APPENDIX XV
Peer-Review Letter and Response to Peer-Review Letter

Ecological Review of the Terrestrial Ecological AEE Prepared for the Hawke's Bay Regional Council Ruataniwha Water Storage Project.

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Introduction.

Kessels and Associates have requested an independent expert peer review of their Terrestrial ecological AEE for the Ruataniwha water storage project in the Hawke's Bay (30.04.2012). The report is titled: "Hawke's Bay Regional Council Ruataniwha Water Storage Project (Draft) Terrestrial Ecological Study Assessment of Ecological effects volume 1 and volume 2 (volume 2 being data appendices)".

The project covers all aspects of terrestrial ecology associated with the inundation behind a dam of the Whero River and some downstream braided river faunal effects. The report covers description from research and field work of the existing vegetation / habitat and fauna, on the values of those components, the "significance" in terms of the Regional and District planning documents, on the expected effects of the proposal on those values and recommends remedial, mitigation and off-sets for those effects.

In undertaking this professional review I note that I am qualified to undertake this review by dint of being an appropriately educated and experienced ecologist with 15 years of consultancy, with specialties in botany, entomology and freshwater ecology as well as experience in avian and bat fauna. In particular I have undertaken similar studies in Canterbury for the Rakaia water storage in Coleridge for the Central Plains, for the Hurunui South Branch irrigation storage programme, the Lake Sumner storage proposal and the proposed Waitohi Dams irrigation storage programme. These programmes have been lodged, and therefore I am acquainted with dam and inundation effects but also the complexities of developing an ecological assessment at large scale with multi-facets. Furthermore, I have similar knowledge and experience with remedial, mitigation and off-setting philosophies and tools.

The following review is aimed at the content of the report and not on issues of readability (other than in instances of clarity of the message), grammar, organisation etc, but on assessment of the methodologies used, on the sufficiency of coverage and data gathered, on the assessment of that data and on the conclusions reported to be supported by that data in regard to values. I pay particular regard to the values assessment, and the mitigation - off-set mitigation sections.

I have made review and commentary on two earlier drafts of this report, prior to this my final and formal report.

As a precursor to this review I note that there are numerous adequacies and sufficiency's in the method, the data, the approach, and rationale etc which are evident in the document reviewed and it is clear that considerable field work has been undertaken (though not always clearly articulated or shown). Also substantial analysis and research and consultation effort has been appropriately applied, but again not always fully expressed or communicated. In this review I make little mention of the correct and appropriate or sufficient aspects, other than to note in general the appropriateness of the most important aspects. I instead focus on aspects that are unclear and important, appear to have deficiencies, require more explanation or raise concerns of correctness or sufficiency for me or require further comment. There is therefore a focus on the negative rather than the positive in the body of this review, and it is not, perhaps, until the conclusion that the sufficiency and appropriateness of the report is wholly articulated.

Review

The brief of the report and its aims.
The objectives as dictated by the Client brief are stipulated in the report and the requirements are listed in the executive summary. They are as to be expected and do not exclude any obvious avenue of study or research.
In essence, they require sufficient field effort and research of existing information to have enabled identification of rarity (threatened taxa) in flora and fauna; to have sufficient information to classify, typify and analyse quality and establish quantity of habitat types present (including spatial mapping) and then to identify effects and to show the quantum of these effects on "key" habitats and rare or threatened species (but on all indigenous systems).
At this point I note that the assessment is not, and cannot, only be about threatened species and "key" habitats but, in the first instance, about all of the habitats and communities and taxa present. I note that in going through the report it is clear that the report has not solely focussed on rarity and "key habitat", but some clarity in regard to what requires mitigation and off-set "compensation" is required following the "significance" section.
Also I note that the report extends itself to identification of wading birds (braided river specialists) 19km downstream of the proposed dam, to report on the effect of river morphology (including diminishment of floods, weed encroachment) on terrestrial ecosystems.
The evolution of the report in response to earlier critic is evident and many of the early requirements of clarification have been meet. However, there remain a few potentially fundamental differences in opinion that cannot be resolved through editing.

Section 2. Methods
The introduction sets out appropriately the study goals and these are as expected and sufficient for purpose.
The approach to threatened and at risk species is up to date and appropriate, including consideration of the habitat usage type when assessing risk.
I am Interested to know why the fish threatened species are presented in the tables of threatened and at risk taxa, given the terrestrial focus.
I further note that while the text in the relevant places identifies Kiwi, banded rail and the possible presence of short tailed bats, the tables (2-5) listing threatened species recorded in the wider area do not include these three taxa? Is it because the historic records consulted did not identify those taxa as present and the survey work did not find them and therefore they were taxa simply considered as potentially present by the authors?

Botanical Methods
The questions of critical importance I considered here were: has sufficient coverage been achieved to:
1) map the habitat/vegetation types and locations accurately;
2) quantify the community types in terms of area;
3) account for all species present (i.e. especially those threatened species historically listed as potentially present);
4) quantify within habitat type the proportions for the various taxa types (dominance etc);
And is that data:
a) visual (observation), b) semi-quantitative (walked transect field lists and observations) or c) fully quantitative – e.g. RECCE
It appears clear that point 1 and (a) are well covered, but in regard to item 3 (b) there are difficulties in interpreting the report. These difficulties include an absence in transect or survey lines shown in the vegetation figure (map) that show the "transects" or passage walked by the botanical survey and other than the 4 RECCE plot locations it is not possible therefore to assesses the coverage of the inundation site species listings survey or to be confident (other than by faith) that sufficient area has been surveyed to account for the absence of threatened plant taxa.
Similarly there are 17 vegetation types noted but only 4 RECCE plots. The locations of the semi quantitative plots alluded to in the report are not shown and the Appendices data is not broken into habitat types, but is a total encounter list? Furthermore, it is not reported how

many of these "plots" were undertaken (they are not represented in the appendices). This limitation shows in the habitat/vegetation type descriptions, where the RECCE plot types are better described, but of course they are also the most complex and mature types.
However, it is apparent that a substantial amount of field work has been done over 6 months and I do not consider the above to be matters of assessment concern, especially when the assessment is hinged on the mapping and broad scale typing and quantifying habitats. The area of some concern, in not understanding the full coverage of the field work, is the risk (and probability) of establishing the presence of rare and threatened taxa. I note at a later date in the report that this point is acknowledged and a recommendation for greater coverage made. This does not however help the assessment determine the presence of threatened species and therefore effects, but I also note that there is a general acceptance in the report that the other listed threatened species not found in surveyors may be present.
In any event I note that a walked botanical transect map with semi-plot locations would ally the concerns of coverage that I have. Currently considerable effort appears to have been undertaken centrally with diminishing effort of survey in the upper western main river arm.
It currently appears that only the habitat types in which the RECCE plots were undertaken have quantative data that allow an estimation of the proportional abundance of various plants in forest tiers. This is not a deficiency necessarily for the assessment assuming the notes and transect lists of the other 13 types are good. Again, without a clear depiction of the survey coverage (or appendices showing type specific species lists) it is hard to judge if the potential to find rare/threatened species was suitably managed. Experience with such surveys and the level of data and mapping would suggest it is, but again the acceptance of the possible presence of those taxa reported in other information, but not found in survey, is an appropriate response.

Sections 3-4.
These sections are appropriate, complete and sufficient

Section 5 - Vegetation Methodology and Results–
The methodology is covered in the general methods section above and is standard and appropriate, though noting again the absence of the semi-quantitative plot data in appendices or survey transect lines on the results map.
In regard to the results of the vegetation, the mapping and classification appears accurate, it follows suitable protocol and produces required results of quantum by community type and has good visual and tabular outputs.

Section 6 – Avifauna methods and results
5 minute count stations cover most of area but some I raise some concern over the western, upper river reach where only 2 stations were placed and where braided river transects (wader walking survey) did not cover. The report also notes the limitations of five minute count method in regard to identifying riverine specialist species (such as banded dotterel). I estimate that two kilometres of braided river could potentially have banded dotterel and I have not been convinced by the survey reported that they are not present.
However, I have a general confidence in the approach taken and the results in regard to blue duck and kiwi (especially with the addition of the bioacoustics) and in general the "bush" bird data. I note that no "play back" technique was used (but further note that in the results section (following the methods) playback was stated to have been used for spotted crake. Such a method may have increased the estimate of fern bird presence. I also note that there are six fern bird records on Figure 10 but only 5 on table 7?
In regard to the Waipaira Lower River Wader survey, a twice recording is sufficient where there is existing data to support the abundance and habitat use assessment.
The data set collected allows an estimate of the magnitude or quantum of the effect although habitat use, such as for NZ falcon for breeding, was not always confirmed. Some reservation in regard to the number of fern bird that are present remains in my mind as I note that the fern bird where found associated with habitat types 33 (wetland) and 24 (broadleaf, small leaved, monocot shrublands), a common and relatively extensive habitat type. Despite the above comments the data collection does allow a reasonable assessment of value, partial

use and therefore effect (accepting the limitations associated with banded dotterel presence and fern bird number and habitat use (the report does not that the "shrublands" are important fern bird type habitat)).

Section 7 - Bats

The method of detection is standard and accepted, the coverage good but again missed the upper western river edge. Additional lower river effort assists greatly with the wider landscape use question. The absence of the upper western extent would not however change the assessment, value or effects. The study achieved its set goals of determining presence and relative levels of activity but not habitat importance or roosting, breeding use. It acknowledges that limitation and suggests suitable further study to cover the required aspects.

A hint of a lesser short tail bat is of interest but given the frequency and potential to be a negative result, it is not of great concern to the assessment.

The habitat utilisation section suggests activity was generally low across the site, although there were exceptions. I think low is unwarranted but in any event the conclusion is that the habitat, especially the mature stands, but also the river's edge and wider habitat types, within the inundation are "important" for short tailed bat.

Other potential areas for survey, to assist in identifying if bats frequent or are resident to the inundation area are supported; and (as is determining roosting and breeding) germane to the assessment of value and effect. However, as it stands there is sufficient information presented to accept that there is value as bat habitat and to, at a suitable but not complete level as yet, understand the potential adverse effects.

Section 8 - Herpetofauna

Despite the surprising result (one specimen), the methods and coverage and timing would suggest a thorough procedure and that the results are representative and valid of the general condition. Given the potential presence of 11 species however, it seems highly unlikely that only 1 individual of 1 species is the sole lizard fauna. Further survey work could be undertaken with a different spatial coverage and/or, a different time, or the effects assessment can assume that the four "common" taxa likely to be present are present. In either way the assessment of effects and the resultant remedial and mitigative actions can be appropriately assessed on the data collected.

Section 9 - Terrestrial Invertebrates

It is unusual to use hymenoptera as the focal order, it is more common to use coleoptera or Lepidoptera and Arachinda. This will and does have implications later when assessing the presence of threatened taxa as the Hitchmough 2005 lists (Hitchmough 2007) do not record any hymenoptera and are largely beetle, Lepidoptera, spider, snail, weta and various single taxa focused. The snail and weta sub focus was inappropriate.

That said, the hymenoptera provide a good guild spread and the diversity within guilds is a reasonable proxy for diversity of invertebrates in total and as an indication of habitat quality.

However, given the collection methods (malaise) and the taxonomic resolution – family and RTU used – beetle fauna, at least, could have been documented. The absence of light trapping for Lepidoptera is of issue (in terms of threatened species) as one of the most identifiable orders with identifiable conservation concerns are Lepidoptera.

To that end the authors have researched Ward 2011 and note his survey results in nearby river type habitats, noting that research discovery of rare (but not threatened) Lepidoptera.

Those things said, the weta and snail methods and outcome are accepted.

The hymenoptera data suggest a rich and diverse invertebrate fauna, further suggesting the habitats present are healthy and of good quality and/or suitably varied. The conclusion that can be drawn at present is that the terrestrial invertebrate fauna are likely representative and diverse. However, it is suggested that more work is required to determine the presence of threatened taxa and that while effects of habitat loss may not be great on a District scale, they may be "more than minor" at a local scale. There is after all no comparative data with the neighbouring Ruahine Park, or other habitat studies to compare (this is also difficulty with the hymenoptera focus).

The deferred approach to collect further data (on other groups) is appropriate and only moderates the assessment of effect (i.e. its accuracy), as the general conclusion must be that healthy representative invertebrate fauna area present in at least the array of habitat types sampled cause consideration of the habitats present to be habitat of "representative" indigenous fauna. This is further discussed in the "significance assessment" section.

Section 10 - Animal Pests & Weeds

No specific weed and pest studies were undertaken, but sufficient information was noted in survey and assumed present from information in the DOC bioweb data and regional pest lists. The effects, in regard to pests and weeds within the inundation area relate to the remains of vegetation fragments around the new lake margin and the potential revegetation of the new margin. It is a matter, as I see it, for a construction management plan and post construction site management (and restoration) plan.

Section 11 - Ecological Significance

An appropriate set of tests are used from the broad LENZ threatened environments data, to the HBRP and CHBDP significance criteria and reference to the RMA and section 6(c).

I must note here however, that the "criteria" for determining significance in both the Regional Policy statement and the District Plan are A-typical of most other criteria throughout other Regions in the country and very different from those used at a national (general) level such as Whaley et al 1995 or the Norton-Roper-Lindsay (2004) set. That is to say they are extremely simplistic and do not contain the usual aspects of ecological criteria found such as representativeness, threatened species, distinctive features, etc.

Initially the early drafts of this report found that "virtually all of the remaining indigenous vegetation and habitat types present within the footprint are ecologically significant".

This current report despite acknowledging that 225 ha of indigenous vegetation/habitat is in acutely threatened and chronically threatened environments (and with indigenous vegetation) finds that only 104 ha of the 163 ha of indigenous vegetation as being significant (based on the RPS and DCP). The report identifies 7.9 ha of DOC land, 81.02 ha of the mature forest types, 23.12 ha of secondary forest and scrub types and 4.95 ha of wetland as significant as well as the 73.76ha of river habitat as significant. It however, does not find the any of the indigenous shrubland and treeland habitats as significant.

The report data and observations within the report as to habitat importance, the fauna use etc suggest strongly to me that the majority of those "shrubland / treeland" areas are in fact important habitat with more than trees over pasture value. In particular the types classified as broadleaf-small leaved tussock shrublands (which I assume equates to the mapped type of broadleaf-small leaved monocot-scrub/cliff-land (type 24), as the text and mapped nomenclature is not consistent)) and (podocarp)/broadleaf-small leaved treeland/shrubland (types 17-20 in mapped vegetation) are both vegetation types which equate to 49.5ha and in my consideration clearly meet some of the criteria (areas > 5 ha regardless of height, some areas do meet the potential 6m height and 30cm DBH class) as well as clearly being important habitat for bats but also fern bird (type 24 was where the Fern bird were found). Furthermore, the report notes (at 12.3.3) that treeland / shrublands are important bird resource (especially kowhai areas) and that some of the areas involved are cliff steep slope vegetation which cannot be expected to have 30 cm DBH and 6m canopy.

In short I consider that the analysis cannot demote 49.5 ha of the Indigenous shrubland/treeland from significance based on the data and evidence presented. It can only potentially argue the beech treeland over pasture as not being significant and the very small area of small-leaved treeland.

Therefore the significant vegetation and habitat should, from my understanding of the presented data and analysis be 232.53 ha and not the 183.03 ha noted in the report.

Given the off-set proposals articulated in section 13, this potential discrepancy does not result in a substantial variation but or effect in regard to ecological "compensation", however, I consider that the level of effect assessment should be cautious in this regard.

I consider that the approach of focussing on the mosaic of indigenous features and not on the valley as a whole (and the exotic systems therein as part of the mosaic) is, in this case, correct and appropriate. I note also that the braided river components should also be an

integral part of the significant habitats both downstream and within the inundation area and it would appear that the report also concludes this.
The individual threatened and at risk species do not need to be relisted here, although they obviously figure in the significance assessment. A list of the criteria the authors consider are meet is provided and aside from the issue I have with the 49.5 ha of indigenous shrubland/treeland as noted above, appears sound and appropriate.

Section 12 - Assessment of Effect
The array of potential adverse terrestrial ecological effects identified is suitably reported and considered for the scale and current detail of the proposed project, such that loss of area and opportunity can be recognised although it remains at a high level. Such a high level is acceptable and normal for a project of this nature in its current level of development.

Botany
The quantum of vegetation and habitat loss is well and suitably calculated and reported and provides the initial sum of habitat and vegetation for consideration of effects. In earlier drafts of the report there was a conclusion that the loss of this area of habitat and vegetation (183 or 243 ha) is a significant adverse effect for the ED. The current report has no concluding statement which articulates the level of effect of the inundation. It is my opinion that such a statement is useful and expected in an effects assessment report (i.e. is the effect of importance, of moment, of significance). It is further expected that the same opinion as in the earlier draft is up held. I note here to that there is a focus from the brief on "key" habitats, and a focus on the report on "significant" habitat and that only "significant" habitat requires mitigation / compensation. This is a debated ecological point, but where the authors accept the additional value of the shrubland/treeland habitat types as "significant" then the issue becomes moot.
With regard to edge effects the rationale for a 20m edge effect and the approach taken and so the quantum of edge effect calculated is supported and appropriate. The "draw down" of the reservoir effect has been considered and identification of the need for a management regime is the appropriate response.
In section 12.2.4 offset mitigation is recommended to "compensate" for the loss of indigenous vegetation (there is no mention of the need to only off set "significant" vegetation in this section).
These "amelioration" sub-sections after each taxa group appear to be about initial remedial, mitigation actions and section 13 is off-set mitigation to cover residual effects. However, the two areas of the report are so strongly over lapped that if that is the intention then that is not clear.
Prior to discussions of remedial and mitigation actions I would expect a discussion on the requirement of "avoidance" of the adverse effects, because of the values present etc. Such an assessment (of the need to avoid the effects) is warranted (even required) to assure the reader that avoidance of effects because of the level of value was considered and is or is not recommended.
Once past that hurdle the nature of the effects largely rules out remedy and "mitigation" as in regard to minimising the effect. However, the report notes that mitigation for indigenous loss "could" involve a mixture of things. Those things being the physical protection, enhancement and legal protection of nearby similar communities. I support, and consider acceptable the strategy to protect "nearby" bush fragments (or wetlands) although it is debatable whether that is compensation or mitigation. Furthermore the revegetation of the reservoir margins (as reported is section 13) is also a debatable but semantic issue of mitigation or off-set "compensation" but I mention it here as also potentially mitigation (as it supports the remaining new-lake edge fragments).
The strategy to secure otherwise diminishing ecological features on private land nearby is an excellent ecological compensatory and net beneficial approach. My only concern is the "could" wording in the report rather than a "recommendation" statement in the report is too weak.
The focus on planting edge species in relation to the draw down will go part way to mitigating draw down effects and a wetland may develop in the delta which could be supported in draw

down by a small bund but in any event the report recognises the issue and has a provision for it.

Avifauna

The main effects of concern are noted to be: wader habitat modification (assumedly in the lower portion), falcon and loss of springtime (kowhai) resource.

I question whether fern bird habitat and potentially bird loss should not also be a main effect and still reserve some doubt as to the presence or absence of waders (Banded dotterel) in the upper-western 2 km river section.

Furthermore, while it is appropriate to note and have a focus on the kowhai as a resource loss, it is equally appropriate to note the loss of berry producing shrublands as a habitat/resource loss and a nesting potential loss. Some of these points are covered loosely in latter text.

That said, in essence the effect is largely dealt with by the consideration of habitat loss in general and the requirements to offset/compensate for that effect.

In my opinion the falcon issue is minor as these birds typically have a number of nesting areas which are used variously and a lost nesting site in the inundation site (unless it was particularly free of predation) will have little to no impact on them.

In regard to the wader habitat 19km downstream, the report correctly identifies flow related issues of weed encroachment, and early breeding season flood management potential on the braided river birds. Rather than noting “desirability” for river bed weed/encroachment management, the report, in my opinion, should “recommend” such an effect mitigation.

The recognition of the value of the seasonal specific and highly valued resource – kowhai - is appropriate as is the identification that there are other local examples of similar resource that is however on private land. The “mitigation” identified in the terrestrial vegetation section also doubles, and is appropriate action, for bush bird mitigation as the improvements to those bush areas will supply improved food resources and safer nesting opportunities to the wider bird population.

The report suggests that the potential adverse effects on the bird species (habitat) can be mitigated by “appropriate” habitat restoration and enhancement. Where that is, as the vegetation section suggests, of the form of protection and enhancement of nearby appropriately vegetated features then I agree and support that approach. I note however, that such discussions would have best been left until the sub-section amelioration. A question arising then is how many features and their total area would be achieved. To some degree this is covered and discussed in section 13 (again complicating the difference between mitigation and off-set “compensation” in the document).

The discussion then considers Fern bird. While the report states that it “should” be possible to provide appropriate habitat nearby, if that refers to the revegetation of the lake margin then firstly that planting is only recommended to be a minimum of 20m wide, which is insufficient area to be permanent and secure habitat and secondly will take a number (possibly 10) years to reach a maturity that may support those birds. If the report is referring to existing nearby habitat the question then is why that habitat has not currently a fern bird population. While the issue of potentially only 5 or 6 birds is not considerable, they are a threatened a species and it is possible that the inundation will result in the local loss of those birds.

It is acknowledged that the lake and new edges, especially where revegetated and managed, will offer new and good avian habitat opportunity (a focus on kowhai in revegetation plans) would seem inappropriate.

Lastly there is discussion of long term pest control of mammal predators and browsers in an appropriate forest or landscape where fragments exist (this fits and is part of the enhancement proposed for the terrestrial mitigation earlier). In this section the report suggests a 5% Residual Trap Catch target. This is a stringent target and provides a low level of predators and is a good control level. However, the report only discusses the control of ship rats, stoats and possum. It suggests cat control may be of benefit but not necessary. Given the fern bird which may still be present, and the potential for wader use in the new delta and lake edges etc I would recommend that cat control is essential.

Bats, Herpetofauna, Invertebrates

The only comment I have here relates to the amelioration sections and to the pest animal control in forest areas, and the general question is how much area and which fragments etc receive how much pest control for what length of time? These are details that can be sorted out in due time, but the length of time of action and generally coverage are important to understand the level of mitigation being offered (or recommended).
In regard to the amelioration of the invertebrate effects, the report correctly identifies transfer of samples of topsoil, litter etc to appropriate forest locations. It then goes on to note that such transfers should not occur until vegetation in replacement habitat has formed a coherent canopy. I suggest that by that time, unless the revegetation, enhancement work is to proceed effects by at least 5 years, the opportunity (due to area clearance and inundation) will be lost by the time the new areas have suitable canopy. Transfer should be to remaining nearby and edge fragments which are not well endowed with ground tier resources but are part of the protect and enhance regime.

General
The following are general observations and conclusions on the values and effects sections.
The effects section does not consider directly the impacts of the loss of the red mistletoe or potential mitigation actions such as seed collection and propagation, translocation or the such like. It might also address those plant species which are threatened that may turn up as further specific searches are made.
Fern bird require a more cautious and circumspect analysis and approach to mitigation.
The "significant" habitats need to include the 49 ha of shrubland type habitats and so the quantum of effected habitat and vegetation is greater than currently considered.
The quantum of mitigation is not yet formulated and the effort in regard to pest animal control is not clear. In that regard it is critical to understand which pest animals will be controlled for to what level and for how long. I note, as is obvious, the benefits from predator mammal and herbivore mammal control is transitory and ceases to be of value sometime after control efforts cease. This makes its use (where not in perpetuity) of "limited" value. It is excellent in assisting translocations and in temporarily increasing a breeding year for specific species or increasing cohorts of plant species etc..

Monitoring
While the sub-sections suggest "amelioration and monitoring" there is little in the way of monitoring requirements for many aspects. While effects largely do not need to be monitored as inundation and clearance are total. Weed invasion etc does require monitoring and is addressed as required in the report. In addition for the bats there are further research requirements (to better assess effects), rather than monitoring. What is missing is a section specifically on monitoring the success of the mitigation and off-set actions so that the success of those programmes proposed can be measured (ensuring bats and birds and resources are improved etc.
Section 13 Biodiversity offsetting recommendations
The heading and methods states that this section provides recommendations but generally throughout is not always clear that the actions and provision are ecological recommendations as some times the options are "coulds" rather than "shoulds" or "required tos" or "recommends". Confusion remains in some part between section 12 (remedy and mitigation) and residual effect off-set mitigation/compensation.

The discussion in regard to the BBOP principals is appropriate in the current political climate although, aspects of the principals are not necessarily in line with the RMA regulations (such as hierarchy's and not-net loss). Furthermore, use of the NPS on biodiversity is also appropriate although, as noted, the NPS is still under review and may yet be substantially modified.
Given the above and the fact that currently the Habitat-Hectare modelling (a tool promoted by DOC coupled with the BBOP principals) that is or has been used in some cases (e.g. Cass Wind farm, Mokihinui HEPS, HMR wind farm) remains experimental and without general ecological agreement nationally, the absence of its use in this case is appropriate and supported by reviewer (as not being required).

Three restoration and enhancement strategies are proposed as off-sets.
The first is labelled Ruataniwha Reservoir Restoration Buffer and Catchment Enhancement Zone.
The aims are to recreate lost riparian margin in indigenous vegetation and to restore and enhance marginal farmland and existing forest, scrub and treeland.
The riparian margin is recommended to be a minimum of 20m in width (largely through planting). Such a band of planting will support existing fragments and connect them which is beneficial. However, a 20 m width will supply a good buffer for the water quality in the reservoir but is not wide enough to create faunal habitat of particular value, as it is all large edge habitat. That habitat will be used by many aquatic invertebrates and a smaller range of terrestrial invertebrates, some reptiles but few bird species (other than as a resource to visit). While the total area may be 46 ha, the reality of such a thin planting is that the habitat value is less than 46 ha.
The second part of the BRES however has a high value in terms of its potential to offset the habitat area losses. However, it will depend on the number, type and condition of "features" in which the protection and enhancement actions take place. From Figure 30 it would appear that there are at least 3 bush fragments to the south of the inundation area (And within the "zone" derived), 10 large fragments to the south-east, and three long gully areas between the two DOC lands north. The report notes that at least 100ha of privately owned land "should" be restored if this BRES can be enacted. I suspect that the potential areas for restoration might be more than 100ha. However, I note that the three gully systems to the north may be of added value as connectivity areas, between the DOC reserves, especially when the pine forestry is felled.
The only caution I add here is that currently this BRES cannot be secured as it requires the acceptance and compliance of the private land owners.
The second BRES id labelled Ruataniwha Riparian Enhancement Zone.
This BRES, being similar to the first but in a boundary around the river below the proposed dam, could potentially cause some 616 ha of ecological feature to be protected and enhanced. This, given the patchwork nature of the fragments in the landscape and the RAPS present should be considered a significant ecological gain. The additional aspects of the wetland and on managing the river and reservoir edge to be free of invasive vegetation (especially willow and lupin) is an appropriate response to the potential effect of a loss of floods, but is less an offset than an expected mitigation action.
The proposed on-going pest management over the potential 616 ha for possum and rats is unlikely to be a reality (a programme in perpetuity) and furthermore care must be taken in only removing rats where cats and stoats are also present as removal of the primary prey source can result in the stoats and cats increasing predation on reptiles, invertebrates and birds. While the attainment of 616 ha of ecological features into protective covenants with fencing and enhancement is a very important and beneficial outcome which, in my opinion would succeed in offsetting the inundation, again the BRES requires the co-operation of willing landowners to allow covenanting and management on their land so the off-set at this stage has no certainty. The third BRES is labelled Ruataniwha threatened species habitat enhancement.
In this BRES the falcon and long tailed bats are the focus. However, I think that the red mistletoe and fern bird should be included in this BRES. The contribution to Wingspan is a suitable offset but I question whether it is actually needed given what I consider to be an unlikely effect related largely to displacement.
In regard to the long-tailed bats and prior to the collection of further data, the recommended assistance programme may be the only viable offset approach and one that has been reviewed and discussed as appropriate on other habitat effect projects.

Conclusion

In summary it is my opinion that the report has met the brief, albeit with a small range of caveats and reliance in places on historic databases of threatened species in lieu of more substantive field work. This situation is common in large scale projects and results often in a conservative approach to the values assessment, which I consider acceptable.

While more survey work could be done, this is always the case, and I consider that only a limited amount of further work is required and would assist in more than a minor way. In particular I consider that work is still required in regard to Lepidoptera to ensure threatened invertebrate species are covered, but it is unlikely that the results of such a survey would change the assessment of effects, cause a need for avoidance or change in any substantive way the mitigation or off set. I remain uncertain about the absence of banded dotterel in the upper 2km of the western upper river section and also remain concerned, to a degree, on fern bird presence.

In regard to the analysis and interpretations I find that the assessments of value and condition are supported by the data and are as expected, except for in the case of 49.5 ha of broadleaf-small-leaved shrub and treeland. I acknowledge that the significance tools provided by the Regional Policy Statement and District Plan are not very detailed or typical of other RMA related significance criteria used in ecological assessments in other parts of the country. Nevertheless, I consider the report currently does not include around 50 ha of habitat type as significant which it should based on values reported within the report. The report concludes with 104 ha of significant vegetation, I consider the data supports about 154 ha of "significant" vegetation.

There is good quantification of the habitat types present, and sufficient enumeration of the fauna surveyed (at least at a proportional level). However, there is a need for some discussion on the seriousness of the effects and, primarily a discussion on the need, or not, based on the values, for the avoidance of effects. Such a summary statement would be very useful as it needs to be clearly stated that the values of each area and the effects to vegetation, bats, etc will (or will not) be significant and adverse but are not (or are) required (from an ecological perspective) to be avoided.

It is my opinion, and acknowledging those areas I have minor concerns or comments on, that the report methods, data, analysis and findings are generally sound and that the evaluation and enumeration is as sound as is required (again acknowledging the need for further bat, Lepidoptera and banded dotterel survey). It is always the case that better approaches and coverage and temporal replication can be cited after the initial work but this work is as good or better as most other applications of its type and is sufficient for purpose.

The mitigation and off-set mitigation sections remain somewhat confusing for the reader given the text over laps in terms and placement of discussion where off-setting is supposed to relate to the residual effects following remedial and mitigation actions. That is a reader clarity issue however and it is not germane to the reports fundamental purpose or findings. In some of the text related to mitigation action there is a lack of certainty or level of "requirement", that is there are statements of "could" and "might", and while I understand that at this early stage those aspects may be difficult to provide detail, mitigation actions and offsetting actions need to be relatively firm and potentially possible and recommended as required (or not) to enable a weight to be placed on the potential offsetting actions.

In relation to the section 13 offset proposals, the first two proposals if they achieved their full potential, would in my opinion mitigate or compensate for the losses related to the project. However, the current standing of those BRES's is in doubt while they rely on land owner voluntary involvement and therefore, like the mitigations above, while the concept is sound and the values and areas to achieve the goals are present and a clear ecological benefit would result, it is difficult to place weight on the BRES as a suitable tool for offsetting given the uncertainty that it could be enacted. Lastly, a monitoring section is required specifically to address mitigation success and the measure of that as well as potential actions where mitigation success fails.

Dr Vaughan Keesing
06.05.2012

Response Letter to Peer-Review by Mr. Gerry Kessels (Kessels & Associates Ltd.)

To: Ruataniwha Water Storage Project – Core Team

From: Gerry Kessels

CC: Vaughan Keesing

Date: 3 April 2013

Re: Response to Ecological Peer Review of the Terrestrial Ecological Study Report – Version March 2013.

This memorandum is in response to Dr Vaughan Keesing's secondary peer review (dated March 2013) of the Terrestrial Ecology Report (TER – Kessels & Associates March 2013) prepared for the Hawke's Bay Regional Investment Company (HBRIC). This memo should be read in conjunction with the primary peer review letter (May 2012); the TER; the Project Description Report (Tonkin & Taylor, May 2013a); the Proposed Integrated Mitigation and Offset Approach Report (HBRIC, 2013f); and the Proposed Conditions Report – Part D of the draft resource consent application for the Ruataniwha Water Storage Scheme (The Scheme).

Attachment One to this memo is in tabulated form and sets out the items raised by Dr. Keesing in March 2013 in the 4th column, with my detailed responses to this secondary peer review in the 5th column. This builds upon the responses in the TER to the initial May 2012 peer review by Dr. Keesing of an earlier feasibility version of the TER, as summarised in the 2nd and 3rd columns. Attachment Two provides quantification and further explanation of the remediation requirements as outlined in the proposed conditions and the mitigation/offset projects as outlined in the mitigation/offset report. Attachment Three presents a map showing an additional area of treeland which on the basis of the review I am now recommending to be included to the existing 182.52ha of vegetation and habitats considered to be significant as identified in the TER. Attachment Four presents the proposed consent conditions pertaining to the remediation package for terrestrial ecology matters during construction - The Reservoir Filling and Edge Rehabilitation Plan (RFERP) in particular. Attachment Five provides a detailed analysis of animal pests within the locality which should be the focus of the remediation and mitigation animal pest control operations, the expected biodiversity gains as a consequence of suitable animal pest control, including gains for key At Risk and Threatened flora and fauna species, and indicative methods of control and localities for that control.

For the most part, my responses to the secondary review have been a matter of clarifying, expanding explanations and re-presenting information which has already been presented in the consent application documents and TER. In particular, Dr. Keesing's concerns regarding translocations of several At Risk and Threatened species as well as details of how the animal pest control programme would be given effect are addressed in this memorandum.

The mitigation proposals, while presented separately, are part of an integrated upper- Tukituki River catchment wide approach to enhancing biodiversity generally and for over 2,700ha of habitats for a wide range of indigenous species, including many At Risk and Threatened flora and fauna. This package relies on the combined effect of a number of management approaches within this mosaic of relatively biodiverse, but often fragmented and degraded, lowland habitats,

grading into upland habitats where blue duck reside. Fencing forests and scrubland from stock, weed control in braided river beds, restoration of wetlands, encouraging legal protection of areas on private land, as well as widespread and targeted animal pest control, would achieve what I consider to be a substantial net benefit, especially so when much of the land included in the three projects is classified as 'National Priority One Land for Biodiversity Protection'.

Other minor points of clarification have also been addressed. There are five substantive matters of the review which I was unable to address based on the information in the TER and other documents presented by the HBRIC application to date. These key outstanding matters of my response to Dr. Keesing's review which require additional analysis or actions are:

1. Further documentation of beetle, spider and moth fauna would be useful and a desk top review with an addendum to the TER, which will be undertaken in the next 2 weeks (by 18th April 2013).
2. Given the discovery of the At Risk *H. trewicki* weta, it is recommended that a further 200 weta boxes be deployed at least 12 months before construction commences and that all weta occupying these boxes are translocated into suitable habitat outside of the dam footprint prior to flooding in accordance with protocols prescribed in the RFERP.
3. That Vegetation Type 19 should be included as being ecologically significant, which equates to an additional 2.69ha being added to the total amount of indigenous vegetation which is considered significant and would be lost under The Scheme's footprint (refer to map in Attachment Three to my memo). This addition does not require further mitigation that what is already on the table.
4. The need to identify areas of established indigenous forest/treeland tree and scrub/scrubland with established and coherent canopies within adjacent land for transfer of soil, leaf litter prior to inundation.
5. The proposed conditions as they stand do not provide opportunities to translocate or seed mistletoe into new protected habitats outside of the flooded area or to monitor the success of the restoration programmes as part of the RFERP. Condition 20 (j) and (I) only refer to fauna monitoring. I consider that the Condition 20(j) should be amended to refer to At Risk and Threatened fauna *and flora* species and that 20 (l) should be amended to require annual monitoring for ten years of *key indicator indigenous* fauna *and flora species and their habitats*.

ATTACHEMENT ONE RESPONSE TABLE

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
Section 2 "Methods - Botanical"	To improve the understanding of the botanical field work coverage, a map showing walked botanical transect with semi-plot locations should be added. This would help with better establishing the probability of other rare or threatened species being present (or absent) within reservoir / dam footprint.	While no walked botanical transects or semi-plot locations were added to results map, appendices II and III contain a plant species list and detailed RECCE plot data respectively. This information can be used to assess the relative composition and abundance of each vegetation type within the surveyed sites.	The point of this review comment was so that the reader could assess visually the level of coverage botanical field work had achieved. The addition of the plot data in Appendices is helpful and the full colour vegetation maps also provide the reader with the missing feel for the level of botanical survey coverage. The reader can now assume reasonable coverage from the detailed maps.	Acknowledged, noting that detailed maps are provided in Appendix II and that the TER has been updated to indicate level of survey effort in section 5.2 of the report.
Section 5 "Vegetation Methodology and Results"	Absence of semi-quantative plot data in appendices or survey transect lines on result map. This would help with better establishing the probability of other rare or threatened species being present (or absent) within reservoir / dam footprint.	See comments on Section 2 "Methods – Botanical" above.	As noted above the RECCE plot data is now available in appendices.	Acknowledged
Section 6 "Avifauna methods and results"	The western, upper river reach has only a low coverage of five-minute bird count stations, and wader walking-surveys did not cover that area. This has the potential for braided river species, such as banded dotterel, to be missed.	Section 6 - Avifauna methods and results contains additional results from field work in November 2012, which also covers the upper, western reach of the planned reservoir. In fact, one adult and one juvenile banded dotterel were discovered during that field work.	This has been a successfully filled report " gap", and I note that it bore a result of interest (i.e. the presence of two banded dotterel).	Acknowledged

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
	Use of ``play-back" method for better determining fernbird presence.	Three additional walk-through surveys were conducted at the lower reach of Dutch Creek during November 2012, and January/February 2013. While searching for blue duck, any fernbird in the area would have also been recorded.	I now accept the level of fern bird survey which includes I am informed, also some searcher call back. The field survey is sufficient to have reasonable certainty over the existing local fern bird population numbers. I further understand, in regard to fern bird, that the population is wider than initially reported and that fern bird are present outside of the inundation area. This will be confirmed by Mr. Kessels' response to this second review.	Acknowledged. Two further fernbird calls were heard by myself on 22 January 2013 and 10 February 2013 while removing automated bat monitors from site 1 and 2 (figure 16, TER). While undertaking surveys of other animals in The Scheme's footprint, myself, Patrick Stewart and David Riddell also conducted numerous informal fernbird 'whistles' in order to illicit responses. The three of us are very familiar with fernbird calls and their habitat requirements, having spent many years surveying for them within the Whangamarino Wetland and in the Coromandel. This, in my view, confirms that the study team has to their best endeavors and with a high degree of certainty found all known localities of fernbird within The Scheme footprint and that fernbird are likely to be widespread in suitable habitat throughout the wider locality. I also note that the Bird Atlas of NZ (199-2004) shows fernbird distributed patchily, along this locality of the Eastern Ruahine.
Section 9 "Terrestrial Invertebrates"	The use of Hymenoptera as focal order is unusual, and the beetle	Apart from a 14 - month occupancy check of weta boxes,	The weta survey has resulted in an important find and has stimulated a	Practicalities mean that only a representative sample of

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
	fauna should have been documented at least. An issue is the absence of light trapping for Lepidoptera, as one of the orders with identifiable conservation concerns.	no further terrestrial invertebrate work has been undertaken.	weta capture and transfer programme to be recommended by Mr. Kessels, which is appropriate. While I agree that The hymenoptera focus is a reasonable proxy for measure of invertebrate species richness and community complexity – thus allowing recognition of good invertebrate communities (and so habitat of value). It remains true that there is a potential for additional "threatened" species to be present and affected (i.e. beetles and spiders, and moths). The potential result of an absence of that data is one relevant to the offset and trap and transfer as opposed to a deficit in the values assessment of the TER.	terrestrial invertebrate orders can be surveyed for. Dr. Marc Hasenbank, who has a PHD in invertebrate ecology, is of the opinion that Hymenoptera were an appropriate proxy (section 9.2, of the TER) as acknowledged by Dr. Keesing. Dr. Hasenbank considered that At Risk and Threatened land snails have the most potential to be present at this site so additional surveys were carried out for snails (section 9.4.3, TER). It is acknowledged that further documentation of beetle, spider and moth fauna would be useful and a desktop review with an addendum to the TER should be undertaken in the next 2 weeks. Given the discovery of the At Risk *H. trewicki* weta, it is recommended that a further 200 weta boxes be deployed at least 12 months before construction commences and that all weta occupying these boxes are translocated into suitable habitat outside of the dam footprint prior to flooding. It should be pointed out that the TER has the following further

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
				recommendations in terms of terrestrial invertebrates: • Further targeted surveys should be considered before construction to expand the search to other terrestrial invertebrate groups (s12.6.1). • Transfer of topsoil, leaf litter and decaying logs from vegetation clearance before flooding commences (s12.6.2). • Animal pest control and excluding stock from currently degraded bush patches as per Project A, B and C in the Mitigation and Offset Report (s12.6.2 for description of expected benefits). The Reservoir Filling and Edge Rehabilitation Plan (RFERP) required under the Proposed Conditions (Part D of the application) provides me further assurance that suitable contingencies for At Risk and Threatened invertebrates will occur if required – refer to Condition 20 (f) to (l) in particular (these are appended as Attachment Four to this memo).

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
Section 11 "Ecological Significance"	The analysis of significant vegetation should include 49.5 ha of the indigenous shrubland/treeland.	Following the assessment criteria for determining significant vegetation cover used in this report, the 49.5 ha of shrubland/treeland has not been included in the analysis of significant vegetation.	This remains a minor point of difference that may be resolved. It was noted in the earlier review that some types of vegetation were not included in the class of significant while appearing to contain fern-bird. It was the reviewer's opinion that "threatened" and "At risk" fauna habitat is typically considered significant in assessments of value. While I concede to the author's final analysis, being they who have undertaken the full analysis, I continue to raise a concern in regard to the significance of the habitats in which taxa of conservation concern abide and trust that these too will be accorded "significance".	It is noted that the two vegetation types of concern to Dr. Keesing have been found not to contain fernbird - or in fact any Threatened or At Risk species (apart from bats which I discuss below). Although it is acknowledged that the shrubland habitat type could provide habitat for fernbird, they have not been recorded there to date. I believe the bird surveys were extensive and covered the key seasons. In particular I note that 5 minute bird counts and transects were conducted within and adjacent to the habitat types Dr. Keesing is referring to and no At Risk or Threatened bird species were found during these surveys (s6.3.3; Figures 8, 9 & 10 TER). In addition, the opportunities for anecdotal discoveries were also high given that the team involved in bat, lizard, invertebrate surveys were also all experienced birders. The long-tailed bats are a different matter. They are likely roosting in and about vegetation types 1,4 and 19 (refer to map 6, Vol. 2, TER) on the Wilson property at ABM stations 12 and 13, as shown in Figures 12 and 15 (TER) by the way of example. There is a considerable emphasis

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
				on bat conservation and habitat protection in relation to the effects of The Scheme. This emphasis is supported by protocols required to be developed in the RFERP (conditions 20 (i)-(l) – refer to Attachment Four). In my opinion these provisions more than adequately provide suitable avoidance, remediation and mitigation measures for bats and their habitats. However, it is acknowledged that vegetation type 19 as shown on Map 6 in Appendix II could be considered as ecologically significant in terms of the relevant district and regional plan criteria given that the 2013 bat surveys confirm that this habitat type is consistently being utilized by long tailed bats. On reflection, it could also be argued that the treeland in Vegetation Type 19 has a sufficiently coherent and dense canopy cover to trigger criterion (ii) of the District Plan criteria (Appendix XII, Vol. 2, TER): '*an area of woody vegetation containing natural occurring tree species, which attain at least 30cm diameter at breast height at maturity…"*.

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
				To this end I now consider it appropriate that Vegetation Type 19 should be included as being ecologically significant, which equates to an additional 2.69ha being added to the total amount of indigenous vegetation which is considered significant and would be lost under the project's footprint (refer to map in Attachment Three to this memo).
Section 12 "Assessment of Effect - Botany"	Include a concluding statement, which articulates the level of effect of the inundation.	An ``Ecological Impact Matrix'' (Table 22 in Section 12.1) has been added, which also makes a reference to the scale of the different effects in a local, regional, as well as national context.	The matrix has satisfied my earlier suggestion.	Acknowledged
	Prior to discussions of remedial and mitigation actions, a discussion on the requirement of "avoidance" of the adverse effects would be expected.	Section 12 contains recommendations for avoidance of effects, where avoidance has been identified to be feasible. Specifically section 12.2.3 "Invasion of Exotic weeds" refers to the need to avoid the spread of exotic weeds during construction of the dam.	What the review was requesting was a plain statement (either at the value or effects stage) as to whether there are values present and affected which of such great value (e.g. of such uniqueness or extreme representativeness) that made granting consent inappropriate from an ecological perspective? Given the report's conclusions it would appear not, but a clear statement to that effect would assist.	In my view such a conclusion should be best given in a statement of evidence by each of the expert witnesses, rather than in a technical report. Nonetheless, given the greater understanding about bat distributions as a consequence of the summer 2013 surveys and the refinement of the mitigation package, along with my review of a set of draft resource consent conditions (which were not available in final draft form during the preparation of the TER), I am satisfied that the project will not lead to ecological effects that are

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				so severe that avoidance seen to be the only option.
	The wording of recommendations in the report is too weak and should be strengthened to clearly identify any main mitigation and offset requirements.	Mitigation and offset package objectives and requirements have been further outlined. Refer to sections 12 and 13, as well as "Ruataniwha Water Storage Scheme – Proposed Integrated Mitigation and Offset Approach" (HBRIC 2013f).	The additions in regard to recommendations for mitigation/offset have been significantly increased in the TER and there is now a standalone mitigation and offset report. However, the report does not assist greatly in enumerating the proposed quantum of offset and its various types. Upon reading the TER and Offset report it appears that there is a significant short fall in offset and that was my initial concern. While there is a package from A to C of proposals it remains unclear what is designed to offset the actual losses. The quantum of offset was discussed with Mr. Kessels and it appears it is a matter of clarity rather than deficiency. As his recommendations (to be listed in his response to this review) will show, once clear, they are suitable cautious and likely in excess of the quantum needed to "balance" the adverse ecological effects.	Refer to Attachment Two to this memo for tabulation of my expectation and understanding of the proposed mitigation and offset package.
	Loss of fernbird habitat, as well as loss of individuals, should have been a main effect.	Section 12.3.3 "Effects on Indigenous Birds and their Habitats within the Reservoir/Dam Footprint" refers to the ability of fernbirds to be able to colonise modified areas, in production pine forest and	The additional information that fern bird are more widely distributed assists in this final review and supports now the logic that the fern bird can and may disperse to the wider (non-inundated) habitats. Nevertheless, fernbird, being an "At	As detailed above, two further fernbird calls were heard by myself on 22 January 2013 and 10 February 2013 while removing automated bat monitors from site 1 and 2 (Figure 16, TER). This,

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
		also indigenous scrub. It is therefore expected that fernbirds are able to move to other appropriate habitat, which is available in the vicinity above the proposed dam level.	Risk" species should have their own trap and transfer (or monitoring to ensure removal) programme.	in my view, confirms that fernbird are likely to be widespread in suitable habitat throughout the wider locality. I also note that the Bird Atlas of NZ (199-2004) shows fernbird distributed, albeit patchily, along this locality of the Eastern Ruahine. I do not consider a separate trap and transfer programme is required for fernbird provided that the flooded operations are not preceded by vegetation clearance before the commencement of flooding as there is suitable available habitat for fernbird to move into in the surrounding landscape, which they would have time to do so even under a 12 month lake filling scenario as predicted by Tonkin and Taylor (2013). The Project Description report only refers to "*Selective clearing of trees that will be submerged by the reservoir*" (s3.1, Construction Environmental Management Plan in Project Description Report). So I do not envisage that wholesale clearance of scrub and vegetation pre-flooding will be undertaken. However, if extensive vegetation

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
				clearance is proposed within habitat for fernbird then I do agree that contingencies for fernbird capture and translocation will be required. The Proposed Conditions (Part D of the application) provides me assurance that suitable contingencies for fern bird will occur if required – refer to Condition 20 (j) in particular.
Section 12 "Assessment of Effect - Avifauna"	Strengthen wording for recommending river bed weed/encroachment management in the report.	Section 13.4.3 "Ruataniwha Riparian Enhancement Zone (River Halo Project)" contains more clearly defined objectives for mitigation and offset package. Also refer to "Ruataniwha Water Storage Scheme – Proposed Integrated Mitigation and Offset Approach" (HBRIC 2013f).	Accepted, although noting the continuing clarity in what the Halo will achieve in terms of type and quantum of offset (assisted I trust by Mr. Kessels' response to this review).	Refer to table in Attachment Two to this memo.
	Cat control in addition to controlling numbers of ship rats, stoats and possum is suggested.	In section 12.3.4 "Amelioration and Monitoring Recommendations for Indigenous Avifauna Effects" the benefit of controlling cat numbers is acknowledged. However, is not considered to be absolutely necessary for arboreal nesting birds.	The TER still remains unclear as to what is meant by mammalian predator control (only referencing ship rats and stouts and possum) and the comment on cats not being necessary (probably) does not assist. In addition predator control is also recommended for bats and lizards and for invertebrates – this means the potential for an entire mammalian suit including brown rat, hedge hog, cats etc. Furthermore the TER document recommends an	The suite of mammalian pest control opportunities is described in the Mitigation and Offset Report (HBRIC 2013f). In addition, the RFERP requires intensive control of animal (and weed) pests during and after the construction period, including control of feral cats, in and around any translocation and habitat enhancement sites (refer to condition 20(f) as shown in Attachment Four).

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
			array of pest animal control for "long" or "sustained" and intensive periods but no-where does it confirm that a full array of predator control will be in place in **perpetuity** or for a length of time determined by meeting an offset/mitigation milestone or success. In discussion Mr. Kessels has agreed to supply evidence that the biodiversity gains required by predator control can be meet within the 30 year consent period for which I understand the predator control to be proposed for. The use of predator control, especially where it is to be promoted as significant mitigation requires substantial details about what, where, how, when and for how long, I cannot find such details clearly articulated within the TER.	The biodiversity gains with suitable animal pest control on New Zealand indigenous fauna and flora are generally very well proven and documented. Attachment Five to this memo outlines some of the expected benefits of suitable pest control as proposed by Projects A, B and C as well as required by the relevant consent conditions pertaining to the RFERP. What animal pest species to control and when and for how long is a complex matter which I expect will be resolved when specific management plans are drafted and locations are found for each of the mitigation/offset projects and RFERP. Suffice to say at this point in time I am confident that for all of the threatened and at risk species (and other key indigenous fauna and flora) at this location, significant benefits would accrue with a sustained pest control programme as proposed for The Scheme (refer to Attachment Five for further details).

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
				I envisage that there are several strategic options for pest control: • Localised control of selected pests to protect particular species (e.g. possum control to protect a local snail/mistletoe population, or stoat control along a river to protect blue duck or cat control to protect bat maternity roosting sites); • Widespread control that targets one pest to protect habitats (e.g. ungulate control to protect forest understoreys); • Multispecies predator (rodents, stoats, possums) control at different scales to protect suites of native species; • Predator (rodents, stoats, possums) and herbivore (possums, goats, deer) control to restore ecosystems. Without fencing (mainland islands) this strategy only makes sense at large scales; and • Targeted control at translocation site. For example pre-translocation monitoring may show that hedgehog control is required at the lizard

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
				translocations sites. Successful control of these pests, as outlined in Attachment Five, would enhance the populations of blue duck, falcon, fernbird, other birds, reptiles, snails, other invertebrates and palatable plants. To what extent is always open to uncertainty in terms of quantifying the exact gains and this will only become apparent over time. However, there is a considerable weight of evidence from elsewhere in New Zealand that most native species respond favorably to control of these pests in the habitats proposed to be targeted and that 30 years of sustained pest control at appropriate locations (as proposed, refer HBRIC 2013f), and in combination with other management and protection measures (such as stock control), will result in substantial gains which are likely to outweigh the loss of habitats associated with The Scheme (e.g. see O'Donnell et al. 2012 for an example).
Section 12 "Assessment of Effect - Bats, Herpetofauna,	In regard to the amelioration of the invertebrate effects, the report correctly identifies transfer of samples of topsoil, litter etc to	Transfer of soil, leaf litter to nearby bush fragments does, however, carry the add-on effect of potentially causing	The TER recommends transfer of material as mitigation. The invertebrate expert still recommends transfer of material to	Agreed and the final recommendations in the TER will be amended with suitable wording to incorporate this

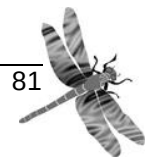
Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
Invertebrates"	appropriate forest locations. It then goes on to note that such transfers should not occur until vegetation in replacement habitat has formed a coherent canopy. By that time, unless the revegetation, enhancement work is to precede effects by at least 5 years, the opportunity (due to area clearance and inundation) will be lost by the time the new areas have suitable canopy. Transfer should be to remaining nearby and edge fragments which are not well endowed with ground tier resources but are part of the protect and enhance regime.	disturbance not only at the donor site, but also at the receptor site as well. Transfer to restoration plantings of vegetation alike to the donor site vegetation may cause a lower disturbance of the overall system. For the canopy to reach maturity before transfer would be considered useful, restoration plantings should precede any construction activity.	restoration/revegetation areas only once the planted vegetation has formed a coherent canopy. In practical terms this transfer must occur then to an area of existing canopy cover (no new plantings will form a canopy cover in time). I understand that the author now agrees with this requirement and will amend the documentation so that leaf litter/duff and woody debris and top soil will be salvaged to within existing canopied remnants.	request.
Section 12 "Assessment of Effect - General"	The effects section does not consider directly the impacts of the loss of the red mistletoe or potential mitigation actions such as seed collection and propagation, translocation or alike.	The mitigation packages include control of pest species, such as possum, which red mistletoe would benefit from. No other potential mitigation measures for red mistletoe have been directly considered. However, means to further the knowledge and understanding of rare or threatened species within the Hawke's Bay region, as well as contributing to the enhancement of habitat for such species form part of the scope of the recommended mitigation and offset packages.	If red mistletoe is scarce in the area, and if the only mistletoe (that found within the reservoir foot print) is lost to the inundation, no amount of pest control will bring the inundated plant back in the wider area, therefore no amount of pest control can mitigate the effect. As with other threatened or at risk species I understand now (following discussion) that the author agrees and that even if it fails a process will be recommended to salvage either seed (and grow it on nearby) and / or the plant of mistletoe for reestablishment.	Agreed and the final recommendations in the TER will be amended with suitable wording to incorporate this request. Proposed Conditions (Part D of the application) provides me further assurance that suitable contingencies for mistletoe will occur if required – refer to Condition 20 (j) in particular (and following my recommended amendment to include reference to flora, as discussed below).

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
	Fernbird require a more cautious and circumspect analysis and approach to mitigation.	See comments to Section 12 "Assessment of Effect - Botany" above.	As noted above, this issue has been resolved.	Agreed and dealt with in my responses above.
	The quantum of mitigation is not yet formulated and the effort in regard to pest animal control is not clear. In that regard it is critical to understand which pest animals will be controlled for to what level and for how long.	Refer to "Ruataniwha Water Storage Scheme – Proposed Integrated Mitigation and Offset Approach" (HBRIC 2013f).	The quantum of possible mitigation have been better quantified. But, as I noted earlier in this review, there are a number of uncertainties. Mr Kessel's, in his response to this review, will tabulate the array of offset and its quantum in terms of new planting, protection and restoration, and in terms of biodiversity assistance by pest control. It becomes then clear that there will be sufficient ecological offset proposed.	Agreed and dealt with in my responses above (and to Attachment 2).
	What is missing is a section specifically on monitoring the success of the mitigation and off-set actions so that the success of those programmes proposed can be measured (ensuring bats and birds and resources are improved etc.)	Refer to "Ruataniwha Water Storage Scheme – Proposed Integrated Mitigation and Offset Approach" (HBRIC 2013f). Where relevent mitigation and offset objectives contain requirement for ongoing survey work to monitor mitigation and offset outcomes for blue duck, as well as wader species utilising the braided river.	A mitigation offset success monitoring programme is required to determine the success of the wide array of actions recommended. There is also a focus on blue duck or on the riverine wader species protection, which while with merit does not address the principal inundation effects. The predator control should be in the first instance support to the wider biodiversity. An apparent semantic aspect but nevertheless important in terms of monitoring the success.	Agreed. It is envisaged that as well as the requirements to monitor under Condition 20 (I) during and post construction (annually for 10 years), monitoring the success of the mitigation projects is also required. Proposed performance targets are given for each of the projects and I had envisaged that one of the key tasks of the 'Ruataniwha Biodiversity Trust' (refer to condition 1, Schedule Two of the Proposed Conditions report) would be to set in place procedures, protocols, performance standards and monitoring regimes to ensure that

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
				the performance targets set out in section 3 of the mitigation/offset report will be achieved over the 30 year period that the projects will be funded for.
Section 12 "Assessment of Effect - Monitoring"	The wording of recommendations in the report is too week and should be strengthened to clearly identify any main mitigation and offset requirements.	Section 13 now contains more clearly defined objectives for mitigation and offset package. Also refer to "Ruataniwha Water Storage Scheme – Proposed Integrated Mitigation and Offset Approach" (HBRIC 2013f).	Section 13 of the TER is an improvement on the earlier draft. Mr. Kessels' further analysis and summary (in the response to this formulated under discussion) assists even further and is required for clarity.	Agreed and dealt with in my responses above.
Section 13 "Biodiversity offsetting recommendations"	A riparian margin of 20 m width will supply a good buffer for the water quality in the reservoir but is not wide enough to create faunal habitat of particular value, as it is all large edge habitat.	The recommendation of a riparian margin of 20m has not been changed.	The review comment made earlier remains in that a 20m buffer is unlikely to supply satisfactory habitat to offset that, which will be lost. It will however, where it is part of an array of offset actions supply new edge habitat, which will have some values that will assist in the offset, but it cannot be considered of itself to be of great habitat value (especially within 20 years).	Agreed. As expressed in Dr. Keesing's response the 20m buffer in itself is unlikely to yield any significant immediate biodiversity gains if it is assessed in isolation. However, if the buffer is extended to include areas of treeland and scrubland currently subject to stock grazing and animal pest browsing as it is likely to do, then the positive effects will be more immediate. It is proposed, subject to landowner approval, that many areas of degraded gully, cliff and remnant vegetation areas around the new lake will be fenced into the 20m buffer and added to the 100ha enhancement of degraded habitats within the farmed portions of lake sub-catchment as outlined in Project A in the mitigation/offset report (HBRIC

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
				2013f). In addition, the RFERP will require animal pest control during and after the construction period (refer proposed condition 20 (f)(i),(v)(vii) in Attachment Four). The specific extent and period of time for this pest control is not specified as yet but I have laid out suggested approach in the table in Attachment Two.
Section 13 "Biodiversity offsetting recommendations - Ruataniwha Reservoir Restoration Buffer and Catchment Enhancement Zone"	The proposed on-going pest management over the potential 616 ha for possum and rats is unlikely to be a reality (a programme in perpetuity) and furthermore, care must be taken in only removing rats where cats and stoats are also present as removal of the primary prey source can result in the stoats and cats increasing predation on reptiles, invertebrates and birds.	Refer to "Ruataniwha Water Storage Scheme – Proposed Integrated Mitigation and Offset Approach" (HBRIC 2013f).	My concerns regarding the reliance on predator control unspecified in exact nature and length of control remains (although Mr Kessel's further evidence on the biodiversity that might be gained within 30years of control within (I assume) the forest fragments protected, would assist. The additional mitigation report and offset does not allay my concerns. However, I also now understand that the predator control sits alongside a substantial actual aversion of loss processes (protection and restore) for other habitat areas and this means an absence on reliance for gains obtained by predator control alone (or new plantings).	Refer to Attachment Two and Attachment Five of this memo for further clarification in terms of how the entire suite of pest control operations would be managed to maximise biodiversity gains. The proposals, while presented separately, will be part of an integrated upper- Tukituki River catchment wide approach to enhancing biodiversity generally and habitats for a range of At Risk and Threatened flora and fauna for over 2,700ha of land. For example, the restoration of c.600ha of forest, scrub and wetland habitats as part of Project B (River Halo Project) will include incentives to encourage landowners to fence remnants from stock and legally protect these remnants in the form of agreements between the landowners and the regional

Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
				council (refer to s3.2.2 of the mitigation/offset report, HBRIC 2013f). It also needs to be highlighted that many of these areas within and adjacent to the River Halo project are Recommended Areas for Protection (refer to Figure 37, TER). Thus they have been identified by the Department of Conservation as having high conservation value. Many of these RAPs on private land receive no management input at present, so the River Halo project provides a unique incentive for landowners to be in a position to protect and manage these areas for their biodiversity values.



Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
Section 13 "Biodiversity offsetting recommendations - Ruataniwha Riparian Enhancement Zone"	While the attainment of 616 ha of ecological features into protective covenants with fencing and enhancement is a very important and beneficial outcome which, would succeed in offsetting the inundation, again the Mitigation and Offset package requires the co-operation of willing landowners to allow covenanting and management on their land so the off-set at this stage has no certainty.	Refer to "Ruataniwha Water Storage Scheme – Proposed Integrated Mitigation and Offset Approach" (HBRIC 2013f).	In regard to "certainty", I understand an array of agreements and processes are being forwarded and I also note that the Regional Council could assure some of the offsets. In any case the ability of the project to assure the offset packages is not one of ecological concern, that being to determine if it is possible to offset, and any ability to deliver the recommended and adopted offset is an issue for consent conditions.	Agreed
	The red mistletoe and fernbird should be included in this Mitigation and Offset package.	Refer to "Ruataniwha Water Storage Scheme – Proposed Integrated Mitigation and Offset Approach" (HBRIC 2013f).	I repeat (as noted above) that this recommendation remains.	I do not agree with Dr. Keesing on this point but acknowledge that his brief did not extent to taking into account the proposed consent conditions. In addition to my comments above relating to fernbird, I consider that specific mitigation will not be required provided wholesale habitat clearance does not occur pre-flooding and given that the proposed buffer planting (c. 46ha) and associated rehabilitation of 100ha treeland and scrublands, 14ha of wetland creation, combined with the animal pest control required in the RFERP, backed up by the translocation and monitoring requirements (in

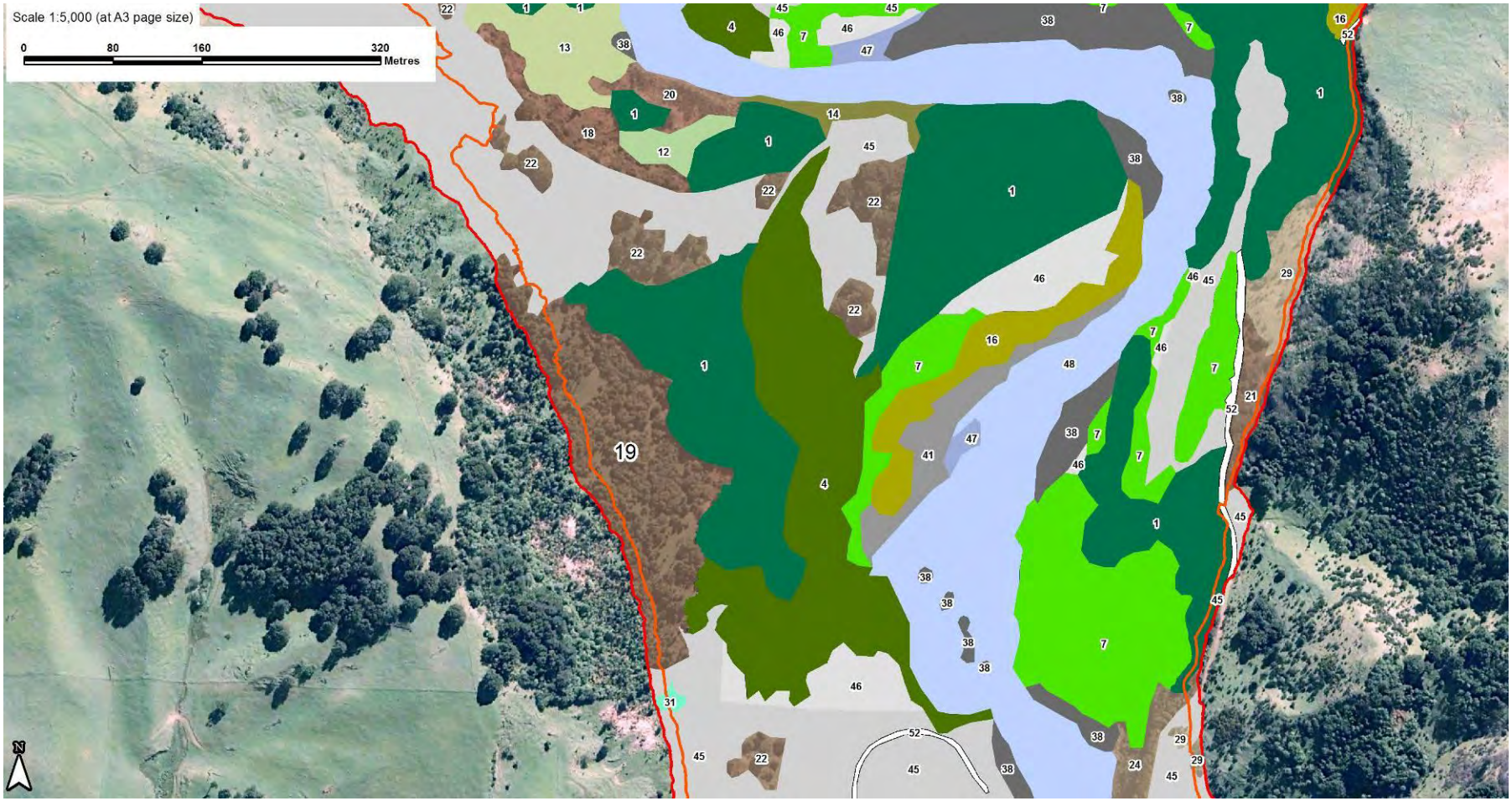
Relevant section	Peer-review May 2012 – Key critic points	How addressed in TER March 2013	Peer-review March 2013 – critic points	Kessels & Associates Response
				the case of fernbird contingencies only), will provide sufficient safeguard to fernbird and their habitats post flooding. Turning to red mistletoe, notwithstanding the fact that reason mistletoe is so rare is likely because of possum browsing and that The Scheme provides funding to carry out possum control in habitat where mistletoe exists outside of the Scheme footprint (acknowledging that specific locations have not been located in the wider upper catchment to date), the proposed conditions do not provide opportunities to translocate or seed mistletoe into new protected habitats outside of the flooded area. Condition 20 (j) and (l) only refer to fauna monitoring. I consider that the Condition 20(j) should be amended to refer to At Risk and Threatened fauna and *flora species* and that 20 (i) should be amended to required monitoring of annual monitoring for ten years of fauna *and flora.*

ATTACHMENT TWO MITIGATION AND OFFSET SUMMARY TABLE

Project	Area	Time Frame	Target Animal Pests	Key Benefit Species and Habitats	Other Management Requirements
RFERP requirements	Not specified but should be over at least 300ha to maximize benefit and create suitable buffer around the 160ha Buffer and Enhancement Zone and translocation sites for key at risk/threatened fauna and flora species.	Not specified but should be at least 10 years, including during construction period and proposed post commissioning monitoring in order to maximize benefits and allow translocated populations and planted areas to establish.	Cats, rats, possums and mustelids. Deer and hedgehog control may also be required; specifically control of hedgehogs around lizard translocation sites.	A variety of habitats supporting a range of indigenous birds, bats, lizards, invertebrates, and vegetation.	Fencing from stock; soil and humus translocation; weed invasion minimization and control protocols during and after construction, bat roost enhancement and replacement.
Project A: Ruataniwha Reservoir Buffer and Catchment Enhancement Zone	Riparian Buffer – 46ha (this is the minimum estimated area but it may well increase with fencing practicalities necessitating the best line approach). Wetland creation – 14ha Enhancement areas – 100ha Total – 160ha	10 years	Not the principal purpose of this project but expectation is that restoration and catchment enhancement over the prescribed 10 year period will be covered by pest control undertaken as part of RFERP requirements.	A variety of habitats supporting a range of indigenous birds, bats, lizards, invertebrates, and vegetation.	Planting 267,700 plants; Fencing from stock; legal protection of 160ha; ongoing weed control.
Project B: Ruataniwha Riparian Enhancement Zone (River	600ha for protection and management, including animal pest control 314ha for river bed plant pest control	30 years	Not principal purpose of this project	A variety of habitats supporting a range of indigenous birds, bats, lizards, invertebrates, and vegetation.	Fencing from stock, legation protection of over 600ha, ongoing weed control.

Halo Project)					
Project C: Ruataniwha Threatened Species Habitat Enhancement	500ha – upper Makaroro River Catchment 600ha – wader bird habitat or blue duck habitat Bat habitat enhancement – not specified – assume at least 250ha	30 years	Cats, rats, possums and mustelids.	Key at risk/threatened species such as bats, blue duck, banded dotterel, falcon, kiwi, as well as mistletoe if present.	Fencing, legal protection (as and if required) and facilitating advocacy of threatened species in Central Hawke's Bay.
Total Minimum Area	2,724ha				

ATTACHMENT THREE VEGETATION TYPE 19 IDENTIFIER MAP



ATTACHMENT FOUR RELEVANT PROPOSED CONSENT CONDITIONS

Reservoir Filling and Edge Rehabilitation Plan (RFERP)

18. The consent holder shall engage a team of independent advisors to prepare a **Reservoir Filling and Edge Rehabilitation Plan** (RFERP) to operate in conjunction with the CEMP and the mitigation and offsetting projects required to be implemented under the conditions of Schedule Three. The team of advisors responsible for preparing the RFERP shall consist of an ecologist, a landscape architect, an engineer, a recreation planner and a cultural advisor. Each advisor shall be suitably qualified and experienced.
19. The RFERP shall be focused on the following objectives:

a) To minimise as far as practicable the loss of indigenous fauna resulting from construction earthworks, vegetation removal and reservoir filling;

b) To manage clearance of vegetation within the reservoir footprint so as to minimise adverse effects on native fauna, particularly bats, and to achieve positive cultural outcomes;

c) To optimise the value of the reservoir and its surrounds for recreational use, having regard to the need for water levels to fluctuate intra year;

To minimise reservoir edge erosion during reservoir - fill, and throughout operation of the Scheme, particularly in areas accessible to the public;

e) To ensure control of animal pests during revegetation of work areas beyond the reservoir footprint;

f) To minimise the effects and introduction of plant pests during the construction period;

g) To ensure planted out areas within construction areas are maintained following completion of construction.

20. The RFERP shall at minimum address the following:

a) Identifying indigenous timber within the reservoir footprint that is suitable for cultural use and establishing methodologies for its harvesting and use for such purposes;

b) Identifying other vegetation within the reservoir footprint needing to be cleared in order to ensure maintenance of visual amenity during reservoir -filling and subsequent Scheme operation;

c) Subject to (a) and (b) above identifying the vegetation within identified construction areas that cannot practically be preserved during the construction process and ensuring that effects on the balance of vegetation are minimised;

d) Identifying priority areas of reservoir edge accessible to the public and providing for their management in order to optimise visual amenity and recreation use of the reservoir;

e) Identifying areas of potential reservoir edge erosion during reservoir-filling and providing for preventative measures to maintain visual amenity, particularly in areas accessible to the public;

f) Managing plant and animal pests as set out below:

i. Appropriate measures to control plant and animal pests during and after the construction period within any construction areas in order to achieve the objectives in condition 14 (e) and (f), including (but not limited to);

ii. Weed monitoring and control within the reservoir margin and in all areas disturbed by construction and those areas adjacent to the disturbed areas that may, as a result of construction, be adversely affected by weeds, and covering all regionally ecologically-threatening species and that are listed in the National Pest Plant Accord;

Weed monitoring inspections within areas proposed to be disturbed to be undertaken by a suitably qualified and experienced person or persons, at a frequency no less than 4-monthly intervals from start of construction until one year after the completion of construction for the Reservoir, and from the one year post construction anniversary, weed monitoring at least annually;

iv. Weed hygiene controls, including equipment wash-down sites and facilities, the sources and hygiene requirements for quarried material, and inspection and preventative measures to prevent terrestrial and freshwater weeds being transported to and from the Scheme sites;

v. Weed monitoring and control as otherwise recommended in the *Integrated Mitigation and Offset Approach Report - HBRIC (May 2013f)*.

vi. Trapping, termination and disposal of possums, wild cats and mustelids around the reservoir area;

vii. Control of wild cats, possums, rats and mustelids within all herpetofauna translocation areas both prior to and after translocating any herpetofauna (to the extent required by (h) below).

g) Appropriate measures to ensure planted out areas within construction areas are maintained following completion of construction, including new planting as required to achieve the standard of revegetation specified in the CEMP.

h) All relevant recommendations arising from the pre-construction herpetofauna, avian and bat surveys undertaken in accordance with the *Terrestrial Ecology Assessment Report filed with the applications - Kessels & Associates (May 2013)*

i) Protocols to minimise the impacts on bats, indigenous birds and lizards during vegetation removal or construction;

j) Where feasible and practical capture and translocation of At Risk and Threatened Fauna species;

k) Procedures for the identification, protection, management and replacement of bat roosts found during the pre-construction surveys, and requiring avoidance of disturbance of all bat maternity roosts while they are in use; and

l) Annual fauna and bat monitoring reports for every year for the first 10 years following the commissioning of the Scheme.

21. The Consent Holder may commence construction activities in accordance with the RFERP unless one or more of the Consent Authorities advises the consent holder in writing within 20 working days of receipt of the RFERP that it refuses to certify the RFERP on the grounds that it fails to meet the requirements of Condition 20 above in relation to an activity within the relevant Consent Authority's jurisdiction, and provides reasons why that view is held.

22. Should the Consent Authorities refuse to certify the RFERP in accordance with Condition 21 above, the consent holder shall submit a revised RFERP to the Consent Authorities for certification as soon as is practicable. The certification process shall follow the same procedure as outlined in Condition 18 to 21 above.

23. Once certified the RFERP may be varied by the consent holder. The certification process for a RFREP Variation shall follow the process outlined in Conditions 18 to 22 above. Construction activities subject to the variation shall not commence until the variation has been certified by the Consent Authority.

24. The consent holder shall comply with the certified RFERP at all times.

ATTACHMENT FIVE SYNOPSIS OF BENEFITS OF ANIMAL AND PLAN PEST CONTROL TO NZ INDIGENOUS FAUNA AND FLORA

Target Animal Pest Species

Ship rats are major predators of small birds, taking eggs and chicks of both arboreal and ground-nesting species. They are also significant predators of *Powelliphanta* snails.

Mice are known predators of invertebrates, particularly caterpillars and spiders (Ruscoe & Murphy, 2005), but there are limited data on the significance of this predation.

Stoats and feral cats are likely the critical threat to blue duck, fernbirds, kiwi and kaka (if present) many other forest birds (e.g. Whitehead *et al*., 2008; Powlesland *et al*., 2009).

Possums are significant predators of land snails in some (but not all) areas. Possums also eat birds and their eggs and browse some native plant species. Rata spp., *Muehlenbeckia australis* leaves and fruit are known to be highly palatable to possums. The scarcity of mistletoes in the Makaroro River area suggests they have already been removed – very likely by possums.

Feral cats are probably present on or around the Makaroro River although I have no evidence of this. Generally, feral cats only reach high (for cats) densities where there are rabbits as prey and cats are thus rare in most forest habitats. Cats are, however, very effective predators on lizards and ground-nesting birds (Gillies & Fitzgerald, 2005) so if cats are present it will be very likely that there will be an impact on any resident populations of skinks, geckos, and on birds such as fernbirds and pipits.

The other animal pest present, and deer and hedgehogs in particular, may need to be managed to fully restore the forest ecosystem. As in all forested ecosystems in New Zealand with ungulates, the forest understorey will lack many of the palatable species found in the absence of ungulates, and this will have long-term consequences for forest structure especially when these species are the seedlings of dominant canopy tree species (e.g. Nugent *et al.*, 2001). Hedgehogs are likely predators of lizards and bird eggs, so may also need targeted control in and around the lizard translation sites (e.g. Jones *et al.*, 2005).

Modern management strategies and techniques attempt to control animal pests with a single technique applied at appropriate intervals. This is now possible using aerial 1080 baiting for the usual suite of small mammals present in most New Zealand habitats (rodents as acute pests and possums as chronic pests). However, the control of ungulates and mustelids/feral cats still requires independent control techniques.

Three of the main pest species present (ship rats, mice and stoats) will have acute but periodic impacts on native species. Ship rat and mouse abundances and impacts will fluctuate with the periodic seeding/masting events, mostly of the beech species but of both beech and some podocarp species. Rodent abundance will be the main driver of stoat abundance. It is these interacting species (Ruscoe *et al.*, 2011) that are the main likely threat to many of the biodiversity values in this area. The other key pest species present (possums and) have chronic and constant impacts, as their numbers remain more constant between years.

Controlling pests and assessing results

Control operations for invasive rodents and possums are routinely carried out in New Zealand to protect native biodiversity. The success of these operations in reducing animal numbers is usually assessed by some measure of abundance. True abundance is difficult to determine therefore more simple indexes of abundance have been developed. There is

evidence that these indexes correlate with true abundance (Brown *et al*., 1996; Forsyth *et al*., 2005; Innes *et al*., 2010; Johnston, 2003). The current most widely and consistently used methods of monitoring are the use of tracking tunnels for rodents (Gillies & Williams, 2007) and trap catch/residual trap catch for possums (NCPA 2010) respectively.

Populations are monitored before and after control operations, usually at seasonal intervals. Optimally, these measures are compared with those taken in a comparable non-treatment area to ensure that changes in populations are significantly different to any natural changes in abundance and are therefore truly the result of the pest control program.

Biodiversity outcomes

There is a strong understanding that controlling pest species benefits native biodiversity. However, robust empirical data is lacking and there is a great deal of uncertainty about the level to which pests must be suppressed in order to protect different biodiversity values (Clayton & Cowan, 2010). A few species have had the kind of intensive research required to establish this link. For rats this link has been made with kokako and research indicates that rats must be suppressed to the point where they have a tracking index of 5% (Innes et al 1999). The 5% rat tracking index has since been adopted as a target for all rat control operations. There is evidence that controlling rats to these low levels also benefits other bird species including wood pigeons (Innes *et al.,* 2004; Innes *et al*., 2010).

Low residual trap catch rates of 1-4% for possums have also been associated with greater juvenile survival and adult abundance for some bird species including kokako and wood pigeons (Innes *et al*.,1999; Innes *et al.,* 2004; Innes *et al*., 2010). It is important to note that both possums and rats must be controlled at the same time for these birds to benefit.

Possums can have a negative impact on vegetation. They show preferences for certain plant species so whilst controlling possums may have little positive effect on some vegetation types, vulnerable species will benefit. There have been some assessments made as to the level to which possums must be reduced in order to protect certain plant species (Table 1). Damage is often measured using the foliar browse index (Payton *et al*., 1990).

Table 1. Taken from Warburton et al (2005). Potential target RTCIs required to protect different vegetation values from possums

Component	RTCI required for protection	Study area	Reference
Mistletoe	<3%	Hauhungaroa	Sweetapple *et al*., 2002
Northern rata forest canopy	<7-9%	Waipoua	Payton *et al.,* 1997
Kohekohe (as a common forest component)	<10%	Motatau	Nugent *et al.,* 2002
Common broadleaved species (kamahi, mahoe, tawa, pokaka, toro and heketara) in conifer-broadleaved forests	<25%	Matemateaonga	Nugent *et al.,* 2001

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Peer-review Letter by Dr. Vaughan Keesing (Boffa Miskell Ltd.)

Boffa Miskell

Memorandum

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Attention:	Stephen Daysh, Martin Williams, Gerry Kessels
Company:	For Hawke's Bay Regional Investment Company Ltd
Date:	03.04.2013
From:	Dr Vaughan Keesing
Message Ref:	Kessels Associates response to the ecological peer review - Version March 2013

Dear Sirs

I have reviewed the response and additional information supplied by Mr Kessels of Kessels Associates Ltd in regards to my second peer review of the AEE and Mitigation and Offset approach report.

I commend his approach and adherence to details and serious consideration of my review.

It appears to me that the substantive aspects of my review have now been attended to and those aspects of a more substantive matter have been well addressed. Principal concerns such as full consideration of values (including threatened species habitat), a fuller predator suite to be managed, and the consideration of salvage of threatened species have all been addressed satisfactorily.

The clarification of the types and quantum of offset/mitigation was one of the major concerns I had and through Mr Kessels response, and especially attachment 2 (summary table), it can now be seen (and better understood) what is recommended by the reporting ecologist. With these clarifications I am now able to weigh and comprehend the aspects of the ecological offset / mitigation.

It is now evident that the recommended package involves 2,700 ha of work that, while relying heavily on predator management, includes planting of new habitat areas (even where that "habitat" will be narrow), and saving and restoring existing fragments of bush, supporting threatened species and biodiversity in general, wetland restoration/recreation and support of riverine systems, existing DOC systems with Blue Duck and specific bat and bat habitat systems.

This reviewer acknowledges the difficulties such a project raises for an assessing ecologist, perched between the RMA, the National Biodiversity Strategies, Offsetting trends, the difficulties of replacing lost habitats in reasonable time frames, and the sheer magnitude of ecological affects. Such large scale effects cannot simply be rendered neutral (or to a net benefit) and it is my consideration that the elements and aspects recommended by Kessels Associates are well conceived and thought through given the projects nature, location and opportunities.

I have not reviewed the conditions of consents and I understand that "stake holder" groups and decision makers will all have an influence in the final ecological programme, but I can now conclude that the ecological assessment of values and effects and the mitigations and offsets recommended are in line with good practice, full and complete, and are sufficient and accurate, in my opinion, as a proper and robust ecological assessment.

Dr Vaughan Keesing
Boffa Miskell ltd
03.04.2013

APPENDIX XVI
Terrestrial Invertebrate Literature Study

Summary

The purpose of this literature study was to provide additional information on any At Risk, or Threatened beetle, spider, butterfly and moth species that could potentially be present within the proposed Scheme area, or which may be encountered within the wider local or regional area. As a result of this literature study a total of 14 species listed as At Risk or Threatened were recorded to be potentially present within the Scheme area, or within the wider region. Based on further investigations into the distribution ranges of those species, as well as consideration of the available habitat within the Scheme area a primary list was compiled by filtering out unlikely species. This primary list included one Threatened beetles species, three At Risk moth species, as well as one Data Deficient moth species, all of which were considered to be potentially present within the Scheme area, or within the wider region.

Introduction

This report is an Addendum to the "Terrestrial Ecology Study – Assessment of Ecological Effects May 2013" report (TER, 2013), which has been prepared for the Hawke's Bay Regional Investment Company Limited (HBRIC Ltd) by Kessels & Associates Limited (KAL) in relation to the proposed Ruataniwha Water Storage Scheme ("the Scheme"). Please refer to the TER (2013) and the project description by Tonkin & Taylor "Ruataniwha Water Storage Scheme Project Description report for Hawke's Bay Regional Investment Company Limited. May 2013a" for further details on the proposed Scheme. Part of the Scheme is formed by a dam and reservoir that are proposed to be located at the upper part of the Waipawa catchment on the Makaroro river, and in accordance with the TER (2013) will be referred to as "the dam" and "the reservoir" within this report.

Section 9 in the TER (2013) covers the terrestrial invertebrate survey work that has been undertaken by KAL to date within the proposed Scheme area. This work has primarily focused on providing a measure of species richness to assess the biodiversity value of the terrestrial invertebrate community within the proposed dam and reservoir area, as well as surveying for the At Risk Hawke's Bay tree weta, *Hemideina trewicki*, and for native land snails in the area affected by the proposed dam and reservoir. The purpose of this literature study is to provide additional information on any At Risk, or Threatened[6] beetle, spider, butterfly and moth species that could potentially be present within the proposed Scheme area, or that may be encountered within the wider local or regional area. Thereby this study forms part of the wider assessment of ecological effects on terrestrial invertebrates, and provides additional information for the resource consenting process for the proposed Scheme in Central Hawke's Bay.

Methodology

The order Coleoptera (beetles) is one of the most diverse insect groups, and stretches across a range of trophic levels (for example, containing herbivore and predator species). It is therefore a group often used for assessing the biodiversity at a given site. While not having a similar trophic span to beetles, Lepidoptera (butterflies and moths) are largely herbivores often associated with specific host plants. Spiders (Araneae) inhabit a large array of microhabitats, and interact with biotic and abiotic factors in a way that can reflect ecological change, thereby making them good

[6] At Risk, Threatened are Threat Status classifications used by the New Zealand Threat Classification System Lists. This report also covers species that were classed as Data Deficient, but have been identified to be potentially present within Scheme area, or wider region.

bio-indicators. The different steps that were used to conduct searches for information on beetle, spider, butterfly and moth species presence within the relevant area of the Hawke's Bay region are outlined below.

Searching species records

The reservoir and dam of the proposed Scheme fall within the Ruahine Ecological District (28.01), which lies to the West of the Maungaharuru (29.01) and Heretaunga (29.02) Ecological Districts that cover the majority of the Hawke's Bay region. When collecting species samples a standardized naming of the location region is used in New Zealand. The North Island location identifier for the Scheme would be the Hawke's Bay area (HB), and the Ruahine Range area (RI). Depending on the source, records were searched for either of those terms, or in some cases the search was conducted using Hawke's Bay or Ruahine Range as simple search terms. As the search for species focused on the Hawke's Bay region, as well as the Ruahine range no neighboring regions were included.

The Department of Conservation's BioWeb database was queried for any At Risk, or Threatened species that may be present within the reservoir and dam area, or within a buffer zone of a ten kilometer radius surrounding the dam and reservoir area as part of the TER (2013) report. No results were returned for terrestrial invertebrates at the time, and no additional BioWeb queries were done as part of this study.

A general web search was conducted to retrieve references that may contain relevant species records. The following combinations of search terms were used and the 20 most relevant hits of each search sighted[7]:

i) (Hawke* BEFORE Bay) AND (Coleoptera OR Lepidoptera OR Araneae)
ii) (Hawke* BEFORE Bay) AND (beetle OR butterfl* OR moth OR spider)
iii) Ruahine AND (Coleoptera OR Lepidoptera OR Araneae)
iV) Ruahine AND (beetle OR butterfl* OR moth OR spider)

The online search was further expanded to the following New Zealand specific journals and historical literature databases that were searched for the terms Ruahine and Hawke's Bay and Hawkes Bay within title or content fields, and references to Arthropods were sighted:
i) New Zealand Journal of Entomology
ii) The Weta
iii) New Zealand Journal of Ecology
iv) New Zealand Journal of Zoology.
v) BUGZ (Bibliography of New Zealand Terrestrial Invertebrates - Online)

Search results were then examined for any species references to beetles, spiders, butterflies and moths. Species references were then filtered based on information on species ecology, distribution ranges, as well as habitat requirements. The first filter criterion was that the species had to be recorded as present within the Hawke's Bay or Ruahine region at some point in time. The source description for species habitat or ecology was then used to assign broad habitat categories to the species record. The second criteria was that a species habitat would have to fall into either one of these categories:
i) 1=grassland (native/exotic);
ii) 2= lowland native shrubland/forest;
iii) 6=wet (includes moist soil, streams, ponds);
iv) 7=parasite;
v) 9=montane/subalpine/alpine (includes montane forest and grassland);
vi) 10=exotic forest; or
vii) blank=undefined.

[7] * = wildcard, which means the given word is searched for but can contain any suffix from wildcard on.

Species that were recorded to occur in other environments, such as coastal or urban, were not included in the analysis. In some cases the habitat descriptions found within the literature related to only a few individuals and therefore this habitat classification may not reflect the full ecology of the species. Where no habitat descriptions were available the species record was classed as "blank" and contained for further analysis.

Identifying Threat Status

The latest set of Threat Classification System Lists for terrestrial invertebrates from the 2008-2011 cycle were used to report on the Threat Status for any beetles (Leschen *et al*., 2012), spiders (Vink *et al*., 2012), butterflies and moths (Stringer *et al*., 2012) recorded as part of this study. Any name changes between the 2005 (Hitchmough *et al*., 2007) and 2008-2011 list versions were also taken into account during matching of species names.

Results

Overview of sources

The literature search returned 11 sources, which contained a range of records for beetle, butterfly and moth, as well as spider species:

i) Castle (1923): Provides an account of his sampling of Lepidoptera near Waipukurau, Hawke's Bay.
ii) Davies (1986): A checklist of Arthropod species for the Hawke's Bay region, including habitat categories for a number of species.
iii) Hamilton (1910): Provides an account of his sampling of Lepidoptera in bush near Morere, Hawke's Bay.
iv) Larochelle & Larivière (2001): Fauna of New Zealand publication on Carabidae (Coleoptera). Provides a catalogue of Carabidae in New Zealand.
v) McGuinness (2001): Publication by the Department of Conservation, which summarizes the conservation requirements of New Zealand's terrestrial invertebrates; contains some information on distribution ranges.
vi) Moeed & Meeds (1992): Outlines an invertebrate study in native forest and riparian bush about 50km NW of Napier. Relevant listed species belong to Lepidoptera and Coleoptera.
vii) NZAC (2013): Electronic tables for Carabidae and Curculionidae in New Zealand are provided through the Landcare Research website.
viii) Patrick (2000): A publication by the Department of Conservation on the conservation status of two species belonging to family Geometridae (Lepidoptera).
ix) Patrick & Dugdale (2000): A publication by the Department of Conservation on the conservation status of New Zealand Lepidoptera.
x) Vink (2002): Fauna of New Zealand publication on Pisauridae (Araneae). Provides a description of Pisauridae in New Zealand.
xi) Vink & Dupérré (2010): Fauna of New Zealand publication on Lycosidae (Araneae). Provides a description of Lycosidae in New Zealand.

Summarized by source the number of species records for each of the three Arthropod orders is given in Table XVI.1. The largest and most divers contribution to the number of species recorded by this study has been by Davies (1986). The majority of species recorded by this literature study were Lepidoptera, while only few species records were found for spiders.

Table XVI.1: Summary of number of species for each Arthropod order by source. Recorded species may be duplicated between sources.

Source	Order	Species count
Castle (1923)	Lepidoptera	68
Davies (1986)	Araneae	6
	Coleoptera	124
	Lepidoptera	355
Hamilton (1910)	Lepidoptera	28
Larochelle & Larivière (2001)	Coleoptera	78
McGuinness (2001)	Coleoptera	2
	Lepidoptera	2
Moeed & Meeds (1992)	Coleoptera	20
	Lepidoptera	2
NZAC (2013)	Coleoptera	61
Patrick (2000)	Lepidoptera	2
Patrick & Dugdale (2000)	Lepidoptera	6
Vink (2002)	Araneae	3
Vink & Dupérré (2010)	Araneae	1

Relevant species records (Coleoptera, Lepidoptera, Araneae)

The total number of species recorded from all sources that were sighted as part of this study was 645, of which 10 species belonged to the order of Araneae, while 211 and 424 species records were found for Coleoptera and Lepidoptera respectively. Details on all the species recorded from each source can be found in the Attachment "Species recorded from Hawke's Bay region by source and for selected habitat categories". The relative number of species records associated with any of the habitat categories is shown in Table XVI.2. Nearly all Lepidoptera species recorded were also associated with native shrub or forest; a similar spread can also be seen for the habitat associations of Coleoptera and Araneae. A large proportion of the sources collected invertebrate samples within or near native forest settings, which is reflected in the habitat association percentages. However, this also reveals a gap in the coverage of other habitats by this literature study.

Table XVI.2 Percentage of recorded species associated with a certain habitat category split by Arthropod order.

Order	Grassland	Native shrubland/forest	Wet	Montane	Exotic forest	Undefined
Araneae	40%	60%	40%	40%	40%	40%
Coleoptera	32%	67%	36%	30%	32%	29%
Lepidoptera	27%	97%	25%	25%	27%	25%
Total	29%	87%	29%	27%	29%	26%

Threatened species

Fourteen terrestrial invertebrate species listed in the latest Threat Classification System Lists were recorded to be potentially present within the Scheme area, or within the wider landscape surrounding the site by this literature study (Table XVI.3). Of these 13 species were Lepidoptera (including 6 At Risk species, and 3 Threatened species, as well as one Synonym of an At Risk species), and one Threatened species of Coleoptera. Three Lepidoptera species classed as Data Deficient were also included into this analysis. A summary of relevant distribution information for each Data Deficient, At Risk or Threatened species recorded is provided below.

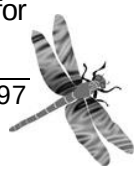
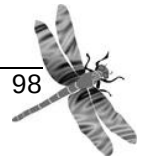


Table XVI.3 List of any terrestrial Arthropod species identified to be potentially present within the Scheme area, or within wider region and listed in the 2008-2011 Threat Classification System lists.

Order	Family	Species	Authority	**Source** (in relation to presence in Hawke's Bay region)	Umbrella Group	Threat Status
Coleoptera	Carabidae	*Mecodema atrox*	Britton	Davies (1986); McGuinness (2001); NZAC (2013)	Threatened	Nationally Endangered
Lepidoptera	Cosmopterigidae	*Pyroderces* sp. 'yellow' undescribed		Patrick & Dugdale (2000)		Data Deficient
Lepidoptera	Geometridae	*Asaphodes obarata*	(Felder)	Davies (1986)	Threatened	Nationally Vulnerable
Lepidoptera	Geometridae	*Asaphodes stinaria*	(Gueneé)	Davies (1986); Patrick & Dugdale (2000); McGuinness (2001); Patrick (2000)	Threatened	Nationally Vulnerable
Lepidoptera	Geometridae	*Austrocidaria lithurga*	(Meyrick)	Davies (1986)	At Risk	Naturally Uncommon
Lepidoptera	Geometridae	*Declana griseata*	Hudson	Davies (1986)	At Risk	Declining
Lepidoptera	Geometridae	*Hydriomena canescens*	Philpott	Davies (1986)		Synonym[8]
Lepidoptera	Geometridae	*Tatosoma agrionata*	(Walker)	Davies (1986)	At Risk	Declining
Lepidoptera	Geometridae	*Xanthorhoe bulbulata*	Gueneé	Patrick (2000)	Threatened	Nationally Critical
Lepidoptera	Noctuidae	*Meterana pictula*	White (in Taylor)	McGuinness (2001)	At Risk	Declining
Lepidoptera	Oecophoridae	*Coridomorpha stella*	Meyrick	Davies (1986)	At Risk	Relict
Lepidoptera	Oecophoridae	*Hierodoris sesioides*[9]	Hoare	Patrick & Dugdale (2000)		Data Deficient
Lepidoptera	Oecophoridae	*Izatha caustopa*	(Meyrick)	Davies (1986)		Data Deficient
Lepidoptera	Tortricidae	*Pyrgotis pyramidias*	Meyrick	Davies (1986)	At Risk	Naturally Uncommon

[8] Only taxonomically indeterminate in so far as the synonymy has not been confirmed. Regarded as synonymous with *Hydriomena clarkei*, which is classed as: At Risk, Declining.
[9] Listed as "*Hierodoris* 'clear wing', undescribed" in Patrick & Dugdale (2000).



Summary of relevant distribution information for At Risk, or Threatened species

Coleoptera

Mecodema atrox Records for the carabid beetle, *Mecodema atrox,* show that it has been collected from native bush near Puketitiri, Hawke's Bay (Little Bush reserve, about 60km NE of proposed water storage Scheme; McGuinness, 2001; NZAC, 2013). *Mecodema atrox* is a flightless carabid beetle, and can be found in wet native forest habitats, as well as exotic plantations (pine-eucalypt; Larochelle & Larivière, 2001); references in McGuinness (2001) state that *M. atrox* requires light, well-drained soil.

Lepidoptera

Asaphodes obarata The geometrid moth *Asaphodes obarata* is recorded in Davies (1973) as collected from Little Bush, a forest reserve near Puketitiri, Hawke's Bay (about 60km NE of the proposed water storage Scheme). However, *A. obarata* has not been listed in Patrick & Dugdale (2000) to occur in the Hawke's Bay region: Tongariro/Taupo, Nelson, Westland, Mid-Canterbury, Otago Lakes, Dunedin, Southland are listed as areas for *A. obarata*'s distribution range. The knowledge on the distribution and the ecology of this moth species are still patchy in parts, and the reasons behind its scarcity in samples over the last 50 years are not yet fully understood (Stringer et *al*., 2012). However, the latest Threat Status Classification System List (2008 - 2011) notes that six records for *A. obarata* have recently been made between Arthur's Pass to western Ureweras (R. A. Hitchmough, *pers. comm.*).

Asaphodes stinaria The geometrid moth *Asaphodes stinaria* has formerly been described as widespread by Hudson (1898), but since then has undergone a severe decline in its distribution and its population numbers Patrick (2000). A summary of records for *Asaphodes stinaria* is provided by Patrick (2000), who lists records from the Hawke's Bay region on at least two occasions:

1. Kaweka Range at 960m along the edge of beech forest (single specimen in 1964)

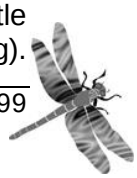
2. Little Bush near Puketitiri (about 60km NE of proposed water storage Scheme)

Davies (1986) lists the main habitat for *A. stinaria* as bush, while Patrick (2000) describes that in a New Zealand wide context this moth species has been collected from coastal localities, inland basins, as well as just above the tree line. Further, references within McGuinness (2001) state that *A. stinaria* may be a forest edge or grassland species. In Patrick & Dugdale (2000) the Hawke's Bay area is still listed as part of this moth's distribution range, however it is noted here that this species has not been sampled from the Hawke's Bay region recently.

Austrocidaria lithurga The geometrid moth, *Austrocidaria lithurga* is listed in Davies (1973) to have been found at Little Bush, Puketitiri (about 60km NE of proposed water storage Scheme), and is recorded in Davies' checklist (1986). Patrick & Dugdale (2000), however, lists the moth's known distribution areas as Wellington and Mid Canterbury.

Declana griseata The areas, from which *Declana griseata* was known, are listed as the Bay of Plenty, Taupo, as well as Southland in Patrick & Dugdale (2000). However, they note that the moth has not been recorded from the Bay of Plenty and Taupo area recently. This vanishing may be connected to its host, leafy Loranthaceae (one of the mistletoe families), having gone extinct in certain areas (Patrick & Dugdale, 1997). Records by Davies (1973) show that this moth had been collected on two occasions between 1965 and 1966 from Little Bush near Puketitiri (about 60km NE of proposed water storage Scheme).

Hydriomena canescens In Davies (1973) this species has been recorded from Little Bush near Puketitiri, however it is now regarded a synonym for *H. clarkei* (At Risk, Declining).



Patrick & Dugdale (2000) list *H. canescens* distribution range as Otago Lakes and Central Otago; and Dunedin, Otago Lakes and Central Otago for *H. clarkei*.

Tatosoma agrionata The geometrid moth, *Tatosoma agrionata,* uses a range of leafy Loranthacceae as host plants (Patrick & Dugdale, 1997). In Patrick & Dugdale (2000) its distribution ranges are listed as follows: from the Bay of Plenty south to Wellington, and from Nelson to Stewart Island. Davies (1973) records this species to have been collected from Little Bush reserve near Puketitiri (about 60km NE of proposed water storage Scheme).

Xanthorhoe bulbulata This geometrid moth has been found at coastal localities, inland basins, as well as above the tree line (Patrick, 2000). The only museum specimen of this species collected from the Hawke's Bay has no specific location information associated with it (Patrick 2000). Literature cited by Patrick (2000) describes *X. bulbulata* to be associated with open grassy areas across a range of altitudes, and was collected from both North and South Island.

Coridomorpha stella This moth species is only known from the North Island of New Zealand (Patrick & Dugdale, 2000): Auckland, Bay of Plenty Wellington are listed as areas for its distribution. However, Davies (1973) also collected *C. stella* from Little Bush (Puketitiri, Hawke's Bay). The latest Threat Classification System List (2008-2011) refers to *C. stella* as *Hierodoris stella* (Meyrick, 1914).

Izatha caustopa In the latest Threat Classification System List (2008-2011) *Izatha caustopa* is classed as Data Deficient. Historical records show that the species has previously been collected from the Hawke's Bay region without specifying sampling location further (Davies, 1986).

Pyrgotis pyramidias Davies (1973) collected this species from Little Bush near Puketitiri, and Patrick & Dugdale (2000) described its distribution range from the Bay of Plenty to Southland.

Hierodoris sesioides Patrick & Dugdale (2000) list this species as "*Hierodoris* 'clear wing', undescribed", but it has subsequently been described as *Hierodoris sesioides* (Hoare, 2005). The species is known from only one specimen (Patrick & Dugdale, 2000) that was sampled from Esk Forest, Maungaharuru Range, Hawke's Bay (about 70km NE from proposed water storage Scheme).

***Pyroderces* sp. 'yellow'** undescribed This moth species is listed in Patrick & Dugdale (2000) to be present within the Hawke's Bay area. Currently this species is only known from Esk Forest, Maungaharuru Range, Hawke's Bay (about 70km NE from proposed water storage Scheme).

Meterana pictula The noctuid moth, *Meterana pictula*, has been collected from Little Bush near Puketitiri, Hawke's Bay (McGuinness, 2001), while Patrick & Dugdale (2000) list the species to be present in the Bay of Plenty, Tongariro/Taupo, Wellington, Nelson and Fjordland areas. It can be found in coastal, montane, and alpine shrublands in the North Island, but is restricted to coastal habitats in the South Island (McGuinness, 2001).

Concluding Remarks

The literature study identified a number of Data Deficient, At Risk and Threatened species that could be encountered within the Scheme area, or within the wider region. These species mainly belonged to the order Lepidoptera, with one species belonging to the order Coleoptera. Based on the source descriptions the main habitat for all Data Deficient, At Risk or Threatened species was identified as native shrubland or forest, with one exception. The Threatened moth *X. bulbulata* is thought to be a forest edge or grassland species. *Xanthorhoe bulbulata*, however, has not been

sighted within the last 20 years, and only twice in the last 70 years (Stringer *et al*., 2012), and there is the possibility that this species is Extinct (Patrick, 2000).

As described in Seldon & Leschen (2011) lowland forest habitat for *Mecodema atrox* on the Volcanic Plateau, as well as in the East of the North Island has been reduced from its original extent. In addition to habitat reduction, *M. atrox* faces the threat of being preyed on by rodents due to its relatively large size and flightlessness (Leschen *et al*., 2012). The terrestrial ecology report (TER, 2013) has identified 80.72ha of mature and secondary indigenous forest that would be affected by the proposed reservoir and dam, and which may potentially provide suitable habitat for *M. atrox*.

Stringer *et al*. (2012) state that only two of New Zealand's At Risk or Threatened moth species are pure forest dwellers, and none of these have been recorded from the Hawke's Bay region. The majority of New Zealand's At Risk or Threatened moth species are associated with non-forest habitats (Patrick & Dugdale, 2000), such as coastal margins, shrublands, river flats and terraces, dry herb field/grassland, wetlands, alpine, tall hardwood shrubland (Stringer *et al*., 2012). The area affected by the proposed dam and reservoir cover 22.71ha of secondary indigenous shrub, and 5.11ha of wetland (TER, 2013); both of these cover types, as well as the surrounding elevated river terraces and forest edge habitats may potentially provide suitable habitat for At Risk, or Threatened moth species. The species records found during this study are slightly biased towards shrubland/forest habitat, as these were the environments sources concentrated their sampling on. Investigations into the invertebrate diversity of the Tukituki and Karamu catchments by Ward (2011) indicated a high diversity of Lepidoptera associated with tussock grasslands in the Tukituki catchment area. None of the invertebrate species explicitly mentioned in Ward (2011; see Tables IX.5 and IX.6 in Appendix IX of TER, 2013) were listed on the latest threat classification list (Stringer *et al*., 2012), though.

For a number of the Data Deficient, At Risk, or Threatened species recorded by this study the distribution information from the relevant sources is conflicting in parts. These species are *A. obarata* (Threatened), *A. stinaria* (Threatened), *A. lithurga* (At Risk), *D. griseata* (At Risk), *H. canescens* (Synonym of At Risk species), and *C. stella* (At Risk). While presence was confirmed by some sources, these species may not be found within the Hawke's Bay region. Two moth species (both Data Deficient), *H. sesioides* and *Pyroderces* sp. 'yellow', are only known from Esk Forest Maungaharuru Range, Hawke's Bay (about 70km NE from proposed water storage Scheme). A number of New Zealand's At Risk, or Threatened moth species are associated to habitats of only small extent (Patrick *et al*., 2010), which could mean that these two species do not occur within the Scheme area.

Based on the results of this literature study and the above considerations the primary list for Data Deficient, At Risk, or Threatened beetle and moth species that could potentially be encountered within the Scheme area, or wider region, includes the Threatened species of *M. atrox* (Coleoptera), the At Risk species of *T. agrionata* (Lepidoptera), *M. pictula* (Lepidoptera) and *P. pyramidias* (Lepidoptera), as well as the Data Deficient species of *I. caustopa* (Lepidoptera).

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[10] The later checklist by Davies (1986) includes all records listed in this source, therefore no separate source table has been created for this reference.

[11] No source table has been created from this reference as all information relevant to recent distribution, conservation status is contained in Davies (1986), Patrick & Dugdale (2000), Stringer et *al.* (2012).

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Attachement Species recorded from Hawke's Bay region by source and for selected habitat categories

Table XVI.5 Castle (1923): Habitat (as defined in source): 1=grassland; 2= bush/forest; 6=wet; 7=parasite; 9=mountain; 10=exotic forest; blank=undefined. A blank Umbrella Group or Threat Status indicates that species has not been listed on the 2008-2011 Threat Classification System Lists, or has been listed as Not Threatened on one of the relevant lists.

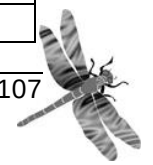
Species	Order	Family	Authority	Habitat	Umbrella Group	Threat Status
Heliothis armigera	Lepidoptera	Noctuidae	(Hübner)			
Euxoa admirationis	Lepidoptera	Noctuidae	(Guenee)			
Agrotis ypsilon	Lepidoptera	Noctuidae	Ochsenheimer			
Aletia unipuncta	Lepidoptera	Noctuidae	Haworth			
Aletia sminthistis	Lepidoptera	Noctuidae	Hampson			
Dipaustica epiastra	Lepidoptera	Noctuidae	(Meyrick)			
Physetica caerulea	Lepidoptera	Noctuidae	(Guenee)			
Persectania disjungens	Lepidoptera	Noctuidae	Walker			
Melanchra insignis	Lepidoptera	Noctuidae	Walker			
Melanchra coeleno	Lepidoptera	Noctuidae	Hudson			
Melanchra omoplaca	Lepidoptera	Noctuidae	Meyer			
Melanchra mollis	Lepidoptera	Noctuidae	Howes			
Ariathisa comma	Lepidoptera	Noctuidae	Walker			
Cosmodes elegans	Lepidoptera	Noctuidae	(Donovan)			
Elvia glaucata	Lepidoptera	Geometridae	Walker			
Phrissogonus laticostatus	Lepidoptera	Geometridae	(Walker)			
Phrissogonus denotatus	Lepidoptera	Geometridae	Meyrick			
Chloroclystis dryas	Lepidoptera	Geometridae	Meyrick			
Chloroclystis maculata	Lepidoptera	Geometridae	Meyrick			
Hydriomena deltoidata	Lepidoptera	Geometridae	(Walker)			
Hydriomena similata	Lepidoptera	Geometridae				
Hydriomena subochraria	Lepidoptera	Geometridae				

Asthena purpureata	Lepidoptera	Geometridae				
Asthena fulchraria	Lepidoptera	Geometridae				
Venusia verriculata	Lepidoptera	Geometridae	Hudson			
Asaphodes megaspilata	Lepidoptera	Geometridae	Walker			
Xanthorhoe rosearia	Lepidoptera	Geometridae	Doubleday			
Xanthorhoe venipunctata	Lepidoptera	Geometridae	Walker			
Xanthorhoe cinerearia	Lepidoptera	Geometridae	Meyrick			
Xanthorhoe rubropunctaria	Lepidoptera	Geometridae				
Xanthorhoe beata	Lepidoptera	Geometridae	Butler			
Xanthorhoe aegrota	Lepidoptera	Geometridae	Butler			
Epirranthis hemipteraria	Lepidoptera	Geometridae	Guenee			
Leptomeris rubraria	Lepidoptera	Geometridae	Doubleday			
Hibernia indocilis	Lepidoptera	Geometridae	Meyrick			
Declana junctilinea	Lepidoptera	Geometridae	(Walker)			
Declana atronivea	Lepidoptera	Geometridae	(Walker)			
Hepialus virescens	Lepidoptera	Hepialidae	Doubleday			
Porina despecta	Lepidoptera	Hepialidae	Meyrick			
Porina umbraculata	Lepidoptera	Hepialidae	Guenee			
Porina signata	Lepidoptera	Hepialidae	Walker			
Porina cervinata	Lepidoptera	Hepialidae	Butler			
Tortrix postvittana	Lepidoptera	Tortricidae	(Walker)			
Tortrix excessana	Lepidoptera	Tortricidae	(Walker)			
Cnephasia jactatana	Lepidoptera	Tortricidae	Walker			
Crocydopora cinigerella	Lepidoptera	Pyralidae	Walker			
Crambus angustipennis	Lepidoptera	Crambidae	Zeller			
Crambus flexuosellus	Lepidoptera	Crambidae	Doubleday			

Crambus vitellus	Lepidoptera	Crambidae	Doubleday			
Diptychophora pyrsophanes	Lepidoptera	Crambidae	Meyrick			
Gadira acerella	Lepidoptera	Crambidae	Walker			
Nymphula nitens	Lepidoptera	Crambidae	Butler			
Diasemia grammalis	Lepidoptera	Crambidae	Doubleday			
Mecyna flavidalis	Lepidoptera	Crambidae	(Doubleday)			
Scoparia philerga	Lepidoptera	Crambidae	Meyrick			
Scoparia leptalea	Lepidoptera	Crambidae	Meyrick			
Scoparia rotuella	Lepidoptera	Crambidae	Felder & Rogenhofer			
Scoparia aspidota	Lepidoptera	Crambidae	(Meyrick)			
Scoparia cataxesta	Lepidoptera	Crambidae	Meyrick			
Scoparia petrina	Lepidoptera	Crambidae	(Meyrick)			
Scoparia submarginalis	Lepidoptera	Crambidae	Walker			
Scoparia indistinctalis	Lepidoptera	Crambidae	Walker			
Scoparia sabulosella	Lepidoptera	Crambidae	(Walker)			
Platyptilia falcatalis	Lepidoptera	Pterophoridae	Walker			
Platyptilia heliastes	Lepidoptera	Pterophoridae				
Alucita innotatalis	Lepidoptera	Pterophoridae	Walker			
Izatha picarella	Lepidoptera	Oecophoridae	(Walker)			
Monopis ethella	Lepidoptera	Tineidae	Newman			

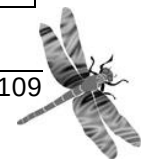
Table XVI.6 Davies (1986): Habitat (as defined in source): 1=grassland; 2= bush/forest; 6=wet; 7=parasite; 9=mountain; 10=exotic forest; blank=undefined. A blank Umbrella Group or Threat Status indicates that species has not been listed on the 2008-2011 Threat Classification System Lists, or has been listed as Not Threatened on one of the relevant lists.

Species	Order	Family	Authority	Habitat	Umbrella Group	Threat Status
Hexathele hochstetteri	Araneae	Dipluridae	Ausserer	2		
Porrothele	Araneae	Dipluridae				
Dysdera crocata	Araneae	Dysderidae	Koch	2		
Dolomedes	Araneae	Pisauridae				
Diaea	Araneae	Thomsidiae				



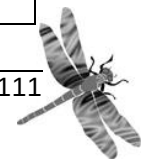
Sidymella	Araneae	Thomsidiae				
Cacephatus inornatus	Coleoptera	Anthribidae	(Sharp)	2		
Hoherius meinertzhageni	Coleoptera	Anthribidae	(Broun)			
Hoplorhaphus spinifer	Coleoptera	Anthribidae	(Sharp)	2		
Liromus pardalis	Coleoptera	Anthribidae	(Pascoe)	2		
Notochoragus crassus	Coleoptera	Anthribidae	(Sharp)	2		
Phymatus phymatodes	Coleoptera	Anthribidae	(Redtenbacher)	2		
Sharpius brouni	Coleoptera	Anthribidae	(Sharp)	2		
Apion ulicis	Coleoptera	Apionidae	(Forster)	1		
Ascalles sp	Coleoptera	Apionidae				
Agathinus tridens	Coleoptera	Belidae	Fabricius	2		
Lasiorrhynchus barbicornis	Coleoptera	Brenthidae	(Fabricius)	2		
Nascioides enysi	Coleoptera	Buprestidae	(Sharp)	2		
Anomotarus variegatus	Coleoptera	Carabidae	Moore			
Bembidion anchonoderus	Coleoptera	Carabidae	Bates			
Bembidion brullei	Coleoptera	Carabidae	Gemminger & Harold			
Bembidion callipeplum	Coleoptera	Carabidae	Bates			
Bembidion charile	Coleoptera	Carabidae	Bates			
Bembidion dehiscens	Coleoptera	Carabidae	Broun			
Bembidion granuliferum	Coleoptera	Carabidae	Lindroth			
Bembidion maorinum	Coleoptera	Carabidae	Bates			
Bembidion musae	Coleoptera	Carabidae	Broun			
Bembidion rotundicolle eustictum	Coleoptera	Carabidae	Bates			
Bembidion tairuense	Coleoptera	Carabidae	Bates			

Bembidion tekapoense	Coleoptera	Carabidae	Broun			
Holcaspis australis	Coleoptera	Carabidae	Broun			
Holcaspis mucronata	Coleoptera	Carabidae	Broun			
Hypharpax abstrusus	Coleoptera	Carabidae	Bates			
Mecodema atrox	**Coleoptera**	**Carabidae**	**Britton**		**Threatened**	**Nationally Endangered**
Mecodema dux	Coleoptera	Carabidae	Britton			
Neocicindela parryi	Coleoptera	Carabidae	(White)	2		
Rhytisternus miser	Coleoptera	Carabidae	(Chaudoir)	6		
Arhopalus ferus	Coleoptera	Cerambycidae	(Mulsant)			
Eurychaena fragilis	Coleoptera	Cerambycidae	(Bates)			
Hypolasius crista	Coleoptera	Cerambycidae	(Fabricius)			
Hypolasius fasciatus	Coleoptera	Cerambycidae	Broun			
Hypolasius rufescens	Coleoptera	Cerambycidae	Broun	2		
Hypolasius viridescens	Coleoptera	Cerambycidae	(Bates)	2		
Liogramma zelandicum	Coleoptera	Cerambycidae	Blanchard	2		
Navomorpha lineatum	Coleoptera	Cerambycidae	Fabricius	2		
Navomorpha stictum	Coleoptera	Cerambycidae	Broun	2		
Navomorpha sulcatum	Coleoptera	Cerambycidae	Fabricius	2		
Ophryqps pallidus	Coleoptera	Cerambycidae	White	2		
Phoracantha semipunctata	Coleoptera	Cerambycidae	(Fabricius)			
Poecilippe medialis	Coleoptera	Cerambycidae	Sharp	2		
Poecilippe stictica	Coleoptera	Cerambycidae	Bates	2		
Polyacanthia flavipes	Coleoptera	Cerambycidae	(White)	2		
Somatidia antarctica	Coleoptera	Cerambycidae	(White)	2		
Stenellipsis maculipennis	Coleoptera	Cerambycidae	(Breuning)	2		
Stenoptes pallidus	Coleoptera	Cerambycidae	(Pascoe)	2		



Tetrorea cilipes	Coleoptera	Cerambycidae	White	2		
Wakefieldia vittata	Coleoptera	Cerambycidae	(Broun)	2		
Xylotoles griseus	Coleoptera	Cerambycidae	Westwood	2		
Xylotoles humeratus	Coleoptera	Cerambycidae	Bates	2		
Xylotoles laetus	Coleoptera	Cerambycidae	White	2		
Xylotoles nanus	Coleoptera	Cerambycidae	Bates	2		
Xylotoles nudus	Coleoptera	Cerambycidae	Bates	2		
Zorion minutum	Coleoptera	Cerambycidae	(Fabricius)	2		
Ecolapsis sculptus	Coleoptera	Chrysomelidae	Broun	2		
Inopelonia testacea	Coleoptera	Chrysomelidae	Broun	1		
Paupris aptera	Coleoptera	Cleridae	Sharp	2		
Scymnus minutulus	Coleoptera	Coccinelidae	Broun	6		
Catoptes binodus	Coleoptera	Curculionidae	(White)			
Desiantha diversipes lineata	Coleoptera	Curculionidae	(Pascoe)			
Desiantha maculata	Coleoptera	Curculionidae	(Blackburn)			
Desiantha variabilis	Coleoptera	Curculionidae	(Broun)			
Hylurgus ligniperda	Coleoptera	Curculionidae	(Fabricius)			
Irenimus compressus	Coleoptera	Curculionidae	(Broun)			
Listroderes delaiguei	Coleoptera	Curculionidae	Germain	1		
Listroderes obliquus	Coleoptera	Curculionidae	Klug	2		
Oropterus coniger	Coleoptera	Curculionidae	White	2		
Otiorhynchus rugosostriatus	Coleoptera	Curculionidae	(Goeze)			
Scolopterus aequus	Coleoptera	Curculionidae	Broun	2		
Scolopterus penicillatus	Coleoptera	Curculionidae	White	2		
Antiporus strigosulus	Coleoptera	Dytiscidae	(Broun)	6		
Antiporus wakefieldi	Coleoptera	Dytiscidae	(Sharp)			
Homoeodytes hookeri	Coleoptera	Dytiscidae	(White)			
Hyphydrus elegans	Coleoptera	Dytiscidae	(Montrouzier)	6		
Lancetes lanceolatus	Coleoptera	Dytiscidae	(Clark)	6		

Liodessus deflectus	Coleoptera	Dytiscidae	Ordish	6		
Liodessus plicatus	Coleoptera	Dytiscidae	(Sharp)	6		
Rhantus pulverosus	Coleoptera	Dytiscidae	(Stephens)	6		
Geramus linecollis	Coleoptera	Elateridae	White	2		
Metablax acutipennis	Coleoptera	Elateridae	(White)	2		
Thoramus wakefieldi	Coleoptera	Elateridae	Sharp	2		
Sternaulax zealandicus	Coleoptera	Histeridae	Marseul	2		
Cercyon analis	Coleoptera	Hydrophilidae	(Paykull)	6		
Enochrus tritus	Coleoptera	Hydrophilidae	Broun	6		
Limnoxenus zelandicus	Coleoptera	Hydrophilidae	Broun	6		
Aridius bifasciatus	Coleoptera	Latridiidae	(Reitter)			
Melanophthalma gibbosa	Coleoptera	Latridiidae	Herbs	1		
Ceratognathus irroratus	Coleoptera	Lucanidae	(Parry)	2		
Dendroblax earlii	Coleoptera	Lucanidae	White	2		
Lissotes reticulatus	Coleoptera	Lucanidae	(Westwood)	2		
Metriorhynchus erraticus	Coleoptera	Lycidae	Broun			
Baculipalpus mollis	Coleoptera	Oedemeridae	(Broun)			
Baculipalpus rarus	Coleoptera	Oedemeridae	Broun			
Baculipalpus stringipennis	Coleoptera	Oedemeridae	(White)			
Koniaphassa obscura	Coleoptera	Oedemeridae	(Broun)			
Parisopalpus thoracicus	Coleoptera	Oedemeridae	(Broun)			
Selenopalpus cyaneus	Coleoptera	Oedemeridae	(Fabricius)			
Thelyphassa nemoralis	Coleoptera	Oedemeridae	(Broun)			
Rhysodes aterrimus	Coleoptera	Rhysodidae	Broun	2		
Chlorochiton longicornis	Coleoptera	Scarabaeidae	(Arrow)	2		



Chlorochiton suturalis	Coleoptera	Scarabaeidae	(Fabricius)	2		
Costelytra macrobruneum	Coleoptera	Scarabaeidae	Given	2		
Costelytra zealandica	Coleoptera	Scarabaeidae	(White)	1		
Heteronychus arator	Coleoptera	Scarabaeidae	(Fabricius)	2		
Odontria autumnalis	Coleoptera	Scarabaeidae	Given	2		
Odontria magnum	Coleoptera	Scarabaeidae	Given	2		
Odontria marmorata	Coleoptera	Scarabaeidae	Broun	2		
Odontria piciceps	Coleoptera	Scarabaeidae	(Broun)	2		
Odontria smithii	Coleoptera	Scarabaeidae	Broun	2		
Odontria syvatica	Coleoptera	Scarabaeidae	Broun	2		
Odontria velutinum	Coleoptera	Scarabaeidae	Given	2		
Odontria xanthosticta	Coleoptera	Scarabaeidae	White	2		
Pyronota festiva	Coleoptera	Scarabaeidae	Fabricius	2		
Sericospilus aenealus	Coleoptera	Scarabaeidae	(Broun)S	1		
Sericospilus truncatus	Coleoptera	Scarabaeidae	Given	2		
Atheta spp	Coleoptera	Staphylinidae				
Necrophilus prolongatus	Coleoptera	Staphylinidae	Sharp	2		
Xantholinus anthracinus	Coleoptera	Staphylinidae	Broun	2		
Chaerodes trachyscelides	Coleoptera	Tenebrionidae	White			
Cilibe otagensis	Coleoptera	Tenebrionidae	Bates			
Uloma tenebrionoides	Coleoptera	Tenebrionidae	White	2		
Nyctemera annulata	Lepidoptera	Arctiidae	(Boisduval)			
Batrachedra agaura	Lepidoptera	Batrachedridae	Meyrick	2		
Batrachedra filicicola	Lepidoptera	Batrachedridae	Meyrick	2		
Carposina charaxias	Lepidoptera	Carposinidae	Meyrick	2		

Carposina eriphylla	Lepidoptera	Carposinidae	Meyrick	2		
Carposina exochana	Lepidoptera	Carposinidae	Meyrick	2		
Carposina gonosemana	Lepidoptera	Carposinidae	Meyrick	2		
Carposina iophaea	Lepidoptera	Carposinidae	Walker	2		
Carposina thalamota	Lepidoptera	Carposinidae	Meyrick	2		
Asterivora colpota	Lepidoptera	Choreutidae	Meyrick	1		
Asterivora combinata	Lepidoptera	Choreutidae	(Walker)	2		
Tebenna bradieyi	Lepidoptera	Choreutidae	Clarke	1		
Batrachedra psathyra	Lepidoptera	Coleophoridae	Meyrick	2		
Coleophora alcyonipennella	Lepidoptera	Coleophoridae	Haworth	1		
Coleophora spissicornis	Lepidoptera	Coleophoridae	Haworth	1		
Phycomorpha metachrysa	Lepidoptera	Copromorphidae	Meyrick	2		
Zapyrasta calliphana	Lepidoptera	Cosmopterigidae	Meyrick	2		
Antiscopa epicomia	Lepidoptera	Crambidae	(Meyrick)	2		
Diasemia grammalis	Lepidoptera	Crambidae	Doubleday			
Gadira acerella	Lepidoptera	Crambidae	(Walker)	2		
Mecyna adversa	Lepidoptera	Crambidae	Philpott	2		
Mecyna daiclealis	Lepidoptera	Crambidae	(Walker)	2		
Mecyna flavidalis	Lepidoptera	Crambidae	(Doubleday)	2		
Mecyna marmarina	Lepidoptera	Crambidae	(Meyrick)	2		
Musotima adunctalis	Lepidoptera	Crambidae	(Felder)	2		
Musotima nitidalis	Lepidoptera	Crambidae	(Walker)	2		
Nymphula nitens	Lepidoptera	Crambidae	(Butler)	6		
Orocrambus apicellus	Lepidoptera	Crambidae	(Meyrick)	1		
Orocrambus augustipennis	Lepidoptera	Crambidae	(Zeller)	1		
Orocrambus cyclopicus	Lepidoptera	Crambidae	(Meyrick)	1		

Orocrambus encophoras	Lepidoptera	Crambidae	(Meyrick)	2		
Orocrambus siriellus	Lepidoptera	Crambidae	(Meyrick)	2		
Pareromene auriscriptella	Lepidoptera	Crambidae	(Meyrick)	2		
Pareromene elaina	Lepidoptera	Crambidae	(Meyrick)	2		
Pareromene harmonica	Lepidoptera	Crambidae	(Meyrick)	2		
Pareromene lepidella	Lepidoptera	Crambidae	(Walker)	2		
Pareromene metallifera	Lepidoptera	Crambidae	(Butler)	2		
Pareromene pyrsophanes	Lepidoptera	Crambidae	(Meyrick)	2		
Pareromene selenae	Lepidoptera	Crambidae	(Meyrick)	2		
Scoparia animosa	Lepidoptera	Crambidae	Meyrick	2		
Scoparia aspidota	Lepidoptera	Crambidae	(Meyrick)	2		
Scoparia asterisca	Lepidoptera	Crambidae	(Meyrick)	2		
Scoparia autochroa	Lepidoptera	Crambidae	Meyrick	2		
Scoparia autumna	Lepidoptera	Crambidae	Philpott	2		
Scoparia bisinualis	Lepidoptera	Crambidae	Hudson	2		
Scoparia cataxesta	Lepidoptera	Crambidae	Meyrick	2		
Scoparia chalicodes	Lepidoptera	Crambidae	Meyrick	2		
Scoparia character	Lepidoptera	Crambidae	Meyrick	2		
Scoparia chimeria	Lepidoptera	Crambidae	Meyrick	2		
Scoparia chlamydota	Lepidoptera	Crambidae	Meyrick	2		
Scoparia colpota	Lepidoptera	Crambidae	Meyrick			
Scoparia cyameuta	Lepidoptera	Crambidae	(Meyrick)	2		
Scoparia cymatias	Lepidoptera	Crambidae	Meyrick	2		
Scoparia dinodes	Lepidoptera	Crambidae	Meyrick	2		
Scoparia diphtheralis	Lepidoptera	Crambidae	Walker	2		
Scoparia dryfactis	Lepidoptera	Crambidae	Meyrick	2		
Scoparia ergatis	Lepidoptera	Crambidae	Meyrick	2		

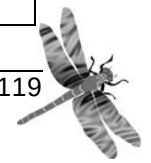
Scoparia feredayi	Lepidoptera	Crambidae	Knaggs	2		
Scoparia hemiplaca	Lepidoptera	Crambidae	Meyrick	2		
Scoparia indistinctalis	Lepidoptera	Crambidae	(Walker)	2		
Scoparia legnota	Lepidoptera	Crambidae	(Meyrick)	2		
Scoparia luminatrix	Lepidoptera	Crambidae	Meyrick	2		
Scoparia meliturga	Lepidoptera	Crambidae	Meyrick	2		
Scoparia minualis	Lepidoptera	Crambidae	Meyrick	2		
Scoparia minusculalis	Lepidoptera	Crambidae	Walker	2		
Scoparia pascoella	Lepidoptera	Crambidae	Philpott	2		
Scoparia periphanes	Lepidoptera	Crambidae	Meyrick	2		
Scoparia phalerias	Lepidoptera	Crambidae	Meyrick	2		
Scoparia pongalis	Lepidoptera	Crambidae	Felder	2		
Scoparia steropaea	Lepidoptera	Crambidae	Meyrick	2		
Scoparia trivirgata	Lepidoptera	Crambidae	(Meyrick)	9		
Scoparia zophochlaena	Lepidoptera	Crambidae	Meyrick	2		
Eutorna caryochroa	Lepidoptera	Elachistidae s.l.	Meyrick	2		
Eutorna symmorpha	Lepidoptera	Elachistidae s.l.	Meyrick	2		
Nymphostola galactina	Lepidoptera	Elachistidae s.l.	(Felder)	2		
Elachista archaeonoma	Lepidoptera	Elachistidae s.s.	Meyrick	2		
Anisoplaca achyrota	Lepidoptera	Gelechiidae	(Meyrick)	2		
Anisoplaca ptyoptera	Lepidoptera	Gelechiidae	Meyrick	2		
Aristotelia paradesma	Lepidoptera	Gelechiidae	(Meyrick)	2		
Gelechia aerobatis	Lepidoptera	Gelechiidae	Meyrick	2		
Gelechia monophragma	Lepidoptera	Gelechiidae	Meyrick	2		
Gelechia parvula	Lepidoptera	Gelechiidae	Philpott	2		
Sitotroga cerealella	Lepidoptera	Gelechiidae	(Olivier)			

Symmetroschema plaesiosema	Lepidoptera	Gelechiidae	Turner			
Thiotricha thorybodes	Lepidoptera	Gelechiidae	Meyrick			
Asaphodes aegrota	Lepidoptera	Geometridae	(Butler)	2		
Asaphodes chlamydota	Lepidoptera	Geometridae	(Meyrick)	2		
Asaphodes clarata	Lepidoptera	Geometridae	(Walker)	2		
Asaphodes megaspilata	Lepidoptera	Geometridae	(Walker)			
Asaphodes obarata	**Lepidoptera**	**Geometridae**	**(Felder)**	**2**	**Threatened**	**Nationally Vulnerable**
Asaphodes prasinias	Lepidoptera	Geometridae	(Meyrick)	2		
Asaphodes stinaria	**Lepidoptera**	**Geometridae**	**(Gueneé)**	**2**	**Threatened**	**Nationally Vulnerable**
Asthena pulchraria	Lepidoptera	Geometridae	(Doubleday)			
Asthena subpurpureata	Lepidoptera	Geometridae	Walker			
Austrocidaria callichlora	Lepidoptera	Geometridae	(Butler)	2		
Austrocidaria lithurga	**Lepidoptera**	**Geometridae**	**(Meyrick)**	**2**	**At Risk**	**Naturally Uncommon**
Austrocidaria similata	Lepidoptera	Geometridae	(Walker)	2		
Chloroclystis nereis	Lepidoptera	Geometridae	(Meyrick)	2		
Chloroclystis semialbata	Lepidoptera	Geometridae	(Walker)	2		
Cleora scriptaria	Lepidoptera	Geometridae	(Walker)	2		
Declana atronivea	Lepidoptera	Geometridae	(Walker)	2		
Declana griseata	**Lepidoptera**	**Geometridae**	**Hudson**	**2**	**At Risk**	**Declining**
Declana hermione	Lepidoptera	Geometridae	(Hudson)	2		
Declana junctilinea	Lepidoptera	Geometridae	Walker	2		
Declana leptomera	Lepidoptera	Geometridae	(Walker)	2		
Epicyme rubropunctaria	Lepidoptera	Geometridae	(Doubleday)	2		
Epiphryne undosata	Lepidoptera	Geometridae	(Felder)	2		

Epiphryne verriculata	Lepidoptera	Geometridae	(Felder)	2		
Epirranthis alectoraria	Lepidoptera	Geometridae	(Walker)	2		
Epirranthis ustaria	Lepidoptera	Geometridae	(Walker)			
Eucymatoge anguligera	Lepidoptera	Geometridae	(Butler)	2		
Eucymatoge gobiata	Lepidoptera	Geometridae	(Felder)	2		
Gargaphia muriferata	Lepidoptera	Geometridae	Walker	2		
Gellonia dejectaria	Lepidoptera	Geometridae	(Walker)	2		
Helastia cineraria	Lepidoptera	Geometridae	(Doubleday)	2		
Helastia lucidata	Lepidoptera	Geometridae	(Walker)	2		
Helastia practica	Lepidoptera	Geometridae	(Meyrick)	2		
Homodotis megaspilata	Lepidoptera	Geometridae	(Walker)	2		
Hydriomena arida	Lepidoptera	Geometridae	(Butler)	2		
Hydriomena canescens	**Lepidoptera**	**Geometridae**	**Philpott**	**2**		**Synonym**
Hydriomena deltoidata	Lepidoptera	Geometridae	(Walker)	2		
Hydriomena rixata	Lepidoptera	Geometridae	(Felder)	2		
Hydriomena similata	Lepidoptera	Geometridae	(Walker)			
Hydriomena subochraria	Lepidoptera	Geometridae	(Doubleday)			
Ischalis fortinata	Lepidoptera	Geometridae	(Guenee)	2		
Ischalis gallaria	Lepidoptera	Geometridae	(Walker)	2		
Ischalis nelsonaria	Lepidoptera	Geometridae	(Felder)	2		
Ischalis variabilis	Lepidoptera	Geometridae	(Warren)	2		
Lythria peronata	Lepidoptera	Geometridae	(Walker)	2		
Microdes epicryptis	Lepidoptera	Geometridae	Meyrick	2		
Microdes quadristrigata	Lepidoptera	Geometridae	(Walker)	2		
Noteras brephos	Lepidoptera	Geometridae	(Walker)	2		
Orthoclydon praefectata	Lepidoptera	Geometridae	(Walker)	2		

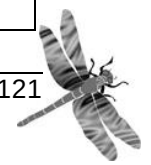
Paradetis porphyrias	Lepidoptera	Geometridae	(Meyrick)	2		
Pasiphila dryas	Lepidoptera	Geometridae	(Meyrick)	2		
Pasiphila fumipalpata	Lepidoptera	Geometridae	(Felder)	2		
Pasiphila lacustris	Lepidoptera	Geometridae	(Meyrick)	2		
Pasiphila lunata	Lepidoptera	Geometridae	(Philpott)	2		
Pasiphila mucosata	Lepidoptera	Geometridae	(Walker)	2		
Pasiphila nereus	Lepidoptera	Geometridae	(Meyrick)	2		
Pasiphila paralodes	Lepidoptera	Geometridae	(Meyrick)	2		
Pasiphila sandycias	Lepidoptera	Geometridae	(Meyrick)	2		
Pasiphila sphragitis	Lepidoptera	Geometridae	(Meyrick)	2		
Pasiphila subpurpureata	Lepidoptera	Geometridae	(Walker)	2		
Pasiphila testulatus	Lepidoptera	Geometridae	(Guenee)	2		
Poecilasthena pulchraria	Lepidoptera	Geometridae	(Doubleday)	2		
Samana falcatella	Lepidoptera	Geometridae	Walker	2		
Selidosema albifasciata	Lepidoptera	Geometridae	Philpott	2		
Selidosema aristarcha	Lepidoptera	Geometridae	Meyrick	2		
Selidosema dejectaria	Lepidoptera	Geometridae	(Walker)	2		
Selidosema fascialata	Lepidoptera	Geometridae	(Philpott)	2		
Selidosema fenerata	Lepidoptera	Geometridae	(Felder)	2		
Selidosema flava	Lepidoptera	Geometridae	Warren	2		
Selidosema indistincta	Lepidoptera	Geometridae	(Butler)	2		
Selidosema insignita	Lepidoptera	Geometridae	Philpott	2		
Selidosema leucelaea	Lepidoptera	Geometridae	Meyrick	2		
Selidosema panagrata	Lepidoptera	Geometridae	(Walker)			
Selidosema pelurgata	Lepidoptera	Geometridae	(Walker)			

Selidosema pergata	Lepidoptera	Geometridae	Philpott	2		
Selidosema productata	Lepidoptera	Geometridae	(Walker)	2		
Selidosema prototoxa	Lepidoptera	Geometridae	Meyrick	2		
Sestra flexata	Lepidoptera	Geometridae	(Walker)	2		
Tatosoma agrionata	**Lepidoptera**	**Geometridae**	**(Walker)**	**2**	**At Risk**	**Declining**
Tatosoma apicipallida	Lepidoptera	Geometridae	Prout	2		
Tatosoma lestevata	Lepidoptera	Geometridae	(Walker)	2		
Tatosoma timora	Lepidoptera	Geometridae	(Meyrick)	2		
Tatosoma tipulata	Lepidoptera	Geometridae	(Walker)	2		
Tatosoma topia	Lepidoptera	Geometridae	(Hudson)	2		
Venusia undosata	Lepidoptera	Geometridae	(Felder)			
Venusia verriculata	Lepidoptera	Geometridae	(Felder)			
Xanthorhoe adonis	Lepidoptera	Geometridae	Hudson			
Xanthorhoe aegrota	Lepidoptera	Geometridae	(Butler)			
Xanthorhoe beata	Lepidoptera	Geometridae	(Butler)			
Xanthorhoe benedicta	Lepidoptera	Geometridae	Meyrick			
Xanthorhoe chlamydota	Lepidoptera	Geometridae	Meyrick			
Xanthorhoe clarata	Lepidoptera	Geometridae	(Walker)			
Xanthorhoe cymozeucta	Lepidoptera	Geometridae	Meyrick)			
Xanthorhoe obarata	Lepidoptera	Geometridae	(Felder)			
Xanthorhoe practica	Lepidoptera	Geometridae	Meyrick			
Xanthorhoe prasinias	Lepidoptera	Geometridae	(Meyrick)			
Xanthorhoe semisignata	Lepidoptera	Geometridae	(Warren)			
Xanthorhoe stinaria	Lepidoptera	Geometridae	(Gueneé)			
Xanthorhoe venipunctata	Lepidoptera	Geometridae	(Walker)			
Glyphipteryx achyloessa	Lepidoptera	Glyphipterigidae	(Meyrick)	2		



Glyphipteryx asteronota	Lepidoptera	Glyphipterigidae	Meyrick	2		
Glyphipteryx oxymachaera	Lepidoptera	Glyphipterigidae	(Meyrick)	2		
Glyphipteryx transversella	Lepidoptera	Glyphipterigidae	(Walker)	2		
Glyphipteryx zelota	Lepidoptera	Glyphipterigidae	Meyrick	2		
Gracilaria chalcodelta	Lepidoptera	Gracillardiidae	Meyrick	2		
Gracilaria linearis	Lepidoptera	Gracillardiidae	Butler	2		
Parectopa aellomacha	Lepidoptera	Gracillardiidae	(Meyrick)	2		
Aenetus virescens	Lepidoptera	Hepialidae	(Doubleday)	2		
Trioxycanus enysii	Lepidoptera	Hepialidae	Butler			
Compsistis bifaciella	Lepidoptera	Lecithoceridae	(Walker)	2		
Lecithocera micromela	Lepidoptera	Lecithoceridae	Low	2		
Lecithocera micromela	Lepidoptera	Lecithoceridae	Low	2		
Lycaena feredayi	Lepidoptera	Lycaenidae	(Bates)	2		
Micropardalis doroxena	Lepidoptera	Micropterigidae	Meyrick	2		
Sabatinca chalcophanes	Lepidoptera	Micropterigidae	(Walker)	2		
Sabatinca demissa	Lepidoptera	Micropterigidae	Philpott	2		
Sabatinca ianthina	Lepidoptera	Micropterigidae	Philpott	2		
Sabatinca zonodoxa	Lepidoptera	Micropterigidae	Meyrick	2		
Mnesarchaea loxoscia	Lepidoptera	Mnesarchaeidae	Meyrick	2		
Achaea janata	Lepidoptera	Noctuidae	(Linnaeus)			
Agrotis spina	Lepidoptera	Noctuidae	Guenee			
Aletia fibrata	Lepidoptera	Noctuidae	Meyrick	2		
Ariathisa comma	Lepidoptera	Noctuidae	(Walker)	2		
Austramathes purpurea	Lepidoptera	Noctuidae	Butler	2		
Bityla defigurata	Lepidoptera	Noctuidae	(Walker)	2		

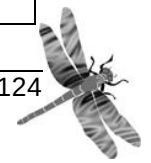
Bityla pallida	**Lepidoptera**	**Noctuidae**	**Hampson**	**2**		**Synonym**
Chrysodeixis argentifera	Lepidoptera	Noctuidae	(Guenee)			
Ectopatria aspersa	Lepidoptera	Noctuidae	(Walker)			
Erania graminosa	Lepidoptera	Noctuidae	(Walker)	2		
Graphania brunneosa	Lepidoptera	Noctuidae	Fox	2		
Graphania chlorodonta	Lepidoptera	Noctuidae	(Hampson)	2		
Graphania lignana	Lepidoptera	Noctuidae	(Walker)	2		
Graphania mollis	Lepidoptera	Noctuidae	(Howes)	2		
Graphania morosa	Lepidoptera	Noctuidae	(Butler)	2		
Graphania paracausta	Lepidoptera	Noctuidae	(Meyrick)	2		
Graphania plena	Lepidoptera	Noctuidae	(Walker)	2		
Graphania prionistis	Lepidoptera	Noctuidae	(Meyrick)	2		
Graphiphora compta	Lepidoptera	Noctuidae	Walker	2		
Hypenodes anticlina	Lepidoptera	Noctuidae	(Meyrick)	2		
Hypenodes costistrigalis	Lepidoptera	Noctuidae	Stephens	2		
Leucania blenheimensis	Lepidoptera	Noctuidae	Fereday			
Leucania paraxysta	Lepidoptera	Noctuidae	(Meyrick)	2		
Leucania semivittata	Lepidoptera	Noctuidae	Walker	2		
Leucania separata	Lepidoptera	Noctuidae	(Walker)	2		
Melanchra coeleno	Lepidoptera	Noctuidae	Hudson	2		
Melanchra decorata	Lepidoptera	Noctuidae	Philpott	2		
Melanchra diameta	Lepidoptera	Noctuidae	Hudson	2		
Melanchra exquisita	Lepidoptera	Noctuidae	Philpott	2		
Melanchra inchoata	Lepidoptera	Noctuidae	Philpott	2		
Melanchra levis	Lepidoptera	Noctuidae	(Philpott)	2		
Melanchra merope	Lepidoptera	Noctuidae	(Hudson)	2		
Melanchra ochthistis	Lepidoptera	Noctuidae	Meyrick	2		
Melanchra octans	Lepidoptera	Noctuidae	Hudson	2		



Melanchra pansicolor	Lepidoptera	Noctuidae	Howes	2		
Melanchra rhodopleura	Lepidoptera	Noctuidae	Meyrick	2		
Melanchra stipata	Lepidoptera	Noctuidae	(Walker)	2		
Melanchra temperata	Lepidoptera	Noctuidae	(Walker)	2		
Melanchra vitiosa	Lepidoptera	Noctuidae	(Butler)	2		
Persectania arotis	Lepidoptera	Noctuidae	Meyrick	2		
Persectania atristriga	Lepidoptera	Noctuidae	(Walker)	2		
Rhapsa scotosialis	Lepidoptera	Noctuidae	(Walker)	2		
Tmetolophota steropastis	Lepidoptera	Noctuidae	(Meyrick)	2		
Barea confusella	Lepidoptera	Oecophoridae	Walker	2		
Barea dinocosma	Lepidoptera	Oecophoridae	(Meyrick)	2		
Barea exarcha	Lepidoptera	Oecophoridae	Meyrick	2		
Borkhausenia amnopis	Lepidoptera	Oecophoridae	Meyrick	2		
Borkhausenia armigerella	Lepidoptera	Oecophoridae	(Walker)	2		
Borkhausenia chlorodelpha	Lepidoptera	Oecophoridae	Meyrick	2		
Borkhausenia chrysogramma	Lepidoptera	Oecophoridae	(Meyrick)	2		
Borkhausenia hemimochla	Lepidoptera	Oecophoridae	(Meyrick)	2		
Borkhausenia innotella	Lepidoptera	Oecophoridae	(Walker)	2		
Borkhausenia plagiatella	Lepidoptera	Oecophoridae	(Walker)	2		
Borkhausenia politis	Lepidoptera	Oecophoridae	(Meyrick)	2		
Borkhausenia siderota	Lepidoptera	Oecophoridae	(Meyrick)	2		
Coridomorpha stella	**Lepidoptera**	**Oecophoridae**	**Meyrick**	**2**	**At Risk**	**Relict**
Cryptolechia compsotypa	Lepidoptera	Oecophoridae	(Meyrick)	2		

Gymnobathra flavidella	Lepidoptera	Oecophoridae	(Walker)	2		
Gymnobathra hamatella	Lepidoptera	Oecophoridae	(Walker)	2		
Gymnobathra hyetodes	Lepidoptera	Oecophoridae	Meyrick	2		
Gymnobathra tholodella	Lepidoptera	Oecophoridae	Meyrick	2		
Heliostibes atychioides	Lepidoptera	Oecophoridae	(Butler)	2		
Heliostibes illita	Lepidoptera	Oecophoridae	(Felder)	2		
Izatha acmonias	Lepidoptera	Oecophoridae	Philpott	2		
Izatha attactella	Lepidoptera	Oecophoridae	Walker	2		
Izatha caustopa	**Lepidoptera**	**Oecophoridae**	**(Meyrick)**	**2**		**Data Deficient**
Izatha epiphanes	Lepidoptera	Oecophoridae	(Meyrick)	2		
Izatha huttoni	Lepidoptera	Oecophoridae	(Butler)	2		
Izatha metadelta	Lepidoptera	Oecophoridae	Meyrick	2		
Izatha peroneanella	Lepidoptera	Oecophoridae	(Walker)	2		
Izatha picarella	Lepidoptera	Oecophoridae	(Walker)	2		
Lathicrossa leucocentra	Lepidoptera	Oecophoridae	Meyrick	2		
Leptocroca asphaitis	Lepidoptera	Oecophoridae	(Meyrick)	2		
Leptocroca scholaea	Lepidoptera	Oecophoridae	(Meyrick)	2		
Scieropepla typhicola	Lepidoptera	Oecophoridae	Meyrick	2		
Trachypepla amphileuca	Lepidoptera	Oecophoridae	Meyrick	2		
Trachypepla aspidephora	Lepidoptera	Oecophoridae	Meyrick	2		
Trachypepla euryleucota	Lepidoptera	Oecophoridae	Meyrick	2		
Trachypepla galaxias	Lepidoptera	Oecophoridae	Meyrick	2		
Trachypepla leucoplanetis	Lepidoptera	Oecophoridae	Meyrick	2		
Trachypepla protochlora	Lepidoptera	Oecophoridae	Meyrick	2		

Vanicela disjunctella	Lepidoptera	Oecophoridae	Walker	2		
Orthenches virgata	Lepidoptera	Plutellidae	Philpott	2		
Plutella sera	Lepidoptera	Plutellidae	Meyrick	2		
Protosynaema quaestuosa	Lepidoptera	Plutellidae	Meyrick	2		
Protosynaema steropucha	Lepidoptera	Plutellidae	Meyrick	2		
Alucita furcatalis	Lepidoptera	Pterophoridae	(Walker)	2		
Alucita innotatalis	Lepidoptera	Pterophoridae	(Walker)	2		
Platyptilia celidota	Lepidoptera	Pterophoridae	(Meyrick)	2		
Platyptilia deprivatilis	Lepidoptera	Pterophoridae	Walker	2		
Platyptilia falcatalis	Lepidoptera	Pterophoridae	(Walker)	2		
Stenoptilia zophodactyla	Lepidoptera	Pterophoridae	Dupont	2		
Endonia psammitis	Lepidoptera	Pyralidae	(Meyrick)	1		
Endonia sabulosella	Lepidoptera	Pyralidae	Meyrick	1		
Galleria mellonella	Lepidoptera	Pyralidae	Linnaeus			
Nesarcha hybrealis	Lepidoptera	Pyralidae	(Walker)			
Nesarcha hybrealis	Lepidoptera	Pyralidae	(Walker)			
Dolichernis chloroleuca	Lepidoptera	Roeslerstammiidae	Meyrick	2		
Deilephila celerio	Lepidoptera	Saturniidae	(Linnaeus)			
Stathmopoda aposema	Lepidoptera	Stathmopodidae	Meyrick	2		
Stathmopoda caminora	Lepidoptera	Stathmopodidae	Meyrick	2		
Stathmopoda coracodes	Lepidoptera	Stathmopodidae	Meyrick	2		
Stathmopoda mysteriasis	Lepidoptera	Stathmopodidae	Meyrick	2		
Stathmopoda phlegyra	Lepidoptera	Stathmopodidae	Meyrick	2		
Stathmopoda plumbiflua	Lepidoptera	Stathmopodidae	Meyrick	2		
Stathmopoda skelloni	Lepidoptera	Stathmopodidae	(Butler)			



Stathmopoda trimolybdias	Lepidoptera	Stathmopodidae	Meyrick	2		
Thylacosceles acridomina	Lepidoptera	Stathmopodidae	Meyrick	2		
Morova subfasciata	Lepidoptera	Thyrididae	Walker	2		
Archyala terranea	Lepidoptera	Tineidae	(Butler)	2		
Crypsitricha mesotypa	Lepidoptera	Tineidae	(Meyrick)	2		
Endophthora tylogramma	Lepidoptera	Tineidae	Meyrick	2		
Erechthias charadrota	Lepidoptera	Tineidae	Meyrick	2		
Erechthias externella	Lepidoptera	Tineidae	(Walker)	2		
Erechthias fulquritella	Lepidoptera	Tineidae	(Walker)	2		
Erechthias hemidistra	Lepidoptera	Tineidae	(Meyrick)	2		
Eschatotypa derogatella	Lepidoptera	Tineidae	(Walker)	2		
Habrophila compseuta	Lepidoptera	Tineidae	Meyrick	2		
Hectacma chasmatias	Lepidoptera	Tineidae	Meyrick	2		
Lysiphragma mixochlora	Lepidoptera	Tineidae	Meyrick	2		
Opogona comptella	Lepidoptera	Tineidae	Walker	2		
Sagephora felix	Lepidoptera	Tineidae	Meyrick	2		
Sagephora phortegella	Lepidoptera	Tineidae	Meyrick	2		
Tinea margaritis	Lepidoptera	Tineidae	Meyrick	2		
Catamacta gavisana	Lepidoptera	Tortricidae	Walker	2		
Cnephasia incessana	Lepidoptera	Tortricidae	(Walker)	2		
Cryptaspasma querula	Lepidoptera	Tortricidae	(Meyrick)	2		
Dipterina imbriferana	Lepidoptera	Tortricidae	Meyrick	2		
Epalxiphora axenana	Lepidoptera	Tortricidae	Meyrick	2		

Eucosma querula	Lepidoptera	Tortricidae	Meyrick			
Eurythecta potamias	Lepidoptera	Tortricidae	(Meyrick)	2		
Grapholitha molesta	Lepidoptera	Tortricidae	(Busck)			
Harmologa amplexana	Lepidoptera	Tortricidae	(Meyrick)	2		
Maoritenes cyclobathra	Lepidoptera	Tortricidae	(Meyrick)	2		
Merophyas leucaniana	Lepidoptera	Tortricidae	(Walker)	2		
Planotortrix conditana	Lepidoptera	Tortricidae	(Walker)	2		
Planotortrix orthocopa	Lepidoptera	Tortricidae	(Meyrick)	2		
Planotortrix orthopis	Lepidoptera	Tortricidae	(Meyrick)	2		
Planotortrix postvittana	Lepidoptera	Tortricidae	(Walker)			
Prothelymna niphostrota	Lepidoptera	Tortricidae	Meyrick	2		
Pyrgotis arcuata	Lepidoptera	Tortricidae	Philpott	2		
Pyrgotis eudorana	Lepidoptera	Tortricidae	Meyrick	2		
Pyrgotis plagiatana	Lepidoptera	Tortricidae	(Walker)	2		
Pyrgotis plinthoglypta	Lepidoptera	Tortricidae	Meyrick	2		
Pyrgotis pyramidias	**Lepidoptera**	**Tortricidae**	**Meyrick**	**2**	**At Risk**	**Naturally Uncommon**
Pyrgotis variegata	Lepidoptera	Tortricidae	(Walker)	2		
Streptiscrates chaophila	Lepidoptera	Tortricidae	Meyrick	2		
Streptiscrates dolopaea	Lepidoptera	Tortricidae	Meyrick	2		
Streptiscrates ejectana	Lepidoptera	Tortricidae	(Walker)	2		
Streptiscrates zopherana	Lepidoptera	Tortricidae	Meyrick	2		
Tortrix flavescens	Lepidoptera	Tortricidae	(Butler)	2		
Zelleria copidota	Lepidoptera	Yponomeutidae	(Meyrick)	2		

Table XVI.7 Hamilton (1910): Habitat (as defined in source): 1=grassland; 2= bush/forest; 6=wet; 7=parasite; 9=subalpine/alpine; 10=exotic forest; blank=undefined. A blank Umbrella Group or Threat Status indicates that species has not been listed on the 2008-2011 Threat Classification System Lists, or has been listed as Not Threatened on one of the relevant lists.

Species	Order	Family	Authority	Habitat	Umbrella Group	Threat Status
Chloroclystis bilineolata	Lepidoptera	Geometridae	Walker	2		
Declana floccosa	Lepidoptera	Geometridae	Walker	2		
Declana yunctihnea	Lepidoptera	Geometridae	Walker	2		
Gonophylla ophiopa	Lepidoptera	Geometridae	(Meyrick)	2		
Hydriomena similata	Lepidoptera	Geometridae		2		
Ipana leptomera	Lepidoptera	Geometridae	Walker	2		
Leptomeris rubraria	Lepidoptera	Geometridae	Doubleday	2		
Selidosema aristarcha	Lepidoptera	Geometridae	Meyrick	2		
Selidosema dejectaria	Lepidoptera	Geometridae	Walker	2		
Selidosema panagrata	Lepidoptera	Geometridae	(Walker)	2		
Selidosema suavis	Lepidoptera	Geometridae	(Butler)	2		
Sestra flexata	Lepidoptera	Geometridae	(Walker)	2		
Xanthorhoe cinerearia	Lepidoptera	Geometridae	Hudson	2		
Hepialus virescens	Lepidoptera	Hepialidae	(Doubleday)	2		
Chrysophanus enysii	Lepidoptera	Lycaenidae	Butler	2		
Chrysophanus salustius	Lepidoptera	Lycaenidae	Fabricius	2		
Lycaena phoebe	Lepidoptera	Lycaenidae	Murray	2		
Bityla defigurata	Lepidoptera	Noctuidae	Walker	2		
Cosmodes elegans	Lepidoptera	Noctuidae	(Donovan)	2		
Leucania atristriga	Lepidoptera	Noctuidae	Walker	2		
Melanchra ewingi	Lepidoptera	Noctuidae	Westwood	2		
Melanchra insignis	Lepidoptera	Noctuidae	Walker	2		
Melanchra lignana	Lepidoptera	Noctuidae	Walker	2		
Melanchra mutans	Lepidoptera	Noctuidae	Walker	2		

Melanchra pelistis	Lepidoptera	Noctuidae	Meyrick	2		
Orthosia comma	Lepidoptera	Noctuidae	Walker	2		
Orthosia margarita	Lepidoptera	Noctuidae	Hawthorne	2		
Vanessa gonerilla	Lepidoptera	Nymphalidae	(Fabricius)	2		

Table XVI.8 Larochelle & Larivière (2001): Habitat (as defined in source): 1=grassland; 2= bush/forest; 6=wet; 7=parasite; 9=subalpine/alpine; 10=exotic forest; blank=undefined. A blank Umbrella Group or Threat Status indicates that species has not been listed on the 2008-2011 Threat Classification System Lists, or has been listed as Not Threatened on one of the relevant lists.

Species	Order	Family	Authority	Habitat	Umbrella Group	Threat Status
Actenonyx bembidioides	Coleoptera	Carabidae	White	6		
Agonocheila antipodum	Coleoptera	Carabidae	Bates			
Allocinopus sculpticollis	Coleoptera	Carabidae	Broun	2,9		
Amarotypus edwardsii	Coleoptera	Carabidae	Bates	2,9		
"Anchomenus" xanthomelas	Coleoptera	Carabidae	Broun			
Anomotarus variegatus	Coleoptera	Carabidae	Moore	1,2		
Aulacopodus brouni	Coleoptera	Carabidae	(Csiki)	2		
Aulacopodus calathoides	Coleoptera	Carabidae	(Broun)	2,9,10		
Bembidion actuarium	Coleoptera	Carabidae	Broun			
Bembidion anchonoderus	Coleoptera	Carabidae	Bates			
Bembidion brullei	Coleoptera	Carabidae	Gemminger & Harold	6		
Bembidion callipeplum	Coleoptera	Carabidae	Bates			
Bembidion charile	Coleoptera	Carabidae	Bates			
Bembidion dehiscens	Coleoptera	Carabidae	Broun			
Bembidion granuliferum	Coleoptera	Carabidae	Lindroth			

Bembidion maorinum levatum	Coleoptera	Carabidae	Lindroth			
Bembidion musae	Coleoptera	Carabidae	Broun			
Bembidion parviceps	Coleoptera	Carabidae	Bates			
Bembidion rotundicolle eustictum	Coleoptera	Carabidae	Bates			
Bembidion solitarium	Coleoptera	Carabidae	Lindroth	6		
Bembidion tairuense	Coleoptera	Carabidae	Bates			
Bembidion tekapoense	Coleoptera	Carabidae	Broun			
Cicindela feredayi	Coleoptera	Carabidae	Bates	2,6,9		
Cicindela parryi	Coleoptera	Carabidae	White	2.9		
Cicindela spilleri	Coleoptera	Carabidae	van Nidek	2,9		
Cicindela tuberculata	Coleoptera	Carabidae	Fabricius	1,2,9		
Clivina vagans	Coleoptera	Carabidae	Putzeys	6		
Ctenognathus adamsi	Coleoptera	Carabidae	(Broun)	2,9		
Ctenognathus cardiophorus	Coleoptera	Carabidae	(Chaudoir)	2,9		
Demetrida nasuta	Coleoptera	Carabidae	White	2,9		
Demetrida aterrima	Coleoptera	Carabidae	Bates			
Dicrochile cephalotes	Coleoptera	Carabidae	Broun	2,9		
Dicrochile maura	Coleoptera	Carabidae	Broun	2,9		
Duvaliomimus watti	Coleoptera	Carabidae	Britton	2,6		
Euthenarus puncticollis	Coleoptera	Carabidae	Bates	1,6,9		
Gaioxenus pilipalpis	Coleoptera	Carabidae	Broun	1,2,9		
Holcaspis dentifera	Coleoptera	Carabidae	Broun	2,9		
Holcaspis hispida	Coleoptera	Carabidae	(Broun)	2,9		
Holcaspis mordax	Coleoptera	Carabidae	Broun	2,9		
Holcaspis mucronata	Coleoptera	Carabidae	Broun	2,9		

Holcaspis oedicnema	Coleoptera	Carabidae	Bates	2,9		
Holcaspis sinuiventris	Coleoptera	Carabidae	(Broun)	2,9		
Holcaspis vagepunctata	Coleoptera	Carabidae	(White)	2,9		
Hypharpax abstrusus	Coleoptera	Carabidae	Bates	1,9		
Hypharpax australis	Coleoptera	Carabidae	(Dejean)	1,9		
Lecanomerus sharpi	Coleoptera	Carabidae	(Csiki)	2,9		
Lecanomerus vestigialis	Coleoptera	Carabidae	(Erichson)	1		
Mecodema crenaticolle	Coleoptera	Carabidae	Redtenbacher	2,10		
Mecodema dux	Coleoptera	Carabidae	Britton	1,2,9		
Mecodema florae	Coleoptera	Carabidae	Britton	2,9		
Mecodema oblongum	Coleoptera	Carabidae	(Broun)	1,2,6,10		
Mecodema occiputale	Coleoptera	Carabidae	Broun	2,9		
Mecodema simplex	Coleoptera	Carabidae	de Castelnau	1,2,9,10		
Mecodema spiniferum	Coleoptera	Carabidae	Broun			
Mecodema sulcatum	Coleoptera	Carabidae	(Sharp)	1,2,10		
Mecyclothorax amplipennis amplipennis	Coleoptera	Carabidae	(Broun)			
Mecyclothorax eplicatus	Coleoptera	Carabidae	(Broun)			
Mecyclothorax rotundicollis	Coleoptera	Carabidae	White	1,2,6,10		
Megadromus capito	Coleoptera	Carabidae	(Broun)	2		
Megadromus turgidiceps	Coleoptera	Carabidae	(Broun)	2,9		
Megadromus vigil	Coleoptera	Carabidae	(White)	2,9		
Molopsida polita	Coleoptera	Carabidae	White	2,9		
Molopsida seriatoporus	Coleoptera	Carabidae	Bates			
Molopsida strenua	Coleoptera	Carabidae	(Broun)	2,9		

Nesamblyops oreobius	Coleoptera	Carabidae	(Broun)	2,9		
Notagonum lawsoni	Coleoptera	Carabidae	(Bates)	6,9		
Notagonum submetallicum	Coleoptera	Carabidae	(White)	1,6,9		
Pentagonica vittipennis	Coleoptera	Carabidae	Chaudoir	2,9		
Pericompsus australis	Coleoptera	Carabidae	(Schaum)			
Platynus macropterus	Coleoptera	Carabidae	(Chaudoir)	1,2,9,10		
Plocamostethus planiusculus	Coleoptera	Carabidae	White	1,2,9		
Prosphodrus occultus	Coleoptera	Carabidae	Britton	2,6		
Prosphodrus waltoni	Coleoptera	Carabidae	Britton	2,6		
Psegmatopterus politissimus	Coleoptera	Carabidae	White			
Rhytisternus miser	Coleoptera	Carabidae	(Chaudoir)	1,2,10		
Scopodes fossulatus	Coleoptera	Carabidae	(Blanchard)	1,6		
Scopodes pustulatus	Coleoptera	Carabidae	Broun	1,2,9		
Syllectus anomalus	Coleoptera	Carabidae	Bates	2,6,9		

Table XVI.9 McGuinness (2001): Habitat (as defined in source): 1=grassland; 2= bush/forest; 6=wet; 7=parasite; 9=subalpine/alpine; 10=exotic forest; blank=undefined. A blank Umbrella Group or Threat Status indicates that species has not been listed on the 2008-2011 Threat Classification System Lists, or has been listed as Not Threatened on one of the relevant lists.

Species	Order	Family	Authority	Habitat	Umbrella Group	Threat Status
Mecodema atrox	**Coleoptera**	**Carabidae**	**Britton**	**2**	**Threatened**	**Nationally Endangered**
Mecodema dux	Coleoptera	Carabidae	Britton	2,9		
Asaphodes stinaria	**Lepidoptera**	**Geometridae**	**Gueneé**	**1**	**Threatened**	**Nationally Vulnerable**
Meterana pictula	**Lepidoptera**	**Noctuidae**	**White (in Taylor)**	**2,9**	**At Risk**	**Declining**

Table XVI.10 Moeed & Meeds (1992): Habitat (as defined in source): 1=grassland; 2= bush/forest; 6=wet; 7=parasite; 9=subalpine/alpine; 10=exotic forest; blank=undefined. A blank Umbrella Group or Threat Status indicates that species has not been listed on the 2008-2011 Threat Classification System Lists, or has been listed as Not Threatened on one of the relevant lists.

Species	Order	Family	Authority	Habitat	Umbrella Group	Threat Status
Actenonyx bembidioides	Coleoptera	Carabidae	White	2		
Artystona erichson	Coleoptera	Tenebrionidae	(White)	2		
Artystona rugiceps	Coleoptera	Tenebrionidae	Bates	2		
Baculipalpus stringipennis	Coleoptera	Oedemeridae		2		
Balcus signatus	Coleoptera	Cleridae	Broun	2		
Ceratognathus parrianus	Coleoptera	Lucanidae	Westwood	2		
Coccinella undecimpunctata	Coleoptera	Coccinelidae	Linnaeus	2		
Demetrida nasuta	Coleoptera	Carabidae	White	2		
Costelytra zealandica	Coleoptera	Scarabaeidae	White	2		
Megadromus capito	Coleoptera	Carabidae	(White)	2		
Leperina farinosa	Coleoptera	Trogossitidae	(Sharp)	2		
Oemona hirta	Coleoptera	Cerambycidae	(Fabricius)	2		
Pyronota festiva	Coleoptera	Scarabaeidae	Fabricius	2		
Saphobius edwardsi	Coleoptera	Scarabaeidae	Sharp	2		
Saphydrus sp.	Coleoptera	Hydrophilidae		2		
Syllectus anomalus	Coleoptera	Carabidae	Bates	2		
Epichorius sp.	Coleoptera	Byrrhidae		2		
Eucolaspis sp.	Coleoptera	Chrysomelidae		2		
Mimopeus sp.	Coleoptera	Tenebrionidae		2		
Odontria sp.	Coleoptera	Scarabaeidae		2		
Bassaris gonerilla	Lepidoptera	Nymphalidae		2		
Nyctemera annulata	Lepidoptera	Arctiidae	Boisduval	2		

Table XVI.11 NZAC(2013): Habitat (as defined in source): 1=grassland; 2= bush/forest; 6=wet; 7=parasite; 9=subalpine/alpine; 10=exotic forest; blank=undefined. A blank Umbrella Group or Threat Status indicates that species has not been listed on the 2008-2011 Threat Classification System Lists, or has been listed as Not Threatened on one of the relevant lists.

Species	Order	Family	Authority	Habitat	Umbrella Group	Threat Status
Actenonyx bembidioides	Coleoptera	Carabidae	White 1846	2		
Amarotypus edwardsii	Coleoptera	Carabidae	Bates 1872	2		
Anchomenus helmsi	Coleoptera	Carabidae	Sharp 1878			
Aulacopodus calathoides	Coleoptera	Carabidae	(Broun 1886)	2		
Bembidion actuarium	Coleoptera	Carabidae	Broun 1903	2		
Bembidion anchonoderus	Coleoptera	Carabidae	Bates 1878	2		
Bembidion callipeplum	Coleoptera	Carabidae	Bates 1878			
Bembidion charile	Coleoptera	Carabidae	Bates 1867	2		
Bembidion granuliferum	Coleoptera	Carabidae	Lindroth 1976	2		
Bembidion musae	Coleoptera	Carabidae	Broun 1882	2		
Bembidion tairuense	Coleoptera	Carabidae	Bates 1878	2		
Bembidion tekapoense	Coleoptera	Carabidae	Broun 1886			
Cicindela parryi	Coleoptera	Carabidae	White 1846	2		
Cicindela tuberculata	Coleoptera	Carabidae	Fabricius 1775	2,9		
Ctenognathus adamsi	Coleoptera	Carabidae	(Broun 1886)	2,9		
Ctenognathus cardiophorus	Coleoptera	Carabidae	(Chaudoir 1879)	2		
Demetrida nasuta	Coleoptera	Carabidae	White 1846	9		
Dicrochile cephalotes	Coleoptera	Carabidae	Broun 1894	6		
Dicrochile maura	Coleoptera	Carabidae	Broun 1880	2		
Gaioxenus pilipalpis	Coleoptera	Carabidae	Broun, 1910	2		
Haplanister crypticus	Coleoptera	Carabidae	Moore 1996	2		
Harpalus australasiae	Coleoptera	Carabidae	Dejean 1829	2		
Holcaspis dentifera	Coleoptera	Carabidae	(Broun 1880)	9		
Holcaspis hispida	Coleoptera	Carabidae	(Broun 1877)	2		
Holcaspis mucronata	Coleoptera	Carabidae	Broun 1886	2,9		
Holcaspis oedicnema	Coleoptera	Carabidae	Bates, 1874	2,9		
Holcaspis sinuiventris	Coleoptera	Carabidae	(Broun 1908)	9		
Holcaspis vagepunctata	Coleoptera	Carabidae	(White 1846)	9		
Hypharpax australis	Coleoptera	Carabidae	(Dejean 1829)	2		

Laemostenus complanatus	Coleoptera	Carabidae	(Dejean 1829)			
Lecanomerus sharpi	Coleoptera	Carabidae	(Csiki, 1932)	2,9		
Mecodema alternans	Coleoptera	Carabidae	Broun 1909			
Mecodema atrox	**Coleoptera**	**Carabidae**	**Britton 1949**	**2**	**Threatened**	**Nationally Endangered**
Mecodema crenicolle	Coleoptera	Carabidae	de Castelnau 1867	2,9		
Mecodema florae	Coleoptera	Carabidae	Britton 1949	9		
Mecodema oblongum	Coleoptera	Carabidae	(Broun 1882)	2		
Mecodema occiputale	Coleoptera	Carabidae	Broun 1923	2		
Mecodema simplex	Coleoptera	Carabidae	de Castelnau 1867			
Mecodema spiniferum	Coleoptera	Carabidae	Broun 1880			
Mecodema sulcatum	Coleoptera	Carabidae	(Sharp 1886)			
Mecodema validum	Coleoptera	Carabidae	Broun 1923	2		
Mecyclothorax amplipennis amplipennis	Coleoptera	Carabidae	(Broun 1912)	9		
Mecyclothorax rotundicollis	Coleoptera	Carabidae	(White 1846)	9		
Megadromus capito	Coleoptera	Carabidae	(White 1846)	2,9		
Megadromus turgidiceps	Coleoptera	Carabidae	(Broun 1908)	9		
Megadromus vigil	Coleoptera	Carabidae	(White, 1846)			
Molopsida polita	Coleoptera	Carabidae	White 1846	9		
Molopsida seriatoporus	Coleoptera	Carabidae	(Bates 1874)	9		
Notagonum lawsoni	Coleoptera	Carabidae	(Bates 1874)	2		
Notagonum submetallicum	Coleoptera	Carabidae	(White 1846)			
Oopterus nigritulus	Coleoptera	Carabidae	Broun 1908	2		
Pentagonica vittipennis	Coleoptera	Carabidae	Chaudoir 1877	2		
Platynus macropterus	Coleoptera	Carabidae	(Chaudoir 1879)	2		
Plocamostethus planiusculus	Coleoptera	Carabidae	(White 1846)	2		
Psegmatopterus politissimus	Coleoptera	Carabidae	(White 1846)	2		
Rhytisternus miser	Coleoptera	Carabidae	(Chaudoir 1865)	2		
Scopodes fossulatus	Coleoptera	Carabidae	(Blanchard 1843)	2		
Scopodes prasinus	Coleoptera	Carabidae	Bates 1878	9		
Syllectus anomalus	Coleoptera	Carabidae	Bates 1878	2		
Triplosarus novaezelandiae	Coleoptera	Carabidae	(de Castelnau 1867)			
Anagotus oconnori	Coleoptera	Curculionidae	Bull	9		

Table XVI.12 Patrick (2000): Habitat (as defined in source): 1=grassland; 2=bush/forest; 6=wet; 7=parasite; 9= subalpine/alpine; 10=exotic forest. A blank Umbrella Group or Threat Status indicates that species has not been listed on the 2008-2011 Threat Classification System Lists, or has been listed as Not Threatened on one of the relevant lists.

Species	Order	Family	Authority	Habitat	Umbrella Group	Threat Status
Asaphodes stinaria	**Lepidoptera**	**Geometridae**	**Gueneé**	**1**	**Threatened**	**Nationally Vulnerable**
Xanthorhoe bulbulata	**Lepidoptera**	**Geometridae**	**Gueneé**	**1,9**	**Threatened**	**Nationally Critical**

Table XVI.13 Patrick & Dugdale (2000): Habitat (as defined in source): 1=grassland; 2= bush/forest; 6=wet; 7=parasite; 9= subalpine/alpine; 10=exotic forest; blank=undefined. A blank Umbrella Group or Threat Status indicates that species has not been listed on the 2008-2011 Threat Classification System Lists, or has been listed as Not Threatened on one of the relevant lists.

Species	Order	Family	Authority	Habitat	Umbrella Group	Threat Status
Zizina oxleyi	Lepidoptera	Lycaenidae	Felder & Felder			
Asaphodes stinaria	**Lepidoptera**	**Geometridae**	**Gueneé**		**Threatened**	**Nationally Vulnerable**
Bityla pallida	Lepidoptera	Noctuidae	Hudson			Synonym[12]
***Hierodoris* 'clear wing', undescribed**[13]	**Lepidoptera**	**Oecophoridae**				**Data Deficient**
***Pyroderces* sp. 'yellow' undescribed**	**Lepidoptera**	**Cosmopterigidae**		**2**		**Data Deficient**
Pseudocoremia albafasciata	Lepidoptera	Geometridae	(Philpott, 1915)			

Table XVI.14 Vink (2002): Habitat (as defined in source): 1=grassland; 2= bush/forest; 6=wet; 7=parasite; 9=subalpine/alpine; 10=exotic forest; blank=undefined. A blank Umbrella Group or Threat Status indicates that species has not been listed on the 2008-2011 Threat Classification System Lists, or has been listed as Not Threatened on one of the relevant lists.

Species	Order	Family	Authority	Habitat	Umbrella Group	Threat Status
Anoteropsis adumbrata	Araneae	Lycosidae	Urquhart	1,9		
Allotrochosina schauinslandi	Araneae	Lycosidae	(Simon)	1,2,6		
Anoteropsis hilaris	Araneae	Lycosidae	(Koch)	1,9		

[12] It is a synonym of the common *Ectopatria aspera* (unpublished data, RJBH). Nothing to do with *B. sericea*, however Threat Status listing included here for completeness.
[13] Described by Hoare (2005) as *Hierodoris sesioides.*

Table XVI.15 Vink & Dupérré (2010): Habitat (as defined in source): 1=grassland; 2= bush/forest; 6=wet; 7=parasite; 9=subalpine/alpine; 10=exotic forest; blank=undefined. A blank Umbrella Group or Threat Status indicates that species has not been listed on the 2008-2011 Threat Classification System Lists, or has been listed as Not Threatened on one of the relevant lists.

Species	Order	Family	Authority	Habitat	Umbrella Group	Threat Status
Dolomedes minor	Araneae	Pisauridae	Koch	1,6,9		