Biodiversity Advice Request

Assessment against Te Wahipounamu Statement of Universal Value: 'Dart passage' tunnel, Fiordland and Mt Aspiring National Park.

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Summary

1 My advice relates to the proposed Milford Dart Tunnel with respect to its potential impacts on biodiversity values of the Te Wahipounamu South West New Zealand World Heritage Area.

2 In relation to biodiversity, the area affected by the proposed tunnel undoubtedly contributes to on-going ecological and biological processes as well as having high biological diversity that is characteristic of Fiordland National Park and the World Heritage Area (World Heritage Criteria No. 9).

3 The area affected by the proposal contains examples of the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation (World Heritage Criterion No. 10)

4 The area affected by the proposed tunnel undoubtedly contributes to on-going ecological and biological processes as well as having high biological diversity that is characteristic of Fiordland National Park and the World Heritage Area, particularly**,**

- threatened bird, lizard and bat species**,**
- significant wetland containing nationally rare and distinct vegetation associations and habitat types**,**
- representative plant communities,
- pristine aquatic environments,
- rich native invertebrate fauna.

5 The extent of the vegetation clearance required for road widening has not been quantified therefore the effects on biodiversity values cannot be adequately assessed.

6 The roosting areas of long-tailed bats in the Hollyford Valley need to be identified so that the potential adverse effects on this population can be minimised or eliminated. Felling of any trees for road widening would need to be carefully considered to minimise the effects on ecological and biological processes with particular reference to bats, mohua, the Otago large gecko(and other hole nesting species), and scarlet mistletoe.

7 The impacts on significant wetland areas adjacent to areas of road widening and tunnel portal access need to be assessed. Predator control may help to mitigate probable impacts but this has to be of a suitable scale and carefully integrated with existing programmes to be meaningful.

Purpose

I have been asked to provide advice to enable an assessment of the Milford Dart Tunnel with respect to the vegetation clearance and the effects on biodiversity values described within the Statement of Outstanding Universal Values for Te Wahipounamu South West New Zealand World Heritage Area (UNESCO).

A World Heritage Site is given a Statement of Outstanding Universal Value by the World Heritage Committee and this forms the key reference to future protection and management of this site. The Statement of Outstanding Universal Value includes a summary of why the site has outstanding universal value and identifies the criteria (of which there are ten) under which the property or site was inscribed. This statement also includes the assessments of the conditions of integrity or authenticity, and the requirements for protection and management.

Te Wahipounamu South West New Zealand World Heritage Area was gazetted in 1990 using a Statement of Outstanding Universal Value according to the following relevant criteria:

vii) it contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;

viii) it has outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;

ix) has outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;

x) contains the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

The Milford Dart Tunnel application seeks to construct an 11.3 km long 5 m single lane bus/coach road tunnel through the Humboldt and Ailsa Ranges to link the Hollyford and Routeburn roads within Te Wahipounamu World Heritage Area.

Focus of advice

This advice is provided in relation to:

- the biodiversity values relative to World Heritage assessment criteria (ix) and (x) (these criteria being the most relevant to biodiversity);

- the biodiversity impacts likely to occur during the construction and operation of the Hollyford and Routeburn tunnel portals and associated road modifications.

In addition, points relating to potential impacts and the mitigating actions required on specific biodiversity values are addressed below in sections 2 & 3. My area of expertise is birds and bats but I have also provided limited information about lizards, invertebrates and scarlet mistletoe after consultation with my colleagues.

Definition of biodiversity

The 1992 United Nations Earth Summit defined biological diversity "as the variability among living organisms from all sources, including, terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems".

Terminology

I use the following terms and abbreviations

"World Heritage Area" (WHA)

"Affected Area" to denote the sites affected by the proposal and specifically the Hollyford Affected Area (HAA) when talking about the Hollyford Tunnel Entrance, Hollyford Airstrip area and Hollyford Road and Routeburn Affected Area (RAA) when talking about the Routeburn Tunnel Entrance.

Section 1

1.1 I will assess biodiversity values for the HAA and RAA against criteria (ix) and (x) as described in the Statement of Outstanding Universal Value.

1.2 The area affected by the proposed tunnel undoubtedly contributes to on-going ecological and biological processes (criterion ix) within the HAA and RAA and the wider WHA.

1.3 The Upper Hollyford Valley and the Lower Dart Valley which overlap the affected areas have been recognised in the Department of Conservation (DOC) ecosystem prioritisation programme as Ecosystem Management Units (EMUs). This recognizes that maintaining a whole range of ecosystems in good condition is important to support the conservation of a full range of species nationally (Noss 1996).

- The Upper Hollyford EMU (32,670 ha) is described as glacially sculpted granite and greywacke ranges supporting forests of red, silver and mountain beech with some conifers, subalpine grasslands and herbfields, alpine lakes, and valley floor wetlands and grasslands.

- The Lower Dart EMU (32,938 ha) is described as a heavily glacial influenced catchment on schist with permanent snow & ice, subalpine grasslands and scrub, forests of red, silver and mountain beech, valley floor grasslands, alpine lakes, and riverbed habitats; high species values.

1.4 On the eastern side of the Hollyford road and airstrip there is a large wetland containing nationally rare and distinct vegetation associations and habitat types. It is dominated by harakeke (*Phormium tenax*) but also has a diverse range of other plants

Pseudopanax crassifolium), broadleaf,(*Griselinia littoralis*) putputaweta (*Carpodetus serratus*), three finger (*Pseudopanax colensoi*), koromiko, *Carex secta*, weeping mapou (*Myrsine divericata*), cabbage tree (*Cordyline australis*), *Coprosma spp*, *Astelia fragrans* and kiokio (*Blechnum capense*) (Ryder Consulting, 2007).

1.5 Freshwater environments in the vicinity of the Hollyford Airstrip (including the wetland cited in Point 1.5 above) are an important sequence of alluvial fans, wetlands, surface water bodies and river floodplain and these waters are representative of the wider WHA (DOC Officers Report 2011).

1.6 The plant successional sequences in the vicinity of the HAA include abundant fruiting and flowering trees and other vegetation within the designated 1 ha portal Site, the 8 ha airstrip spoil dump and areas required for widening the Hollyford Road. These areas represent a significant resource for territorial birds and bats using the local area as well as those species foraging over larger landscape scales.

1.7 The affected areas (RAA & HAA) also contribute to criterion (x) by supporting almost complete bird communities.

- The RAA has a significant proportion of indigenous bird species representative of fertile red beech (*Nothofagus fusca*) dominant forest communities in the WHA (Table 1).

- The HAA has a similarly characteristic complement of podocarp-beech dwelling bird species (Table 1).

1.8 Together, the values listed in 1.3 to 1.7 contribute to the outstanding examples of ecological and biological processes, ecosystems and communities, which make up the World Heritage Area.

1.9 Both sites have high biological diversity of threatened bird and bat species (Table 1) (Criterion x). One species, the long-tailed bat is classified as nationally critical, the highest threat ranking. Two species (possibly three) are classified as nationally endangered; kaka (*Nestor meridionalis*), falcon (*Falco novaeseelandiae*) and possibly short-

tailed bat (*Mystacina tuberculata*)) and one is nationally vulnerable, mohua (*Mohoua ochrocephela*).

1.10 A number of "keystone" bird species are present in the RAA and HAA (Table 2). Keystone species are those which influence the ecosystem in ways that are disproportionately large compared to their abundance. They are important contributors to maintaining fully functioning ecosystem processes as pollinators, seed dispersers and ecosystem engineers. For example, kaka, tui (*Prosthemadera novaeseelandiae*), bellbirds (*Anthornis melanura*)and mohua are major pollinators and NZ pigeon (*Hemiphaga novaeseelandiae*), tui and bellbirds are major seed dispersers. If pollinators and seed dispersers are reduced in numbers then forest health may decline, seed banks may be reduced, and regeneration of some plants species limited. Kaka and kea (*Nestor notabilis*) act as ecosystem engineers because their activities modify the physical structure of their environment. They are the only species that excavate sapwood of live trees and heart wood of dead or decaying snags usually in search of insect larvae. These activities accelerate important decay processes and nutrient cycling. To sustain fauna populations there needs to be sufficient amounts of foraging, roosting and breeding sites for species to maintain viable populations in perpetuity. Sufficient habitat needs to be available so that fauna can disperse, and still thrive, if unfavourable conditions develop. Any activity that reduces habitat therefore has the potential to have a detrimental effect on ecosystem and biological processes.

1.11 Both sites are likely to support the lizard *Woodworthia* aff. *maculatus* 'Otago large gecko'(Jo Monks, DOC, pers. comm.). These lizards have been recorded close to the RAA and in the Eglinton Valley adjacent to the Hollyford (DOC Herpetofauna Database). Shed gecko skins were found in the surveys done at the RAA (Ryder Consulting 2007) indicating presence. They are notoriously difficult to survey. In the Eglinton Valley they were first found up red beech trees in long-tailed bat cavities. Numerous spotlighting surveys over a three month period detected no further sightings (Colin O'Donnell, DOC, pers.comm.).

1.12 Lizards are known to be important pollinators and seed dispersers in New Zealand forests (Whitaker 1987) and new research is confirming that these roles are very significant in terms of ecosystem processes (Wotton 2000, 2002; Olesen & Valido 2003; Justin Smith, University of Auckland pers. comm.). Grassland skinks *(Oligosoma polychroma*) are also likely to be present in the RAA (Ryder Consulting 2007).

1.13 Mohua have disappeared from 95% of their former range (Ministry for Environment, 2007). They have not been recorded from the Hollyford Valley for many years. The population in the Dart/Routeburn Valleys however is one of the largest in the country. Previous studies have shown that mohua are very vulnerable to rats (Dilks et al. 2003, O'Donnell et al. 2002). The Routeburn/Dart Valley is part of the South Island Pest Response Advisory Group programme and already has predator control in years when there are high rat numbers. Rat irruptions, however are notoriously difficult to predict and in 2011 rat numbers increased quicker and reached levels greater than expected resulting in a 75% decline of mohua in the valley (Graeme Elliott, DOC pers. comm.). Loss of additional habitat may result in even further decline.

1.14 Studies of radio-tagged kaka in the Eglinton Valley have shown that the adjacent Hollyford Valley provides a significant seasonal food resource, especially when southern rata (*Metrosideros umbellata*) and fuchsia (*Fuchsia excorticata*) are flowering. Kaka may range over more than 10,000 hectares to fulfil their foraging needs (Leech 2006, Leech et al. 2008; Peter Dilks, DOC, pers. *comm*). Usually there are only one or two major food sources available at one time, so if one source is compromised then there is likely to be significant negative impacts over large areas (O'Donnell 1991, O'Donnell & Dilks 1994). Kaka are also likely to be resident in areas directly adjacent to the HAA and RAA during the breeding season. Kaka require cavities within large trees for nesting. Removal of any nest trees will therefore have a significant impact.

1.15 Fernbirds are likely to be present in the wetland area described in 1.4 and in shrubby areas along the Hollyford Road. Fernbirds having been observed at the base of Deadmans Track and from Swamp Creek in the Hollyford (DOC Fernbird database DOCDM-713503) but there have been no formal surveys to determine the size of the population. Over 90% of New Zealand wetlands have disappeared (Aussiel et al. 2008) and therefore any wetland and the associated bird species must be considered significant.

1.16 Assessment of the aquatic environment at the HAA showed clear waters indicative of a pristine environment. 24 macro invertebrates were indentified indicating good taxonomic richness. Five species of fish were identified in the vicinity of the HAA with three of them native including the Long-finned eel (*Anguilla dieffenbachii*) (Ryder Consultancy, 2007).

1.17 Over 121 native invertebrates in two invertebrate classes were found in a short survey of both the RAA and HAA. In total, 60 moth species were found in the HAA and 49 sampled in the RAA showing rich native invertebrate fauna indicative of a diverse ecology and flora. Of particular note was the NZ red admiral butterfly (*Vanessa gonerilla*) which depends on various native and introduced nettles (*Urtica*) to support the larvae (Patrick, 2007).

Table 1: Characteristic vertebrate species of the Hollyford and Routeburn valleys

Species	2008 threat category	Hollyford	Routeburn
Long-tailed bat *Chalinolobus tuberculatus*	Nationally critical	Present	Present
Short-tailed bat *Mystacina tuberculata*	Nationally endangered	May be present	May be present
Mohua *Mohoua ochrocephela*	Nationally vulnerable	Not present	Present
South Island Kaka *Nestor meridionalis*	Nationally endangered	Present	Present
Yellow-crowned parakeet *Cyanoramphus auriceps*	Not threatened	Present	Present
Kea *Nestor notabilis*	Naturally uncommon	Present	Present
South Island robin *Petroica australis*	Not threatened	Present	Present
NZ falcon *Falco novaeseelandiae*	Nationally endangered	Present	Present
NZ pigeon *Hemiphaga novaeseelandiae*	Not threatened	Present	Present
Morepork *Ninox novaeseelandiae*	Not threatened	Present	Present
South Island rifleman *Acanthisitta chloris*	Declining	Present	Present
Tui *Prosthemadera novaeseelandiae*	Not threatened	Present	Present
Brown creeper *Mohoua noveseelandiae*	Not threatened	Present	Present
Yellow-breasted tit *Petroica macrocephala*	Not threatened	Present	Present
Bellbird *Anthornis melanura*	Not threatened	Present	Present
Shining cuckoo *Chrysococcyx lucidus lucidus*	Not threatened	Present	Present
Long-tailed cuckoo *Eudynamys taitensis*	Naturally uncommon	Present	Present

Species	2008 threat category	Hollyford	Routeburn
NZ kingfisher *Todiramphus sancta*	Not threatened	Present	Present
Grey warbler *Gerygone igata*	Not threatened	Present	Present
South Island fantail *Rhipidura fuliginosa*	Not threatened	Present	Present
Silvereye *Zosterops lateralis*	Not threatened	Present	Present
Paradise shelduck *Tadorna variegata*	Not threatened	Present	Present
South Island Fernbird *Bowdleria punctata*	Declining	Likely to be present	May be present
Black shag *Phalacrocorax carbo*	Naturally uncommon	Present	Present
Little shag *Phalacrocorax melanoleucos*	Naturally uncommon	Present	Present
Otago/Southland large gecko *Woodworthia* aff. *maculatus*	Declining	Likely to be present	Likely to be present

Data sources: Ryder Consulting 2007, Southey 2008, Wildland Consultants 2007, Miskelly et al. 2008

Table 2: Keystone bird species present in the Hollyford or the Routeburn road ends

		Primary foraging behaviours									
Species	Carnivore (Top predator)	Aerial insectivore	Foliage insectivore	Bark insectivore	Ground insectivore	Pollinator	Seed disperser/ frugivore	Ecosystem engineer	Foliage/ seed browser	Sap feeder	Scavenger
Mohua			Yes	Yes		Yes		Yes			
NZ falcon	Yes										
Harrier (*Circus approximans*)	Yes										Yes
Kaka			Yes	Yes		Yes	Yes	Yes	Yes	Yes	
Kea			Yes	Yes		Yes	Yes	Yes	Yes		
Y-c parakeet			Yes	Yes					Yes		
Morepork	Yes	Yes			Yes						
NZ kingfisher	Yes	Yes									
NZ pigeon							Yes		Yes		
Long-tailed cuckoo	Yes	Yes									
Shining cuckoo			Yes								
SI robin			Yes	Yes	Yes						
Yellow-breasted tit		Yes	Yes	Yes	Yes						
Brown creeper			Yes	Yes							
Grey warbler			Yes								
SI fantail		Yes	Yes	Yes	Yes						
SI rifleman			Yes	Yes							
Bellbird			Yes	Yes		Yes	Yes				
Tui		Yes	Yes	Yes		Yes	Yes				
Silvereye			Yes	Yes		Yes	Yes				

Section 2

What are the likely impacts of the proposed applications on those values described in the Statement of Outstanding Universal Value?

2.1 The likely impacts on the habitat of indigenous fauna caused by the tunnel application include the following:

- Habitat loss including potential roosting/nesting trees and wetland areas in the HAA. Fauna may be killed, injured and/or displaced;
- Habitat loss including potential roosting/nesting trees in the RAA. Fauna may be killed, injured and/or displaced;
- River, wetland and forest habitats in the HAA are likely to be modified and feeding, roosting and nesting habitats put at risk;
- Forest habitats in the RAA are likely to be modified and feeding, roosting and nesting habitats put at risk.

2.2 The main effects on fauna would be;

- Loss of feeding habitat, shelter, roosting sites and nesting habitats

  (i) in forested areas due to felling forest or shrubland habitats.

  (ii) in wetland areas due to clearance or alteration of drainage patterns.

- Direct deaths of protected wildlife through either; killing birds or bats by crushing nests or adults or young when felling trees or undertaking construction work.

I have also been asked to address the following specific points;

2.3 The effects of the vegetation clearance, particularly the removal of large trees, associated with road widening in the Routeburn Valley on the persistence of populations of threatened flora (with particular reference to scarlet mistletoe, *Peraxilla tetrapetela*) and fauna in that location

2.4 There is no estimate of the number of trees involved in the road widening therefore any assessments of the size of the impacts on biodiversity is hard to quantify.

2.5 However, hole nesting species such as mohua, parakeets (*Cyanoramphus auriceps*), robins (*Petroica australis*), kaka and bats will be directly affected by the loss of trees. If scarlet mistletoe is located on the trees or has the potential to live on the tree then this will result in loss of habitat for that species. The loss of these trees may consequently affect the ecological and biological processes that occur in the RAA. Mohua are known specialist pollinators of mistletoe (O'Donnell & Dilks 1994, Kelly et al. 2006). This is a good example of the intricacies of the biological and ecological processes found within Fiordland National Park the wider WHA.

2.6 Long-tailed bat roosting sites have been identified within the RAA (Lawrence & Humphries. 2009). If trees to be felled are being used by bats the result could be catastrophic for the social group. Long-tailed bats are more likely to be crushed or killed when trees are felled than flying birds because they sleep in tree cavities during the day. They often enter a state of 'torpor' (similar to hibernation), and can take a minimum of 15 minutes to wake even when disturbed (let alone successfully escape a tree being felled).

2.7 The DOC Officers Report 2011 states the effects of the tunnel at the RAA says the effects will be minor as the proposed area comprises exotic grasses with scattered occasional matagouri (*Discaria toumatou*) and other shrubs and surrounded by established beech forest. The report does not acknowledge that lizards may be present in the grassland (Ryder 2007), the surrounding trees could be used as roosting areas by bats and the grassland is likely to be used as a foraging area by bats (Lawrence & Humphries, 2009).

2.8 The effects of the vegetation clearance associated with the development of the tunnel and roading in the Hollyford Valley on the persistence of populations of bats in that location.

2.9 As in 2.1 there is no indication about the number of trees that are likely to be felled for the road widening or the potential incursion into wetland areas. This is likely to include about 14 km of road.

2.10 Long-tailed bats are present in the Hollyford Valley and will be present in the areas affected by road widening and potentially in the tunnel portal. Bat surveys were undertaken by the Department of Conservation between 1992 and 2002 along the Hollyford Valley road between the Milford-Gunns Camp turnoff and the road end where the Hollyford track starts. Eight standard bat detector surveys were undertaken along 17-20 km of road. One survey was in winter when bats are usually inactive. Of the remaining seven surveys, the percentage of surveys that had bats on them was between 5-30%. This is a lower encounter rate than the Eglinton surveys but the monitoring method is highly variable and does not give any indication of numbers (O'Donnell & Langton, 2003). Most bats were detected in the upper valley (0-10 km from the turnoff), which is within the HAA. No further work appears to have been done to determine the size of the population present. There have been no recent bat detector surveys of bats present or any radio-tracking study to identify roost trees.

2.11 The DOC Officers Report 2011 states that "the risk bats would be adversely affected is low". I would disagree with this statement until adequate surveys of bat roosting requirements in the area were completed. Long-tailed bats roost in tree cavities and congregate together in social groups during the breeding season. If roost trees are felled the effects may be catastrophic for the local population. Long-tailed bats have highly complex social structures (O'Donnell 2000b) and use relatively small roosting areas (for example, average 9.5─27 hectares in breeding females; O'Donnell 2001). They use traditional areas in the forest and always return to them even though it may seem that there is other apparently suitable forest nearby. Within these roosting areas they use many different trees. Usually a colony is spread over a number of trees on any one day, and usually they move to a new tree each day. They rarely roost outside these areas (O'Donnell 2000, 2001; O'Donnell & Sedgeley 1999, 2006). Some of the roost trees in the Eglinton Valley are still being used >15 years after first being identified (Colin O'Donnell, DOC, pers. comm.).

2.12 The DOC Officers Report 2011 states that there are no large red beech trees in the area proposed for clearance in the HAA but this statement does not include the road widening and there are some red beech in these areas. Although long-tailed bats have very strict roost preferences in terms cavity structure and microclimate they are not limited to red beech but use a variety of species including matai (*Prumnopitys taxifolia*), silver beech, rata and rimu (Sedgeley & O'Donnell 1999a, 1999b; Sedgeley 2001; O'Donnell & Sedgeley 2006). They move to different roost trees every night therefore

2.13 The DOC Officers Report 2011 does not comment on the potential for any reduction in water quality from the Airstrip Spoil Disposal Area that will affect the freshwater fish and invertebrate food supplies that are crucial for birds that use the Hollyford River. The birds that use the Hollyford river rely on small freshwater fish (shags) and freshwater invertebrates (waterfowl) (and the algae that feed them) for their food supplies.

2.14 Assessment of the number of fernbird territories would be required if wetlands areas were to be affected by the road widening in the HAA. The ability of displaced fernbirds to move elsewhere and survive is doubtful and the patchiness of habitat means that preferred nesting sites may be lost permanently.

2.15 Lizards are slow moving and often totally inactive in suboptimum conditions (especially low temperatures). If the Otago large gecko is present then individuals are more likely to be crushed or killed than flying birds and are will be unlikely to move away from a tree if it is being felled. Home ranges of gecko tend to be small. In a study on Waiheke Island average movements of individuals was just 1.9 metres over a two week period (Jo Monks, DOC, pers comm.). Similar results were found for jewelled geckos in Otago (Knox 2010).

Section 3

3.1 The ability to mitigate any effects on the persistence of the populations of these threatened species at these locations.

3.2 Before effective mitigation can be considered there needs to be an assessment on how many trees are likely to need removal for road widening at both sites. These trees then need to be assessed for the presence of scarlet mistletoe and for their potential use by bats in the RAA and HAA. A radio-tracking study of the HAA bats is essential to locate roosting sites. A radio-tracking survey at the RAA in 2009 showed that the current Routeburn shelter has a high density of roost sites (Lawrence & Humphries, 2009), therefore any tree removed from this area will have to be carefully assessed according to the DOC guidelines (Bat tree inspections protocol DOCDM- 916158). However these

3.3 There needs to be an assessment of how much of the wetland areas will be affected by the road widening in the HAA and what bird and invertebrate species are resident in these areas before effective mitigation can be considered.

3.4 The DOC Officers Report 2011 states that if a concession is granted the concessionaire needs to contribute, in consultation with the Department of Conservation, an effective pest control (including weeds) programme. At present there is some stoat trapping in the Hollyford Valley and some possum recovery for fur (G. Hill, DOC pers. comm.). In the Routeburn Valley adjacent to the RAA there is currently integrated pest management for stoats, rats and possums using a combination of toxins and trapping as part the South Island Pest Response Advisory Strategy. Any further plans for predator control would have to integrate with the current programmes to provide the maximum benefit. An effective predator control plan has the potential to compensate for some aspects of the loss of significant fauna values but it would not mitigate for loss of significant habitat including roosting and nesting trees and wetland areas.

3.5 I agree that the above ground construction works need to avoid nesting periods for birds.

References

Ausseil A; Gerbeaux P; Chadderton WL; Stephens RT; Brown DJ; Leathwick J. 2008. Wetland ecosystems of national importance for biodiversity. Criteria, methods and candidate list of nationally important inland wetlands. Landcare contract report LC0708/158, Landcare Research, Lincoln.

Dilks P, Willans M, Pryde M, Fraser I. 2003. Large scale stoat control to protect mohua (*Mohoua ochrocephela*) and kaka (*Nestor meridionalis*) in the Eglinton Valley, Fiordland, New Zealand. New Zealand Journal of Ecology 27(1): 1–9.

DOC Officers Report 2011 http://www.doc.govt.nz/documents/getting-involved/consultations/current-consultations/southland/officers-report-milford-dart-

Kelly D, Robertson A, Ladley J, Anderson S 2006. Relative (un) importance of introduced animals as pollinators and dispersers of native plants. Chapter 15 In Allen RB, Lee WG (eds) Biological invasions in New Zealand, Springer Verlag Berlin, Heidelberg.

Knox CD. 2010. Habitat requirements of the jewelled gecko (*Naultinus gemmeus*): effects of grazing, predation and habitat fragmentation. Unpublished MSc thesis. University of Otago, Dunedin. 107 p.

Lawrence B, Humphries A 2009. Long-tailed bat (*Chalinolobus tuberculatus*)A sample of

Communal Roost Locations, Lower Routeburn,. Internal Report Docdm- 51846, Department of Conservation, Wellington.

Leech TJ. 2006. Evaluating kaka (*Nestor meridionalis*) as an umbrella species for lowland forests in New Zealand. MSC thesis, University of Otago, Dunedin.

Leech TJ, Gormley AM, Seddon PJ. 2008. Estimating the minimum viable population size of kaka (*Nestor meridionalis*), a potential surrogate species in New Zealand lowland forest. Biological Conservation 141: 681–691.

Ministry for the Environment. 1997. The State of New Zealand's Environment 1997. Wellington: Ministry for the Environment and GP Publications.

Miskelly CM, Dowding JE, Elliot GP, Hitchmough RA, Powlesland RG, Robertson HA, Sagar PM, Scofield RP, Taylor GA 2008. Conservation status of New Zealand birds. Notornis 55: 117 135.

Noss RF 1996. Ecosystems as conservation targets. Trends in Ecology and Evolution 11: 351.

O'Donnell CFJ 1991. Application of the wildlife corridors concept to temperate rainforest sites, North Westland, New Zealand. Chapt. 9 In: Nature Conservation 2: The role of corridors. D.A. Saunders & R.J. Hobbs (eds). Surrey Beatty & Sons: Chipping Norton.

O'Donnell CFJ 2000. Cryptic local populations in a temperate rainforest bat *Chalinolobus tuberculatus* in New Zealand. Animal Conservation 3:287-297.

O'Donnell CFJ 2001. Home range and use of space by *Chalinolobus tuberculatus*, a temperate rainforest bat from New Zealand. Journal of Zoology (London) 253: 253-264.

O'Donnell CFJ, Dilks PJ 1994. Foods and foraging of forest birds in temperate rainforest, South Westland, New Zealand. New Zealand Journal of Ecology 18: 87-107.

O'Donnell CKJ, Langton S 2003. Power to detect trends in abundance of long-tailed bats (*Chalinolobus tuberculatus*) using counts on line transects. Science for Conservation 224, Department of Conservation, Wellington.

O'Donnell C, Roberts A, Lyall J 2002. Mohua (yellowhead) Recovery Plan. Department of Conservation, Wellington.

O'Donnell CFJ; Sedgeley JA. 1999. Use of roosts by the long-tailed bat, *Chalinolobus tuberculatus*, in temperate rainforest in New Zealand. Journal of Mammalogy 80: 913-923.

O'Donnell CFJ, Sedgeley JA. 2006. Causes and consequences of tree-cavity roosting in a temperate bat, *Chalinolobus tuberculatus*, from New Zealand. Chapter 17 In: Z. Akbar, G. F. McCracken, and T. H. Kunz (eds.). Functional and Evolutionary Ecology of Bats. Oxford University Press, New York.

Olesen JM, Valido A. 2003. Lizards as pollinators and seed dispersers: an island phenomenon. Trends in Ecology & Evolution 18:177-181.

Patrick BH 2007. Entomological effects associated with the proposed Milfor-Dart tunnel through the Humboldt mountains of Western Otago. New Zealand Butterfly Enterprises Limited, Alexandra, New Zealand.

Pryde M A, Lettink M, O'Donnell CFJ 2006. Survivorship in two populations of long-tailed bats (*Chalinolobus tuberculatus*) in New Zealand. New Zealand Journal of Zoology 33: 85–89.

Ryder Consulting 2007. Milford Dart An overview of ecological assessments. Ryder Consulting Limited, Dunedin.

Sedgeley JA 2001. Quality of cavity micro-climate as a factor influencing maternity roost selection by a tree-dwelling bat, Chalinolobus tuberculatus, in New Zealand. Journal of Applied Ecology 38: 425–438.

Sedgeley JA, O'Donnell CFJ 1999a. Roost selection by the long-tailed bat, Chalinolobus tuberculatus, in temperate New Zealand rainforest and its implications for the conservation of bats in managed forests. Biological Conservation 88: 261–276.

Sedgeley JA, O'Donnell CFJ 1999b. Factors influencing the selection of roost cavities by a temperate rainforest bat (Vespertilionidae: Chalinolobus tuberculatus) in New Zealand. Journal of Zoology (London) 249: 437–446.

Sedgeley JA, O'Donnell CFJ 2004. Roost use by long-tailed bats in South Canterbury: Testing predictions of roost site selection in a highly fragmented landscape. NZ Journal of Ecology 28: 1–18.

Southey I 2008. Birds and Bats in the Routeburn, 11-19th November 2008. Internal Report, Department of Conservation, Wellington.

UNESCO http://whc.unesco.org/en/list/551

Whitaker AH. 1987. The roles of lizards in New Zealand plant reproductive strategies. New Zealand Journal of Botany 25:315-328.

Wildlands Consultancy 2007. Milford-Dart Tunnel Concession Application: Audit of Ecological Information. Contract report 1496. Wildlands Consultancy Limited, Dunedin.

Wotton DM. 2000. Frugivory and seed dispersal by the common gecko *Hoplodactylus maculatus*. Unpublished MSc thesis, Victoria University of Wellington, Wellington. 64 pp.

Wotton DM. 2002. Effectiveness of the common gecko (*Hoplodactylus maculatus*) as a seed disperser on Mana Island, New Zealand. New Zealand Journal of Botany 40:639-647.