably necessary to form a transparent catalogue and quick access to research relevant categories.

Curious visitors should find a virtual New Zealand seabird centre on the main website. All "branches" of in reality existent seabird centres such as Long Point, Sandager Bird observatory and Leith Marine Science Centre should be easily found on the site. Besides the access of various data bases (see above) the visitor should find little streams from nest/burrow cams of seabirds on shore to wake even more curiosity (Gaskin, 2007). Main seabird biology, threat status, as well as a schedule of School/visitor activities and upcoming events in different regions should be highlighted on the website.

5.3 Reintroduction proposal of seabird species at Long Point

The lack of seabird data shows that the reintroduction of traditionally abundant seabird species in the Catlins coastal region at Long Point is a challenging conservation project. At this stage, it should be focused on the already abundant seabird species at Long Point such as Yellow-eyed penguin, Fiordland-crested Penguin (recently reappearing; pers. Comment David McFarlane), Spotted Shags and Sooty Shearwater (Table 5.3.1).

All other proposed seabird species are recently not abundant on Long Point. This leads to the assumption, that there must be significant deficits in seabird suitable habitats. Anthropogenic factors were discussed earlier (see above). Archeological findings about historical seabird abundance might not be sighted and cataloged at this stage (see above) and more information about the social and foraging behavior has to be investigated. Main interest of further research should be on suitable breeding habitats for all proposed seabird species at Long Point. This might provide the possibility of optimal recovery for significantly depleted seabird populations at Long Point and the Southern sea. Further investigations must be conducted along the Long Point cliffs about the native salt sprays tolerant coastal turfs *Leptinella dioica*, *L. squalida* and *Crassula moschata*. This research will show significant findings about suitable habitat for seabird breeding sites at Long Point including facts for a potential reintroduction of the iconic White-capped albatross and Grey-backed storm petrel (Table 5.3.1, see below*)*.

Gummer (2003) explains that translocations of seabird chicks were successfully applied in many earlier occasions, but are expensive wildlife management actions and have to be carefully investigated beforehand.

One significant, and apparently the most important aspect is that trapping numbers of mammalian predators must be significantly low before any planned and conducted seabird reintroduction.

The use of decoys and audio attractions and artificial burrows are wildlife management tools that can be applied at Long Point to increase already existing populations of seabird species. Audio attractions will help to mimic a more active breeding site for Sooty Shearwater (*Puffinus griseus*; Gummer, 2003; see below).For the long term project of reintroducing the iconic White-capped albatross (*Thalassarche steadi)* at Long Point the use of decoys seems inevitable (see below).

The evaluation of proposed seabirds at Long Point

The rankings of the species are based on their threat classification, importance to ecosystem processes and advocacy potential. Additional research is urgent for the reintroduction of the proposed, but recently not abundant seabird species to Long Point. Most suitable species are ranked from low (1= Most suitable) to high (9= high changes of suitability, but more intense conservation effort needed and/or poor/ insufficient data available). Major findings about the ecology for Long Point suitable historic seabird species is presented below and in Table 5.3.1.

Seabird species ranked 4*; 7*-9* are proposed provisionally. The lack of qualitative data about the ecology and population dynamics for the proposed seabird species 4*; 7*-9* (Table 5.3.1), might lead after further investigations to the conclusion that those seabirds are not suitable for the reintroduction at Long Point. Again, this restoration project of Long Point is a long term concern and requires appropriate and well balanced conservation actions.

Yellow-eyed Penguin; *(Megadyptes antipodes)* Ranking No. 1

The naturally vulnerable (Miskelly et al, 2008; Table 5.3.1) Yellow-eyed penguin (Hoiho) has an established breeding colony at Long Point. Yellow-eyed Penguins can indicate varieties in the oceanic productivity by changes in their foraging habits and prey composition (MCS, 2009). It is assumed that the abundance of Yellow-eyed penguins on the mainland is reduced due to unsuitable habitat conditions. The Yellow eyed penguin prefers coastal shrublands as breeding habitat (Gummer, 2003). Hoiho is the driver of ecotourism on the Otago Peninsula, but it is assumed that uncontrolled tourism has a significant negative impact on the breeding success of this species (McClung et al, 2004).Gummer (2003) reports the successful use of yellow-eyed penguin decoys to attract this species to more mainland sites. Hoiho was significantly attracted by the decoys, but so far no recordings exist about the establishment of successful breeding sites.

Long Point, including Cosgrove creek as a part of the Southern Shelf IBA is in the recent 2010/11 breeding season home for (49 +21) 70 breeding pairs of Yellow-eyed penguins (YEP; personal comment David McFarlane). Moore (1992) calculated the overall population of YEP of 5930 to 6970 birds in 1988/89. Severe events of chick mortality in 1990 on the South Island as well as declining numbers of individuals on Campbell Island during 1987-1998 (DOC, 2001) might let assume that Moore's (1992) YEP population estimates are still in the same figure range. If this is true, Long Point including the Cosgrove creek Reserve would directly qualify for international IBA standards by having more than 1% of the species world population.

Ironically after genetically and morphological research (Bossenkool et al, 2009) is the assumption that yellow eyed penguins had a dramatic range expansion about 1500 AD from subantarctic Islands to the South Island . Recent genetic research by Bossenkool et al (2009) revealed that yellow eyed penguins on the South Island have an independent and distinctive small gene pool compared with the species subantarctic relatives. This indicates a low tendency in long distance migrations of adult birds. It is strongly recommended (Bossenkool et al, 2009) not to compare observed population dynamics from South Island *M. Antipodes* with the dynamics of the subantarctic species respectively.

Especially during breeding and fledgling times anthropogenic disturbance caused by ecotourism have to be reduced to a minimum level. This can be achieved by the construction of for Hoiho hidden and camouflaged look out points.

Fiordland-crested penguin;(*Eudyptes pachyrhynchus*) Ranking No. 2

The naturally vulnerable (Miskelly et al, 2008; Table 5.3.1) Fiordland-crested penguin was formerly abundant in the Catlins region, but faced significant hunting pressure by early Polynesian land occupiers (Anderson, 1992). Until recently it was assumed that the Fiordland-crested Penguin only visits the mainland for moulting purposes. However, there was a sighting in 2010 of a (in a later stage) unsuccessful breeding pair at Long Point (David McFarlane pers. Comment). Besides studies on oceanic productivity, further investigations about the ecology of this cryptic species could be conducted. Studies about species interaction with Yellow-eyed penguins are strongly recommended. The use of Fiordland-crested Penguin decoys might help to attract this species (Gummer, 2003). The action plan for endangered species (Taylor, 2000a) was not focusing on translocations of this species. Threat management at existing sites remains the highest priority in terms of actions for recovery. However, if Long Point becomes predator free and provides suitable breeding habitat, Fiordland crested penguins would be a further significant attraction for ecotourism.

Sooty shearwater; (*Puffinus griseus*; titi); Ranking No. 3

The conservation status of Sooty shearwater is: At risk and declining (Miskelly et al, 2008; Table 5.3.1). Large breeding colonies of titi are found on Foveaux Straight Island, Stewart Island and the Snares. This nocturnal colonial-nesting petrel breeds during the Southern hemisphere summer on and around the New Zealand mainland, before its northerly migration to the northern Atlantic and Pacific during the southern winter (Warham et al, 1982). Warham et al (1982) explain that the ecological importance of Sooty Shearwater is outstanding due to their large numbers of individuals in anthropogenic undisturbed colonies. Sooty shearwaters create up to 3m long burrows, which provide the soil with essential nutrients such as guano, nesting material, feathers and dead birds. However, mainland colonies of titi are rare and significantly decimated by introduced mammalian predators. Another threat for Sooty shearwater is the collapsing of burrows caused by grazing ungulates and human visitors of breeding sites. Ecotourism must avoid disturbing breeding grounds of Sooty Shearwater. Long Point has a few titi occupied burrows, which are assumed to be immigrating birds from offshore island populations (Taylor, 2000b). Main focus for the revitalisation of the colony at Long Point should be the optimizing of breeding grounds including the preparation of artificial burrows to increase the number of breeding pairs (Priddel et al, 2006). Warham (1982) describes that colonies of titi on the Snares mainly occur in forested vegetation, or with the presence of several tussocks *(Poa tennantiana; Poa astonii and Hebe elliptica*). Priddel et al (2006) investigated on Gould's Petrels and how efficient audio attraction is for independent translocations of this species. It was found that the exact attraction mechanism of audio cues remains uncertain, but the Gould's petrel side fidelity was significantly increased by it. Priddel et al (2006) assume that the use of audio attractions might be applied for many burrow nesting petrel species.

White-capped albatross; (*Thalassarche steadi);* Ranking No. 4*

The population of White-capped albatross is declining and at risk (Table 5.3.1). The use of decoys and audio attractions appear to be an appropriate management tool to attract sub adult and mature albatrosses on appropriate predator free high cliff habitats (Gummer, 2003). Baker et al (2010) conducted a population estimate of White-capped albatross on the Auckland Islands. It was found that the global majority of the species population (95%; 72,000 individuals) breeds on Disappointment Island. The birds breed extensively on the slopes of steep cliffs that are covered in high grasses, but avoid the plateau of the Island (Baker, 2010). Further was investigated (Baker et al, 2010) that the colonies of white capped albatross on the South West Cape and Adams Island nest preferably at steep tussock covered slopes. Biology and ecology of this seabird is poorly investigated (Taylor (2000a). Former research about chick translocations of the Laysan albatross on Hawaii showed very limited success (Gummer, 2003). Gummer

(2003) assumes that chick translocations should only be conducted with non threatened albatross species, because of a significant occurring mortality rate and uncertainty about the optimal release age of albatross chicks at new sites after the translocation. For a successful translocation of Laysan albatrosses the chick translocation is assumed to be somewhere between 1- 5.5 months of age. Gummer (2003) assumes that in general albatrosses have a strong tendency to return to their natal site (philopatry).

Based on limited information on the species ecology the reintroduction of the historic occurring White-capped albatross at Long Point (Hamel, 1977; See above) has to be considered as a long term project. It might commence in the near future with the help of decoys and audio attractions. Mainland colonies of this iconic species have a high advocacy potential for Long Point by gaining international recognition.

Spotted Shag; (*Stictocarbo punctatus punctatus*; or *Phalacrocorax p.*); Ranking No. 5

The spotted shag is considered as not threatened (Miskelly, 2008; Table 5.3.1). However, this species breeds only in New Zealand (Taylor, 2000 b). Investigations about interactions with commercial long line fisheries and inshore set nets are not planned for this species (MCS, 2009). Baird et al (2010) found a high uncertainty factor, if the naturally vulnerable Stewart Island Shag *(Leucocarbo chalconotus*; see below) is at risk through commercial fisheries. Taylor (2000 b) reports a research deficit in the diet composition of spotted shags. Lalas (1993) found that spotted shags have a restricted diet and primarily prey on short-lived pelagic fish. Earlier findings of Lalas (1983) focused on the contents of regurgitated pellets from spotted shags that lead to the latter assumption. However, further research is recommended.

The findings of Gillham (1960) show that the ground nesting spotted shag produces guano which causes a dieback of the vegetation when it has direct contact. The edges of the ground breeding sites in Otago showed the native shrubs of *Hebe elliptica* and *Poa astonii*. Spotted shags are also known to breed on bare cliff rocks (Gillham, 1960). Further investigations are necessary about the long term effect of spotted shag guano on the vegetation.

The population dynamics of spotted shags is still poorly investigated. There is no qualitative data about natal philopatry, pair and nest site fidelity available (Taylor, 2000 b). This not threatened species is expected to be sensitive to disturbance by human boating activities (Taylor, 2000 b). The spotted shags spectacular fishing and diving maneuvers close to the shore are attractive to bird observers. Population dynamics are still to be investigated; their findings might reveal details that can be used for studies on threatened shag species. Data about the nest numbers and the breeding success can reveal the distal and proximal availability of prey and its abundance (Lalas, 1983). Lalas (1983) assumes that spotted shags are an ideal indicator species for the long-term monitoring of marine perturbations on seabirds.

Stewart Island Shag; *Leucocarbo chalconotus*; Ranking No. 6

The Stewart Island shag is considered as nationally vulnerable (Miskelly et al, 2008; Table 5.3.1). This species faces the same threats by set net fisheries as the spotted shag (Taylor, 2000 a; see above). Taylor (2000 a) recommends to fence colonies at mainland sites to exclude predators and stock. Shag species are a target for illegal shooting in many Otago and Southland areas. Taylor (2000) assumes that this inappropriate human behavior towards this nationally vulnerable species can be changed with an advocacy program and the legal protection of Stewart Island Shag colonies. Stewart Island and Spotted shag are traditionally abundant in the Southland area (Lallas, 1993). The reintroduction of the Stewart Island Shag at Long Point should occur after the spotted shag. The spotted shag is not threatened and might be a suitable species for research on chick translocations. After the successful reintroduction of the spotted shag further research is necessary to investigate the impact of shag species guano on the vegetation. Both species will be attractive to seabird observing visitors at Long Point.

Mottled Petrel; *Pterodroma inexpectata*; Ranking No. 7*

The Mottled petrel's conservation status is relict (Miskelly et al, 2008; Table 5.3.1). The Mottled Petrel breeds only on south New Zealand's offshore Islands (Fiordland: Front and Shag Island; Foveaux Straight: Big and Little Solander Island; Stewart Island: Whenua Hou, Big South cape, Solomon; and the Snares; Taylor, 2000a). Further is assumed (Holdaway et al, 2001; Taylor, 2000a) that the Mottled petrel nested on many mainland sites of the North and South Island.

Its expiration occurred through forest clearance, fires and the introduction of mammalian predators, especially feral cats, Norway rats and stoats. On offshore Islands this seabird species is harmed by predation of Weka. Population size of this poor known petrel species was estimated between 200,000- 400,000 breeding pairs in the largest breeding colony on Whenua Hou (Codfish Island; Warham et al, 1977). More recent research conducted by Scott et al (2009) found that this population might be slightly declining with recently existing 160,000 breeding pairs. Scott et al (2009) further found that the ground burrow nesting petrel uses very soft soil habitat that can be easily crushed by human visitors. Taylor (2000a) strongly recommends the establishing of new colonies within the former breeding ranges that might include save sites on the South Island. Taylor (2000a) further assumes that this species might be suitable for chick translocations. The use of audio attractions can be a successful management action to lure adult birds during their nocturnal display flights over potential breeding sites. Those occur in the time period between November and February.

Grey-backed storm petrel; (*Garrodia nereis)*; Ranking No. 8*

The conservation status of the Grey-backed storm petrel is categorized as relict (Miskelly et al, 2008; Table 5.3.1). This species is range restricted by its loss of breeding sites on the New Zealand mainland, but is considered as 'save overseas' (Miskelly et al, 2008). Holdaway et al

(1999) found that in prehistoric times New Zealand's smallest petrel was abundant in the north Canterbury region. At Ardenest (Waikari, North Canterbury) soil analysis at a deposit accumulated by now extinct laughing owls (*Sceloglaux albifacies*) showed that grey-backed storm petrels once were prey objects of those birds. Holdaway et al (1999) further assumed that those smaller burrow-nesting seabirds were extirpated on the mainland with the arrival of kiore and later with the arrival of ship rats at the mainland and near offshore Islands. However, due to the lack of available data about *Garrodia nereis* in the Catlins region, its abundance can only be assumed at this stage. Interestingly is that the preferred breeding sites of Grey-backed storm petrels on Falkland Islands, South Georgia Islands, Kerguelen Islands are found in the inside of tussock grass bushes for burrow building(Wood, 1970; Croxall, 1980; Weimerskirch et al, 1989). Parkinson (2006) reports that at the moment *Garrodia nereis can* only be spotted south of Stewart Island. This small petrel would be a long term reintroduction project for Long Point, which has to be carefully investigated. However, the Foveaux Straight induced "wind funnel" along the Catlins coast (see above) might be able to provide a suitable tussock habitat at Long Point for this species.

Cooks Petrel; (*Pterodroma cookie*); Ranking No. 9*

The Cooks petrel is considered as "relict" due to losing 90% of its former breeding range (Miskelly et al, 2008; Table 5.3.1). Parkinson (2006) reports that on Codfish Island, Cooks petrels increased in numbers of breeding pairs after the removal of weka (*Gallirallus australis*). Further is assumed that before the arrival of mankind (>800 years B.P.), Cooks petrel bred on coastal and interior ranges of the New Zealand mainland (Holdaway et al, 2001; Rayner et al, 2007).

The research conducted by Rayner et al (2007) showed that the breeding distribution of Cook's Petrels on Little Barrier and Codfish Island predominantly occurs above 300 m. Breeding burrows of the species occur also on lower altitude (~100m), where the habitat can be associated with steep slopes, shorter distance to the ridgeline, lower canopy heights, with less cover and more large stems of broadleaf forest such as Pohutukawa (*Metrosideros excelsa*), Kauri (*Agathis australis*) and Tawa (*Beilschmiedia tawa*). Rayner et al (2007) assume that the world biggest Cooks petrel breeding colony at Little Barrier Island (estimated 50,000 breeding pairs, but uncertain) went through a significant habitat change of its lower slopes by fires and loggings of early Polynesian and European settlers. Further had the introduction of ungulates, feral cats and rats a significant impact on the birdlife until their eradication in 2004. Rayner et al (2007) explain that effective conservation strategies for Cooks petrel are hard to conduct due to the lack of data about the basic biology of this species. However, the reintroduction of Cooks petrel at Long Point will involve high conservation effort, but would make a significant contribution to the ecosystem by the inland abundance range of this seabird species.

.5.3.1 **Table of ranking species by their threat classification, importance in ecosystem processes and advocacy potential at Long Point; 1= Most suitable; 9= high chances of suitability but high conservation/research effort**

Rank/ Seabird -species/ Family	New Zealand threat ranking	Contribution to ecosystem	Advocacy potential
1 Yellow-eyed penguin (*Megadyptes antipodes*)/ Spheniscidae	Nationally vulnerable 1000-5000 mature individuals (unnatural), stable **Qualifier:** Extreme Fluctuations	• Indicator species for oceanic productivity • Guano/ biomass provides nutrients for vegetation	• Most popular ecotourism species on South Island, NZ • With a few more breeding pairs Long Point becomes a direct IBA qualifier
2 Fiordland-crested Penguin (*Eudyptes pachyrhynchus*)/ Spheniscidae	Nationally vulnerable 1000-5000 mature individuals 10%-50% population decline **Qualifier:** Sparse	• Indicator species for oceanic productivity • Guano/ biomass provides nutrients for vegetation	• Attracts ecotourism • Cryptic lifestyle, attractive research animal
3 Sooty Shearwater/ (*Puffinus griseus*)/ Porcellariidae	At risk/ Declining >100000 mature animals 10%-70% population decline **Qualifier:** Secure overseas	• Mobile linkers of aquatic nutrients • Forest birds might directly feed on aquatic invertebrates in *P. griseus* colonies • Active ecosystem engineers through burrow building and seed dispersal	• Shearwaters were important food sources in prehistoric times in NZ • Burrow cams can reveal cryptic lifestyle for tourists • Artificial burrow building and setting as attraction for regional pupil • Use of audio attractions
4* New Zealand white-Capped Mollymawk/ (*Thalassarche cauta steadi*)/ Diomedeidae	At risk/ Declining >100000 mature animals 10%-70% population decline **Qualifier:**Range restricted; Data poor	• Mobile linkers of aquatic nutrients	• Iconic species with high attraction for ecotourism/ only mainland colony of species • Long Point albatross research site

5 Spotted Shag /*Stictocarbo-*; or: *Phalacrocorax punctatus*/ Phalacrocoracidae	Not threatened	• Mobile linkers of aquatic nutrients	• "Control bird" fast adaption to environmental changes • Attractive for tourists with its fishing "manoeuvres " • Nutritional studies on inshore fish stocks • Research on guano composition and affect for ecosystem
6 Stewart Island Shag/ *Leucocarbo chalconotus*/ Phalacrocoracidae	Nationally vulnerable 1000-5000 mature individuals (unnatural)	• Mobile linkers of aquatic nutrients	• See spotted shag • Vulnerable species needs advocacy against illegal shooting
7* Mottled Petrel *Pterodroma inexpectata*/ Procellariidae	Relict >20000 mature individuals Stable or increasing **Qualifier:**Range restricted; increasing	• See sooty shearwater	• See sooty shearwater • Urgent need for research on biological and ecological parameters of species • Use of audio attractions
8* Grey-backed storm petrel (*Garrodia nereis*)/ Hydrobatidae	Relict >20000 mature individuals Stable **Qualifier:** Range restricted; Secure overseas	• See sooty shearwater	• See sooty shearwater • Current breeding grounds in tussocks; indicates need for habitat restoration
9* Cooks Petrel (*Pterodroma cookii*)/ Procellariidae	Relict >20000 mature individuals Stable or increasing **Qualifier:**Range restricted; increasing	• See sooty shearwater	• See sooty shearwater • Urgent need for research on biological and ecological parameters of species such as optimal breeding altitude

6.0 Conclusion

The question to be investigated in future research is: Why did seabirds change their breeding environment from the mainland and mainly live cryptic and hidden now on remote offshore Islands?

The ecosystem of the Catlins represents a fluent equilibrium that is defined by mild but significant regular occurring natural microclimatic changes which create variations of flora and fauna in coastal areas and tidal zones. The slow but permanent succession of the Catlins forest shows many variables in its vegetation patterns.

Historical findings show that seabirds were traditionally abundant in high numbers of several species on the mainland of New Zealand, including the Catlins region and Long Point.

Investigations on seabird predation show partially expected results. The eradication of mammalian predators is essential to protect seabirds and all of New Zealands native wildlife. Ecosystems are quite complex and some species find extraordinary niches for themselves. However, the price can be a significant depletion of the affected population.

Seabird bycatches of commercial fisheries have to be further investigated. If there is a food competition between the both, it needs additional research to estimate the amount of fish that can be yield from the southern ocean.

Sparse colonies of existing seabird species might compromise the long term survival of these species. With their function as a catalyst additive “device” for the forest, the return of seabirds to the mainland would be a great benefit to Long Point and the Catlins ecosystem. Guano and various other seabird biomass supplies create new life. Seabird ecosystem services provide rich nutrients for the bottom and several higher levels in the food chain and hereby have numerous wide ranging positive effects for the equilibrium in ecological systems. New seabird colonies raise the chance of survival for that species significantly by getting further abundant. This was once the case for most seabird species in historical times and can be in near future again. Seabirds are the vagabonds of the ocean and only need a safe place to breed and raise their chicks.

Long Point is with the help of reasonable conservation and wildlife management actions a place of opportunity for threatened seabird populations. Scientific research and the integration of the community can create a super-regional project that protects the heritage and wildlife of the Catlins region on an international scale. This will attract in seabird conservation interested people from the whole world. Long Point and the Catlins consist of a wide variety of native recently- and historical- abundant seabird species and many of them might consider it home.

The first step of a sustainable restoration of Long Point is to bring the sea-birds home. The forest regeneration will commence in a moderate time window by seabird guano from several descent sized seabird colonies that breed on spectacular Long Point cliffs. With the absence of mammalian predators the insect and bird life recovers and the abundance of native fruit trees attracts indigenous seed dispersing terrestrial birds again. River and marine inshore fish species will benefit from the recovered nutrient transfer between land and ocean as well.

However, the recent natural environment of the Catlins region shows the state of an anthropogenic disequilibrium. Time is a challenge in active conservation and work is to bring the balance back to an ecosystem. It is recommended to act now.

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