Before the Fast-track Panel

Under:	The Fast-track Approvals Act 2024
In the matter of:	FTAA-2507-1089 – Bengio-Ophir Gold Project

Statement of advice

Warren Chinn

Terrestrial Invertebrate Ecology

Technical Advisor, Department of Conservation

18 March 2026

Department of Conservation
Te Papa Atawhai

Te Kāwanatanga o Aotearoa
New Zealand Government

Executive Summary

1. This advice reports on the invertebrate values present within a catchment on the western flanks of the Dunstan Mountains, Central Otago. Matakanui Gold Ltd. have applied through the Fast Track Approvals Act to mine for gold in the location.

2. The proposed mining method would be hard rock open-pit excavation. The area includes a diverse fauna of indigenous invertebrates, of which many are endemic to Central Otago.

3. The applicant engaged ecological consultant Habitat NZ Ltd., to carry out an extensive invertebrate survey of the area proposed for disturbance and beyond.

4. I agree with many of the findings of the consultants, especially the high species diversity of the project site.

5. I consider the consultant's survey report presented considerable ambiguity because there seems to be missing and confusing information about species counted and identified.

6. Key survey findings include the discovery of eighteen insect species of conservation interest, of which four are threatened while another four species are potentially threatened and nine were at risk.

7. I have reservations about the mitigation proposed, as much of the proposed method appears to be experimental with a low probability of ecological benefit

8. I have concerns about the proposed lighting regime and the potential impacts to invertebrates because constant, bright lights are likely to negatively affect the behaviour and life history traits of flying and ground dwelling invertebrates.

9. I have assessed the proposed ecological offsetting and consider the proposals are unlikely to achieve an environmental "no net loss".

10. This is because the effects of landscape disturbance on the suite of indigenous invertebrates will encourage more exotic species and the structure of the indigenous invertebrate community is likely to be compromised.

Introduction

11. My full name is Warren Guy Hill Chinn.

Instructions

12. I have been requested to provide expert advice (on behalf of the Department of Conservation DOC), on the Bendigo Ophir Gold Mine Proposal Fast-track application.

13. My advice specifically relates to the application for consent and may be used to inform the Department's s51 and s53 comments.

Qualification and Experience

14. I am a Technical Advisor with the Department of Conservation, animal ecology.

15. My speciality is the ecology and conservation of indigenous terrestrial invertebrates, particularly in the South Island high country. I have been in my role for 20 years and have extensive experience surveying and reporting on the South Island invertebrate fauna.

16. My field experience includes many species' conservation programmes, more than 10 years with the Tenure Review programme in which I surveyed 32 high country properties for invertebrate values. During the tenure review work I inspected properties in Otago, Canterbury and Marlborough.

17. I have written dozens of scientific reports and published papers on alpine invertebrate evolution, the effects of climate change on alpine invertebrate species, oceanic island invertebrate ecology, agricultural insect management, molecular genetic techniques for biosecurity and have contributed to ecology books.

18. I have previously been an expert witness for several local council hearings and have written Environment Court expert evidence (on behalf of the Department of Conservation) in regard to the Te Kuha coal mine application.

19. I am currently involved in a number of Fast-track Act applications that require expert invertebrate ecology advice and information.

20. I have visited the Oceana Gold Macraes mine in Otago three times and have a good working knowledge of open-pit hard rock mining.

21. I am familiar with the proposed Bendigo mine location and surrounding landscape. I have visited the area on numerous occasions for work and in a personal capacity. Visits specifically relating to the mine application were made on December 13th 2023 (invitation by the applicant to DOC Central Otago District Office) and December 17th 2025. Between these visits I inspected both sides of Shepherds Creek valley (including

the Ardgour Rise on the true right). I am familiar with the historic Come in Time (CIT) battery site and proposed location for the CIT pit, similarly the Rise and Shine (RAS) pit and the upper catchment of the creek. I have sampled invertebrates from several locations adjacent to Thomson Gorge Road, Thomsons Saddle area and the head waters of Shepherds Creek catchment.

22. I hold a BSc and MSc (1st Class Hons) in zoology and entomology from the University of Canterbury. My thesis topic was the molecular genetic patterns of alpine cockroach populations in relation to Pleistocene glaciations.

Code of conduct

23. While I acknowledge this is not an Environment Court Proceeding, I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2023. I have complied with the Code of Conduct in the preparation of this advice. Unless I state otherwise, this advice is within my area of expertise, and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

Material Considered

24. In preparing this advice I have reviewed the following application documents:

    i. Substantive application:
        - Project description (A.10)
        - Assessment of environmental effects (A.13)
        - Management and monitoring of actual and potential environmental effects (A.14)
        - Conclusion (A.16)

    ii. Terrestrial Invertebrate Survey (Habitat NZ Ltd, 2025) (B.11)

    iii. Terrestrial Invertebrate Management Plan (Habitat NZ Ltd, 2025) (G.06)

    iv. Assessment of Ecological Effects: Terrestrial Ecology (Alliance Ecology 2025) (B.08)

    v. Exterior Lighting Report (Cosgroves 2025) (B.31).

25. My advice addresses the following issues:

    i. Matters relating to the proposed mine disturbance area.

    ii. The Indigenous invertebrate species recorded from the Bendigo area and their significance.

    iii. The area of affected invertebrate habitat and species management.

    iv. The number of invertebrate species recorded by Habitat NZ Ltd.

v. A field trip undertaken in December 2025.

vi. Data interpretation of the Habitat NZ Ltd. invertebrate survey.

vii. Invertebrate community structure.

viii. The applicant's approach to ameliorating the impact of hard-rock mining on invertebrates at Bendigo.

ix. Artificial lighting.

x. Offsetting.

xi. Conclusions.

A wealth of species

26. Central Otago boasts some of the highest levels of invertebrate species endemism in the South Island, rivalled only by north-west Nelson. This is largely due to a vast landscape of great antiquity and geological stability that resides under a continental climate. During the Pleistocene Epoch most of Central Otago was spared the effects of glaciations, in contrast, the western invertebrate fauna underwent repeated population fragmentation and recombination in response to extensive glaciations. Similarly, the Central Otago biota has never been subject to the drastic effects of volcanism, unlike the North Island biota. Under these stable environmental conditions, the ancestral invertebrate biota became entrenched with the flowering plants to form deep co-evolutionary relationships, manifested today in the numerous moth-plant associations.

27. Among the many shy but hardy invertebrates in modern Central Otago there are some remarkable types including velvet worms, big bumbling chafers, a giant ground beetle (the largest in Aotearoa New Zealand), and a tree wētā that nevertheless lives under rock slabs. There are salt-pan adapted moths and trap-door spiders, but the true ambassadors of Otago's tussock country are the moths, particularly flightless types that prefer to stay out of the perpetual winds. The proportion of native moth species in Otago may be as high as 60% of the entire national count (Patrick 1989; 1994a; 1994b; Peat and Patrick 1999; Patrick and Dugdale 2000; Derraik *et al*. 2010). From this perspective, these small animals represent significant stocks in the biological bank of Aotearoa New Zealand. Few regions in the country hold so much concentrated wealth of species as Otago, and yet species continue to decline.

Location and proposed mining area

28. The proposed Bendigo mining operation would be located in Shepherds Creek on the north-west flanks of the central Dunstan Mountains, Otago (Figure 1). The Dunstan mountains were formed through anti-clinal folding of ancient Haast Schists (some 200 million years old), although the mountain range itself is around Miocene age (5-15 million years ago). Gold is present in atomic quantities within crystals of the mineral arsenopyrite, an iron sulphide mineral rich in arsenic that forms under high pressure in superheated water.

29. The footprint of the proposed mining activity was estimated at 610ha or 6.1 km^2 by consultant ecologists Alliance Ecology (Alliance Ecology 2025) (Figure 2). A second footprint map was produced by Habitat NZ Ltd, within their invertebrate ecology report (Habitat NZ Ltd. 2025a). That map includes an ecological buffer zone, and I have reproduced a version of the map (Figure 1). By my analysis, the total area (including buffer) would consume almost the entire length of Shepherds creek (some 8 kms), with an average width of 2 kms and vertical rise by 570 meters (from Clutha Valley floor to Thomsons Saddle). Using those figures, the disturbed area seems more like a 16 km^2 (1600 ha), corridor of habitat disturbance as even the buffer is likely to sustain effects of dust, vibration, light spill at night and hydrology changes etc. Within my mapped demarcation line, there resides a diverse fauna of indigenous invertebrates as documented by the applicant's own ecologist, Habitat NZ in their report (Habitat NZ Ltd. 2025a).

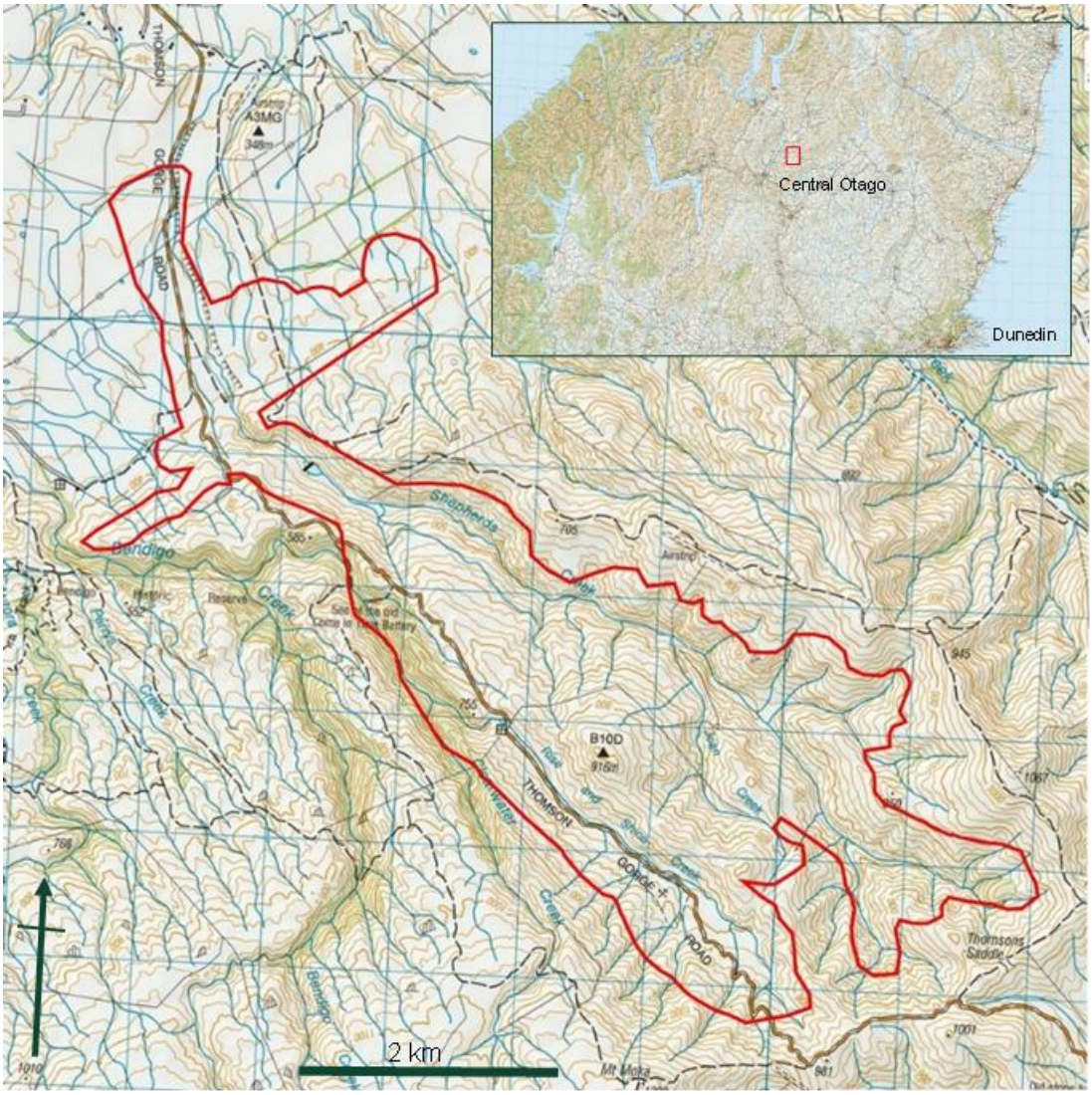


Figure 1. Topographic map showing the locality and direct disturbance footprint (DDF) of proposed mining activities, including peripheral buffer. Map re-drawn from the Terrestrial Invertebrate Survey (Habitat NZ Ltd. 2025a).

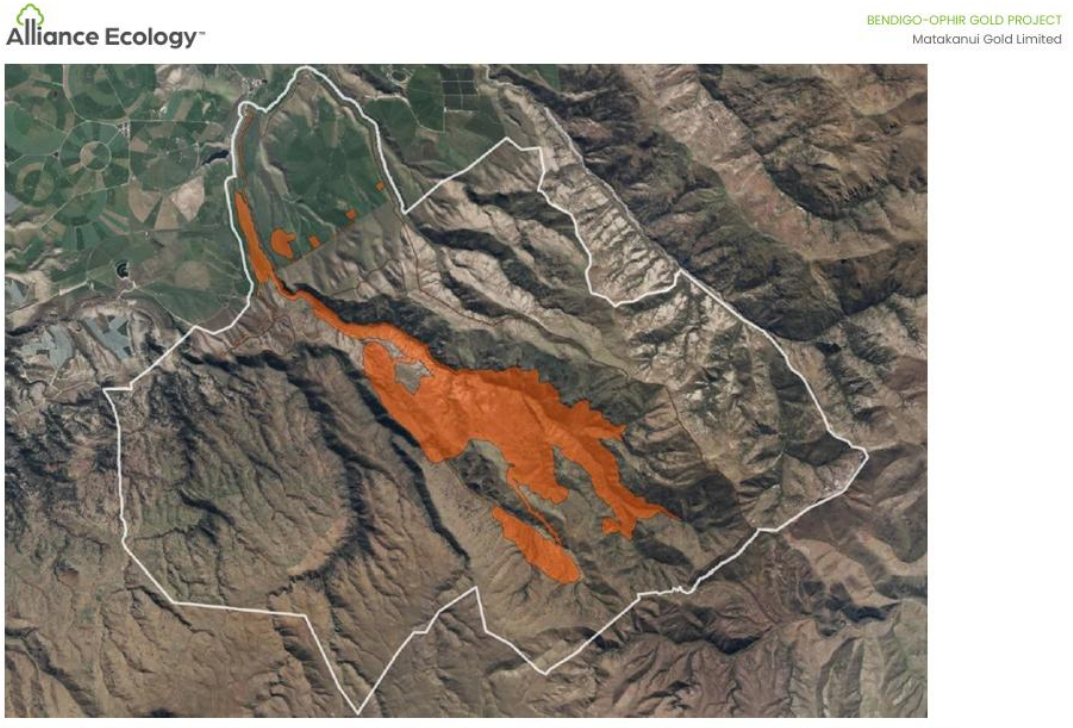


Figure 2: The Direct Disturbance Footprint (DDF)(orange polygon) within the Ecological Study Area (ESA)(white border)

Figure 2. A reproduction of the Alliance Ecology map showing the DDF (orange shading). The impact area is estimated to be 610 hectares. In my view, the DDF consumes the majority of the Shepherds Creek catchment which supports a diverse invertebrate community as documented by Habitat NZ Ltd, 2025a.

Indigenous invertebrate species recorded from the Bendigo area and their significance

30. Matakanui Gold Ltd. engaged independent ecology consultant 'Habitat NZ Wildlife management' to carry out an invertebrate survey of the area proposed for gold mining, referred to here as Habitat NZ Ltd. At 69 pages, their invertebrate report was substantial and canvassed a wide range of methods and results (Habitat NZ 2025a). The same consultant prepared a Terrestrial Invertebrate Management Plan (TIMP), and Figure 3 shows an extract from that report (originally presented as table 1). The table lists 18 invertebrate taxa of conservation interest including four threatened species of which two moth species are endangered (the Nationally Critical *Sporophyla oenospora* and Nationally Endangered *Homodotis* 'sp. A'). No threat ranking references were provided in either report (Habitat NZ Ltd. 2025a and 2025b) and presumably the authors based their assessments on the Department of Conservation (DOC) threat ranking system (Rolfe *et al*. 2022).

31. The dominance of moths recorded in the Habitat NZ reports is not surprising given the range of habitat types on the Dunstan Mountains , including mat-forming vegetation, tussock grasslands, native shrublands, stream banks and wetlands. The TIMP document also lists four new species of beetle, specifically a weevil in the genus *Inophloeus* sp., and three ground beetles (*Harpalus* sp., *Megadromus* new sp. 1 and *Megadromus* new sp. 2). In my view, the first two taxa may well be new species since weevils are very diverse and often confined to a host plant (in this case speargrass that today has a patchy distribution due to human-induced vegetation change, primarily by fire).

32. However, I am of the view that the two new *Megadromus* beetle species may represent a case of mis-identification rather than species new to entomological science. This is because *Megadromus* beetles are large and easily detected and while the South Island fauna is diverse, many species have been described, particularly those in proximity to human settlement. In other words, I would be surprised if the *Megadromus* beetles found by Habitat NZ Ltd, had not already been noted during the Protected Natural Areas (PNA) and tenure review surveys, or during other visits to the Dunstan Mountains by professional and amateur entomologists.

33. In my opinion, the two *Megadromus* species are more likely to be *Megadromus sandageri* and *Neoferonia procerula* (the latter is very similar to *Megadromus* and easily

mistaken)[1]. I am not as confident about the number of potential new species in the area as recorded by Habitat NZ Ltd. On the other hand, if that tally is correct, then the case to leave what remaining habitat exists, for species survival is compelling.

34.

Threat status	Sub status	Species name	Type of Invertebrate
Threatened	Nationally Critical	*Sporophyla oenospora*	Moth
	Nationally Endangered*	*Homodotis sp. A (NZAC-CO)*	Moth
	Nationally Vulnerable	*"Pseudocoremia" cineracia*	Moth
	Nationally Vulnerable	*Pasiphila sp. 'Olearia'*	Moth
	Potentially Threatened	*Harpalus new sp.*	Ground beetle
New Species	Potentially Threatened	*Inophloeus new sp.*	Weevil
	Potentially Threatened	*Megadromus new sp.1*	Beetle
	Potentially Threatened	*Megadromus new sp.2*	Beetle
At Risk	Declining	*Phaulacridium otagoense*	Short-horned grasshopper
	Declining*	*Agrotis admirationis*	Moth
	Declining*	*Asaphodes recta*	Moth
	Declining*	*Elachista helonoma*	Moth
	Declining*	*Ichneutica toroneura*	Moth
	Declining*	*Nyctemera annulata*	Magpie moth
	Declining*	*Paranotoreas fulva*	Moth
	Uncommon*	*Ichneutica sistens*	Moth
	Uncommon*	*Meterana exquisite*	Exquisite owlet moth
Not Assessed	Of importance	*Scythris sp.1*	Moth

Figure 3. An extract from the Terrestrial Invertebrate Management Plan (Habitat NZ Ltd). showing 13 invertebrates of conservation interest that are proposed for management under the Bendigo mine proposal.

Area of affected invertebrate habitat and species management

35. The Habitat NZ Ltd report estimates that an area of 550 ha is within the 'Direct Disturbance Footprint' (DDF), but this excludes a 'buffer' area, adding a 150 m perimeter to the affected area (Habitat NZ, 2025a). The authors imply that at least 222 invertebrate species will be affected by direct and indirect impacts (Habitat NZ 2025b), although this is unknown. What is certain, is that the immediate effect of mining will result in the total removal of invertebrate habitat, community fragmentation and local modification of the

[1] There are two South Island carabid specialists that could have probably given a swift identification for the specimens, they are; Peter Johns, retired, and Dr Steve Pawson of SCION in Canterbury. In 2005 Peter Johns provided a useful information booklet about these, and other ground beetle species of interest in the South Island (Johns 2005), and yet this reference wasn't cited in the Habitat NZ Ltd reports.

invertebrate community at mine closure, depending on when that occurs. I agree with the initial Habitat NZ report on these facts.

36. Notable threatened invertebrate species that are likely to be impacted by the proposed mine activities include the grasshopper *Phaulacridium otagoense*, several moth species and speargrass weevils. However, measuring effects is only feasible by comparative community-level indices and probably only after the mine has closed. For that reason, in my opinion commentary on invertebrate population re-colonisation and persistence within Shepherds Creek is an a-posteriori approach and speculative.

37. Intensive, species-level invertebrate conservation is generally suited to small populations of large-bodied, flightless, slow-reproducing and predator-vulnerable types (e.g. land snails and giant wētā). Few of the invertebrates identified in the Habitat NZ report fit that criteria with the exception of the *Inophloeus* weevil. This situation comes about because the suite of invertebrates at Bendigo are generally mobile within the landscape and are associated with a mosaic of habitat types. This ecological characteristic implies that any conservation programme for invertebrates needs to be at a landscape scale (i.e. square kilometres) to effect community-level interactions between many species—including plants, invertebrates, lizards and birds.

The number of invertebrate species recorded by Habitat NZ Ltd

38. In nearly all entomology surveys, the core of the study is the species list, from which all analysis and assessment of the invertebrate community will depend on. The Habitat NZ report does not make clear the number of invertebrate species sampled from their comprehensive survey (including the area proposed for mining and a periphery for comparative study). From the results section, the report states: "…222 species were native, 29 species were introduced, and the remaining were indeterminate at the species level…' (p. 26, Habitat NZ Ltd, 2025a). The report does not state how many samples were indeterminate. Based on the report, the total number of identified species in the report was 251 (222 + 29).

39. To confirm this number, I re-counted all the species from Appendix 2 in the report, and found a total 425 taxa, some 40% more species than recorded of which nearly 41% were unidentified taxa (Table 1). This leaves the remainder of the report open to various errors. For example, what were the other species types? How do the additional species change the ratio of introduced to native? Were there more threatened species? What else have the authors potentially mis-interpreted? The inconsistent species count weakens the findings and conclusion in the Habitat NZ report.

Invertebrate category	Habitat NZ Ltd. report	My count
Native	222	222
Introduced	29	29
Unidentified	?	174
Totals	**251**	**425**

Table 1. Counts of taxa from Appendix 2 'Terrestrial invertebrate survey list', Habitat NZ Ltd 2025a.

40. The Habitat NZ report notes that individual invertebrates were also counted to a total of 29,565 specimens. This is appropriate because individual counts are necessary for deriving community indices. Where complete identifications were not possible the terms indeterminate (indet.) or sp. were used ('indet' refers to taxa whose diagnostic features are not preserved while 'sp.' applies to taxa that cannot be identified to species level). I was surprised that no mention of 'recognisable taxonomic units' (RTUs) was made. Although not necessary, RTU is the standard terminology in this situation.

41. In one case, the taxonomic *Order* (within the Class Insecta) was considered indeterminate. This seems unusual, especially given that 81 individuals within this order were found. This is a substantial quantity of individuals that would have influenced the community-level statistics. In my experience of identifying insects, it is extremely unlikely that the Order of any insect, larval or adult stage is not able to be identified because an order carries such a high level of diagnostic characters. Examples of insect order include; beetles, wasps, moths, flies etc. It might have been more meaningful to have omitted those specimens from the data or better still, sequence their DNA to reveal the taxonomy.

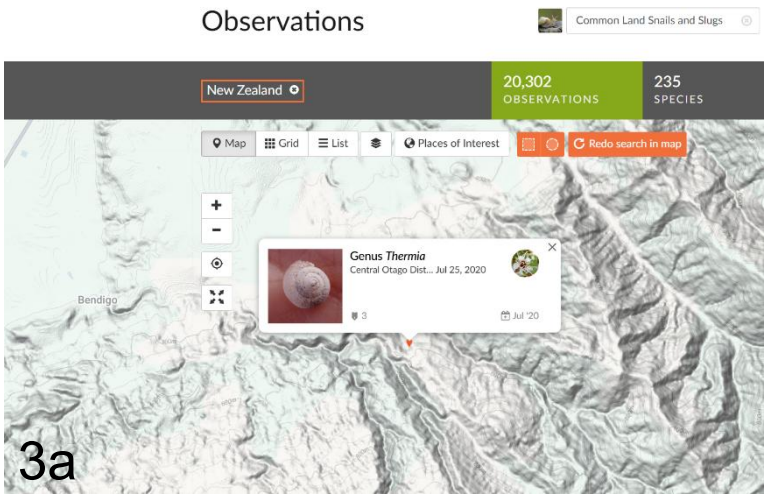
42. My concern here is that these unidentified numbers make the statistics look impressive but lend no useful information about the composition and structure of the indigenous invertebrate community at Bendigo.

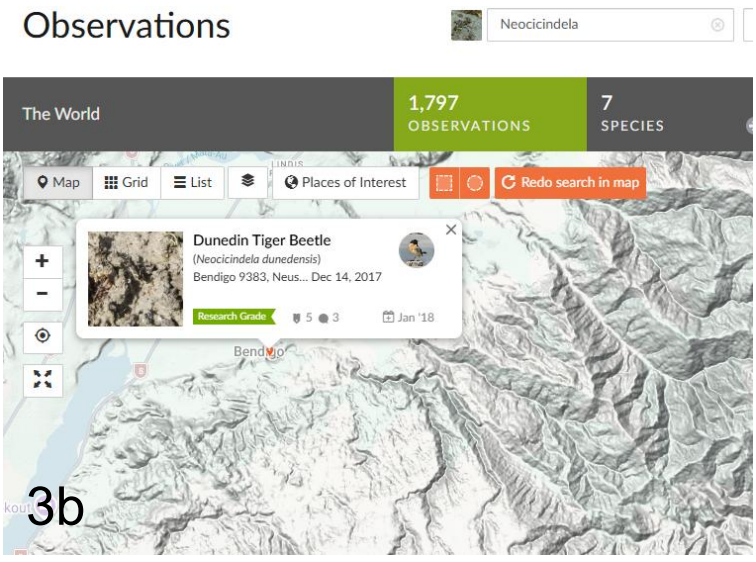
December 2025 field trip

43. Along with ecologist Max Crowe, I visited the Come in Time, Rise and Shine and Thomsons Saddle area on 17th December 2025. Some of the vegetation was still flowering while other plants had finished. I sampled invertebrates at the Come in Time area where substantial numbers of the grasshopper *Phaulacridium otagoense* were re-confirmed, often on the extensive *Roulia* mat-forming plants. *Roulia* is endemic and highly characteristic of semi-arid, exposed landscapes and invariably attracts many invertebrates. Of those, wheat bugs (Lygaeidae) are usually abundant on the plant. This

was the case at the Come in Time location, where every *Roulia* plant was infested with *Nyssius huttoni*, a common seed bug that feeds on the flowers while using the plant for mating. At the same location, I noted a *Neoramia* spider. *Neoramia* is an endemic genus, the spiders being more common in the South Island and generally confined to undisturbed, native ecosystems.

44. Meanwhile, at the Rise and Shine Creek area, I noted several specimens of the native Red Coat dragonfly (*Xanthocnemis zealandica*). The Habitat NZ Ltd survey did not report *Neoramia* nor any Odonata (dragon flies and damselflies), the latter are always associated with bodies of water. Similarly, no terrestrial micro snails (mollusca) or Tiger Beetles (Cicindela) were listed in the Habitat NZ reports. The New Zealand terrestrial micro snail fauna is ubiquitous and often highly endemic where found. Tiger beetles are also common in dryland habitats. I carried out a quick search on iNaturalist and noted a record of *Thermia* (Pinwheel snails) above Bendigo and located under a *Melicytus* plant ('Porcupine' shrub). The Tiger Beetle record was of *Neocicindela dunedinense* and came from the foot of the Dunstan Mountains , but no further than 2-3 kms from the Bendigo mine area (Figure 3a and 3b).





Figures 3a and 3b. Top (3a), an iNaturalist record of the endemic terrestrial snail (*Thermia*) from the Dunstan Mountains. The specimen was recorded from near the gold mining area yet was not mentioned in the Habitat NZ report (Habitat NZ 2025a). Bottom (3b), an iNaturalist record of the Tiger beetle *Neocicindela dunedinense* from the foot of the Dunstan Mountains, again near the area surveyed by Habitat NZ Ltd. 2025a.

Data interpretation of the Habitat NZ Ltd. invertebrate survey

45. Given the uncertain count of invertebrate species within the Habitat NZ Ltd. report (Habitat NZ 2025a), it was difficult to calculate the proportion of threatened species-to-total-species. From the available species data, I estimated approximately 0.033 species per hectare, which seems quite low to me (and seemingly at odds with the extensive survey), and yet no comparative information was provided to understand the ecological significance of this value. Habitat NZ also reported on several undescribed beetle species. If this is the case, it suggests the entire surveyed area may have a significant invertebrate fauna (at least for beetles) and I consider it should be further surveyed to determine the population sizes of these new species. No recommendation of this nature was made.

46. The Habitat NZ Ltd. report provided a range of metrics to assess the ecological community. These included species richness (number of taxa), species abundance (number of individuals) and two diversity indices; the Shannon-Weiner and Simpson index. These measures have different philosophical approaches to describing community diversity although both require counts of individuals and an absolute number of species (a value which isn't clear from the Habitat NZ Ltd. report). Shannon's index gives insight on the species evenness within a community while Simpson's index gives insight into rare versus dominant species. Both are valid tests, and each offers a slightly different understanding on the sampled community.

47. The report states *"There were no notable differences in invertebrate family richness, abundance, Shannon's diversity, and Simpson's diversity across survey zones or habitat types (GLMM, >0.05)."* (Habitat NZ 2025a). Essentially, location did not show any variation in taxonomic richness. This is unsurprising because the taxonomic level used for the analysis was at the family level, and one would naturally expect nearly all invertebrate families to occur in most terrestrial habitats. Use of the species level would have provided a finer scale of diversity for the 550ha surveyed. To that extent, the power of the species diversity indices was diluted because the analyses were applied at a coarse taxonomic level.

Invertebrate community structure

48. This section of the Habitat NZ Ltd. assessment was the most important but also in my view the most confusing. The key pieces of information that nearly all invertebrate surveys need to describe are species diversity, relative abundance, species evenness

and in some cases, a species-area curve. Diversity and abundance scores were attended to in the assessment, but there was no information about the other indices in the report.

49. An informative graph for probably all community ecology studies is the relative abundance or ‘rarefaction curve’ (reduction in density). These plots show a characteristic frequency of individuals within species (or taxonomic rank), a characteristic of most communities. Few species tend to dominate while many species become increasing rare and, to some extent, abundance curves also display the complexity, evenness and the resource partitioning within a community.

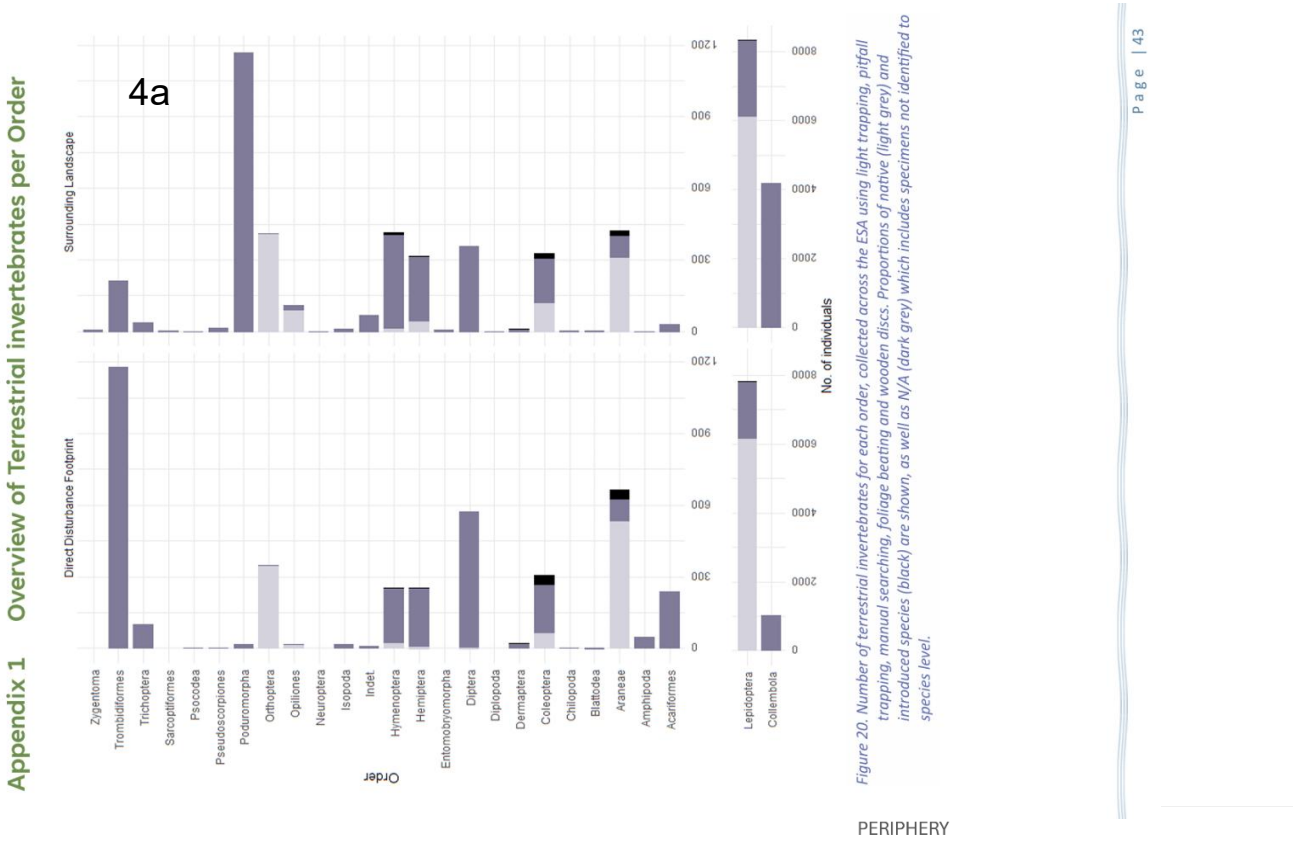
50. The Habitat NZ report did provide a version of the species abundance graph in Appendix 1 of the report (Figure 4, below). The graph and information about the community structure would have been better placed early in the results section. In my view, the report authors did not appreciate the significance of the abundance graph by constructing the plot incorrectly while demoting this critical piece of information in lieu of colourful (but non-intuitive) Principle-Component-Analysis (PCA) plots. To me, the PCA plots contribute little to an assessment of the invertebrate community and may be distracting.

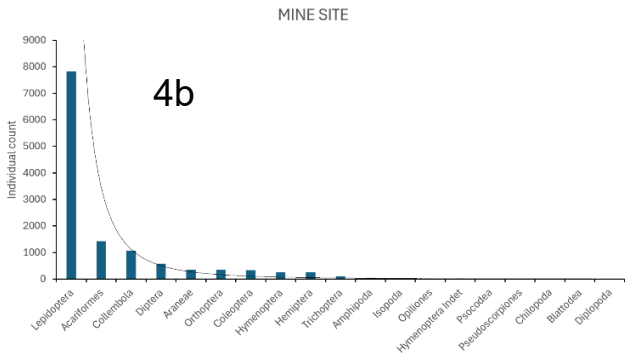
51. I constructed three abundance graphs from the reported raw data and decomposed these into ‘Periphery’ (outside the mine disturbance area), ‘Mine’ (the area proposed for mining and ‘All sites’ (the entire data set). I have grouped the graphs with the original from the report to clarify the information (Figure 4).

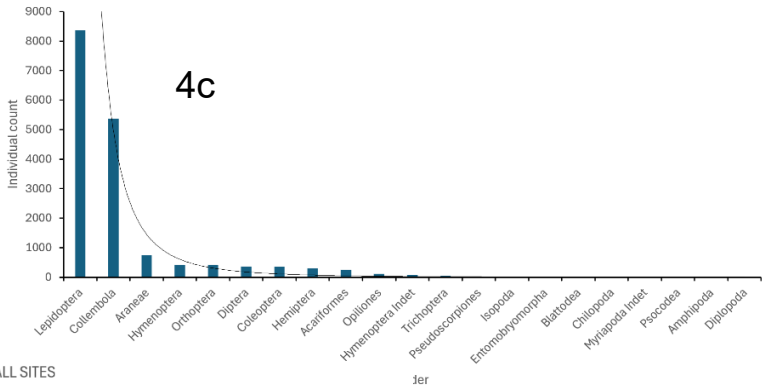
52. Each plot shows a typical ‘asymptotic’ curve and in each graph lepidoptera (moths & butterflies) were the dominant group. This is not surprising given the grassland and native shrubland habitat on the Dunstan Mountains. The next most common group in the graphs were mites and springtails (Collembola). Again, not surprising as these invertebrates are cosmopolitan organisms that occupy most surfaces, soils and vegetation where they consume detritus. In turn, spiders prey on the common invertebrates, and we see they are the third or fourth most common group, illustrating the trophic hierarchy of the sampled invertebrate community. The ecological community is skewed toward moths, mites, flies, spiders and beetles.

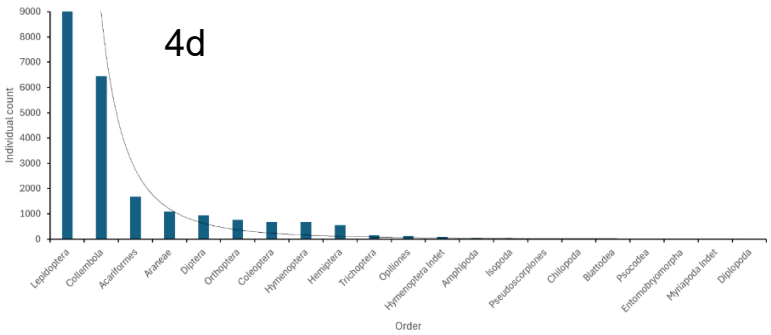
53. From my reading of the Habitat NZ Ltd reports, the authors were less clear about the basic community ecology system at Bendigo than the rigorous statistical manipulations. This is important because it is the community structure that represents the value of an ecosystem, not simply a list of rare or threatened species. An alternative approach is to show the structure and function of an ecosystem, often across any sequences that may exist in an ecosystem (e.g. altitude range, climate variation, soil composition etc).

54. This is the ‘top-down’ approach and it can provide an understanding of how to protect and maintain ecological sequences for long-term insurance. By contrast, the ‘bottom - up’ species approach to conservation has highly beneficial gains for the short term but this can result in biased or highly skewed ecological responses. An extreme example is the artificially refrigerated *Powelliphanta* snail population from the Stockton area on the West Coast. The species survives but the original habitat is in doubt.









Figures 4a-d. Species abundance curves showing terrestrial invertebrate taxa sampled from the western slopes of the Dunstan Mountains during the Habitat NZ Ltd ecological survey, 2025 (4a). Graphs 4b,c and d show the same data re-organised into standard species abundance curves, by sampling area. In this configuration, the community structure can be easily understood and shows that very few species dominate the community while many species are very limited. The lower graphs also indicate that moths, springtails and spiders are the most abundant constituents in this semi-arid, resource-constrained community.

The applicant's approach to ameliorating impacts of hard-rock mining on invertebrate communities at Bendigo

55. On page 17 the applicant's AEE states:

"The overarching objective and intended biodiversity outcome for addressing residual effects is to achieve, where possible, demonstrable benefits to indigenous terrestrial and wetland biodiversity that outweigh impacts within 35 years of granting of approvals" (Alliance ecology 2025).

56. The suggested methods to achieve this outcome include (and I paraphrase); rehabilitating 889 ha of land to the north, south, and east of the DDF. While habitat enhancement will be undertaken using seed sources, propagules and fauna that can colonise and establish within the DDF during the ecological rehabilitation process. In my view, this approach gives an impression of gardening rather than allowing indigenous elements to progressively colonise the hill sides and gullies. I read a sense of urgency and justification from this approach. Haste need not be part of the process. Besides, there is a premier example of long-term ecological restoration through the work of conservation botanist Hugh Wilson at Hinewai, Banks Peninsula. Here, the indigenous vegetation has re-colonised pasture lands in a successional pattern, albeit in the absence of mammalian herbivores, and granted, the annual rainfall is higher.

57. Meanwhile, for invertebrates, the Habitat NZ Ltd TIMP report is more specific, stating;

"The effects hierarchy is applied across a range of management measures designed to protect the highest-risk invertebrate species where possible, their host plants, and their critical habitat."

The report then itemises four key methods to achieve this outcome including;

- Surveying areas prior to open cast mining (presumably to retrieve insects)
- Shifting ('salvaging') grasshoppers and speargrass weevils to another place
- Shifting and re-planting critical host plants (i.e. speargrass)
- Breeding programmes for the moth (*Sporophyla oenospora*) and the grasshopper *Phaulacridium otagoense*.

58. Additionally, protecting native shrublands and trees (e.g. *Olearia* spp.) is presented as an overall invertebrate conservation method. In all, the species conservation ideas are biologically coherent, yet I have reservations about the technical challenges and long-term success of the breeding programmes and the re-locating of *Aciphylla* (speargrass).

59. Depending on the methods, breeding a population of *Sporophyla oenospora* (snout moths) will necessitate obtaining a substantial population of female and male specimens for containment in an insectary. The species is known from as far north as Castle Hill in Canterbury and south to Queenstown (Ben Lomond). Specimens from those locations may be required to prevent a catastrophic crash of the parent population at Bendigo, which may occur through the very effort to re-habilitate the species by harvesting the last of the remnant population (iatrogenesis).

60. In this situation, in my view, there will be two hurdles. Firstly, obtaining the appropriate permits and making a decision about genetic stocks and the long-term genetic diversity. There are significant risks with this proposal. Secondly, the extant population is likely to persist in-situ if pests are kept in check (particularly mice) and by maintaining as much original habitat as possible on the Dunstan Mountains. Captive breeding of grasshoppers may be successful as this has been achieved, to some extent, for *Sigaus robustus*. However, the same attendant requirements as the moth will exist.

61. In my experience working with the Canterbury knobbled weevil, shifting speargrass plants in the hope they will continue to grow is fraught with challenges, not least due to the very long tap root of the plant. Again, it may be more efficient to leave these host plants where they are and perhaps set up predator exclusion fences around thickets of the plants.

62. The intended net gains for invertebrates through the proposed restoration schemes, are extremely uncertain. Unlike vegetation restoration, invertebrates move around and are preyed on by a wide range of predators. In all cases, the Habitat NZ Ltd TIMP seems highly experimental with no proven track record for any of the methods listed. For these reasons and opinions, I consider the proposed mitigation measures for invertebrates to be highly risky, uncertain and were offered with a trial-and-error attitude.

Artificial lighting

63. Matakanui Gold engaged a lighting consultant to assess the exterior lighting effects at the proposed mining operation at Bendigo. Cosgroves prepared a report (Cosgroves 2025) detailing lighting while the Habitat NZ Ltd report detailed invertebrates, yet neither report combined the two factors. However, the Alliance Ecology report did address, to some extent, the ecological issues regarding lighting. My concerns about lighting are

primarily the effects on indigenous moths, other flying taxa and ground dwelling invertebrates.

64. The exterior lighting report offered the following four methods to mitigate effects of artificial light on nocturnal invertebrates:

- No artificial lights to be directed toward the sky.
- That light colour temperature be no higher than 3000 kelvins (orange toned). However, this will not be a strict rule for safety and operation reasons.
- No overnight lighting within areas not involved in mining activity.
- Lights will be directed away from cushion fields for invertebrate benefit and shrouds fitted to some lights (Cosgroves 2025).

65. The report devotes a considerable amount of text to lighting compliance. The chief antagonists to the lighting plan were the native cushion plant habitats and the Central Otago District Council requirements (CODC) to comply with the recent Dark Sky Reserve component of the District Plan.

66. I will not add further detail here about the types of lights, lumens, tower heights etc. The key point is that any lighting is a problem for all nocturnal invertebrates and the more lighting the greater the impact. There is a confident and growing body of scientific literature on the effects of Light Emitting Diodes (LED) on invertebrates, and these lights are being widely used in New Zealand. The intensity of these lights, and their residual blue-spectrum wavelength, is a serious problem for invertebrates.

67. Moths are particularly susceptible to LED as they are attracted to the lights since brightness is more significant than colour temperature. Once attracted, moths will fly around rapidly until exhausted, fall to the ground and can then be eaten by any number of nocturnal predators (see Farnworth *et al*. 2018; McNaughton *et al*. 2022; Pawson and Bader 2014; Schofield *et al*. 2023).

68. While moths are positively phototactic (attracted to light) many other ground dwelling invertebrates are negatively phototactic (repelled by light) and will be forced away from any surfaces they might have previously occupied at night, should artificial light be present. In both cases, broad scale artificial lighting at night (ALAN) will be anathema to the life history traits of the indigenous invertebrate fauna at Bendigo.

Offsetting

69. From my point of view, efforts to offset the loss of invertebrate habitat from the Shepherds Creek catchment, seems highly speculative and risky. This is because the desired results of restoration will likely take a very long time at the mine site due to

extreme environmental conditions (very dry, hot, cold and windy). The composition of the restored surfaces will, likely, be more homogeneous compared to the existing surfaces and adjacent slopes. Under this situation, the surfaces within a modified Shepherds Creek catchment may be more prone to erosion by wind and water than at present. Fresh and eroding surfaces represent a high-disturbance regime. In this situation the 'ecological clock' is being continuously re-set at a frequency greater than the surrounding lands.

70. High disturbance regimes tend to favour exotic vegetation over indigenous flora because the former are almost always disturbance-adapted colonisers (ruderals). In turn, the community of invertebrates that occupy such environments also tend to be introduced species, typically concomitant pollinators, consumers and predators. Examples include bumble bees, honeybees, wasps, ants, white cabbage butterflies, herbivorous beetles, moths, spittle bugs, soldier flies, spiders etc. The outcome is a subtle transition from an indigenous to an exotic invertebrate community that excludes native species.

71. Disturbance to soil horizons is also important. The nymphal stage of native cicada may persist underground for several years (feeding on the roots of native plants). Eventually, the adult emerges, feeds on the sap of native plants, calls, mates and continues the life cycle. Like many of our invertebrates, Cicada are low-disturbance adapted insects. The Habitat NZ Ltd survey report lists five cicada species present at Bendigo (but only three were positively identified as *Kikihia angusta*, *K. rosea* and *Maoricicada clamitans*). The revelation of such high cicada diversity is yet another challenge for the applicant's ecologists to accommodate because the proposal will destroy the habitat of those insects at site.

72. To attempt to offset these matters appears to me like a zero-sum phenomenon in which one gain is equivalent to one loss. I would go further and suggest it will be a nett loss for invertebrate diversity, if nothing more than the subtle erosion of indigenous habitat across the Dunstan Mountains. Habitats of this character in Central Otago, are no longer being formed in the absence of human activity and what remains of indigenous (and somewhat modified) habitat is incrementally reducing, decade by decade. I term this process the 'ecological ratchet', because it describes a one-way trajectory of steady habitat modification, away from the indigenous and toward a more homogeneous biota. The result is a cosmopolitan ecological state of lower intrinsic value.

Conclusions

73. The proposed series of open-pit gold mines in Shepherds Creek, Bendigo, will serve to reduce the occupied area and composition of the existing indigenous invertebrate community. The presence of at least 18 invertebrate species of high conservation

interest or carrying a threat status, illustrates the significance of the area within the ecological region. That Bendigo is rich with endemic moth species also tells us about the importance of tussock grasslands and native shrubland habitat as these are essential host plants to the fauna. And yet these vegetation communities are themselves under constant threat throughout the region, either by fire, agriculture, sub-divisions and, probably, from general complacency.

Proposals by the mine applicant to salvage, breed and re-locate invertebrates of conservation concern, seems to me to be highly risky with considerable uncertainty and little if any proven track record of prior success. Meanwhile, efforts to offset and restore the indigenous invertebrate communities presents (to me), a manifesto that will encourage exotic invertebrate species into an area that currently supports a sustainable community of important native species. In other words, the proposal will have the opposite outcome from that intended.

References:

- B.08 – Alliance Ecology Ltd 2025. Assessment of Ecological Effects: Terrestrial ecology. Bendigo-Ophir gold project. Unpublished client report for Matakanui Gold Limited. pp. 202.
- B.31 – Cosgroves Limited. 2025. Bendigo Ophir Gold Project. Exterior Lighting Report. pp 23.
- B.11 – Habitat NZ Ltd. 2025a. Bendigo-Ophir Gold Project: Terrestrial Invertebrate Survey. Habitat NZ Ltd. Auckland.
- José, D.G.B., Barratt, B. I. P., Sirvid, P., Macfarlane, R.P., Patrick, B.H., Early, J., Eyles, A.C., Johns, P. M., Fraser, P.M., Barker, G.M., Henderson, R., Dale, P.J., Harvey, M.S., Fenwick, G., Mclellan, I.D., Dickinson, K.J.M. and Closs, G.P. 2010. Invertebrate survey of a modified native shrubland, Brookdale Covenant, Rock and Pillar Range, Otago, New Zealand. *New Zealand Journal of Zoology* **28**(3): 273-290.
- Farnworth, B., Innes, J. Kelly, C., Littler, R. and Waas, J.R. 2018. Photons and foraging: Artificial light at night generates avoidance behaviour in male, but not female, New Zealand weta. Environmental Pollution (236): 82-90.
- Habitat NZ Ltd. 2025a. Bendigo-Ophir Gold Project: Terrestrial Invertebrate Survey. Habitat NZ Ltd. Auckland. Unpublished client report for Matakanui Gold Ltd. pp. 69.
- Habitat NZ Ltd. 2025b. Bendigo-Ophir Gold Project: Terrestrial Invertebrate Management Plan. Habitat NZ Ltd., Auckland. Unpublished client report for Matakanui Gold Ltd. pp. 33.
- Johns, P.M. 2005. Field guide to South Island carabid beetles of conservation interest. Department of Conservation, Christchurch. pp 74. ISBN 0-478-226779-9.
- Matakanui Gold Limited 2025. Matakanui Gold Limited Bendigo-Ophir Gold Project. Substantive Application document. Part A .10 Section 3. Project description, A.13 Section 6. Assessment of Environmental Effects and A. 14. Section 7. Management and Monitoring of Actual and Potential Environmental Effects. Section 9 Conclusion. Unpublished client reports.
- McNaughton, E.J., Gaston, K.J., Beggs, J., Jones, D. and Stanley, M.C. 2022. Areas of ecological importance are exposed to risk from urban sky glow: Auckland, Aotearoa-New Zealand as a case study. Urban Ecosystems 25(1): 273-284.
- Patrick, B.H. 1989. Lepidoptera of Central Otago Saltpans. Department of Conservation, Wellington. pp. 43.
- _____ 1994a. Valley floor Lepidoptera from Central Otago. Miscellaneous Series No. 19. Department of Conservation, Wellington. pp. 54.

- _____1994b. Hawkdun Ecological District Invertebrate Survey. Science & Research No. 64. Department of Conservation, Wellington. pp 22.
- _____2000a. Lepidoptera of small-leaved divaricating *Olearia* in New Zealand and their conservation priority. Science for Conservation 168. Department of Conservation, Wellington. pp 26.
- Patrick, B.H. and Dugdale, J.S. 2000. Conservation status of the New Zealand Lepidoptera. Science for Conservation 136.Department of Conservation, Wellington. pp 32.
- Pawson, S.M. and Bader, M.K.F. 2014. LED lighting increases the ecological impact of light pollution irrespective of colour temperature. Ecological Applications 24(7): 1561-1568.
- Peat, N. and Patrick, B. 1999. Wild Central. Discovering the natural history of Central Otago. University of Otago Press. Pp 143.
- Rolfe, J., Hitchmough, R., Michel, P., Makan, T., Cooper, J.A., de Lange, P., Townsend, A.J., Miskelly, C.M. and Molloy, J. 2022. New Zealand Threat Classification System manual 2022. Department of Conservation, Te Papa Atawhai, Wellington NZ. 45pp. www.doc.govt.nz/nztcs
- Schofield, J., Hogsden, K., Greenwood, M.J., Smith, B.J. and Harding, J.S. 2023. The colour temperature and placement of LED lighting near rivers can reduce attraction of flying caddisflies. Freshwater Biology 68 (2) 2095-2108. *DOI /* 10.1111/fwb.14177