Vitenskapskomiteen for mat og miljø
Norwegian Scientific Committee for Food and Environment

Mottatte innspill og respons fra VKM

VKM vil takke for gode innspill/kommentarer i forbindelse med den åpne innspillsrunden av utkastet til protokoll for Miljødirektoratets oppdrag på «Virkninger av klimaendringer på insekter» Oppfordringen til å komme med innspill ble sendt direkte til e-post-adresser til 59 personer og institusjoner den 29. juni 2026. I tillegg ble det lagt ut generell informasjon om den åpne innspillsrunden på VKMs nettsider. Frist for innspill ble satt til 16. august 2026.

Innspillene har vært drøftet; først i prosjektgruppen for oppdraget som har skrevet utkast til respons, og deretter behandlet i godkjenningsgruppen for oppdraget, VKMs faggruppe for biologisk mangfold. (Prosjektgruppen har så drøftet innspillene fra faggruppen og endret responsen i samsvar med disse).

Oppsummert mottok VKM høringsinnspill fra fem ulike aktører/institusjoner. Nedenfor følger alle innspillene i sin helhet med respons fra VKM og en redegjørelse for om innspillet har ført til endring av utkast til protokollen. Innspillene ble levert inn per kapittel og er derfor strukturert slik de er mottatt. Kun kapitler der det er kommet innspill fra den enkelte aktør/institusjon er tatt med. Innspillene er gjengitt på det språket de ble levert inn og står i kursiv.

Dette dokumentet vil bli publisert i tilknytning til den endelige protokollen for arbeidet.

From the University of Oslo (Bastiaan Staar)

<u>On chapter 1:</u>
There is good framing of purpose and scope; the Red List table is a strong evidence anchor; the conceptual framework (Figure 1) is reasonably clean and will do real work organizing the final report; the delimitations subsection (1.4) is honest and well-bounded (no meta-analysis, no species-by-species risk assessment).

VKMs response
Thank you.

Note that 1.2 states ~20,000 species recorded in Norway; 1.4 says ~15,000 recorded out of ~23,000 estimated. These numbers should be reconciled — as written they contradict each other and will be an easy target in open consultation.

VKMs response and changes
The numbers have been reconciled and the introduction cut down in length so they are only mentioned once

The Milankovitch cycles, Medieval Warm Period, and especially the claim about human blood chemistry leaving "healthy ranges" by 2085 read as interesting general context (a bit essay like) but aren't protocol-relevant and introduce a somewhat striking claim resting on a single source. I wonder

if its worth to consider trimming 1.3 substantially or moving the general climate-science primer to an annex, keeping only what's needed to justify the SSP3-7.0/RCP2.6 and 2050/2100 choices.

VKMs response and changes
The section has been trimmed, including the reference to human blood chemistry. It is likely to be used again in the main report as an example of how a lot of biomedical research data only exist for our own species, pointing to a knowledge gap where physiological responses in certain insects may be important but have not been studied.

The implications of using SSP3-7.0 as the main reference scenario will be described in the main report, but justification beyond references will be kept to a minimum as the scenario is established as the official baseline for Norwegian climate risk analyses

Now the protocol does repeatedly state climate and land-use interact, but never operationalizes how; there's no sub-question in Table 2 that asks, e.g., "how does habitat fragmentation modify insects' capacity to track shifting climate envelopes?" It's folded generically into 3a/3.a's catch-all "how do climate change and climatic extremes interact with other drivers" question rather than given its own analytical treatment, even though land-use change is arguably the single largest known driver of insect decline in Europe (larger than climate change alone, per most attribution studies) — I wonder it its worth naming that evidence explicitly rather than listing it alongside pesticides and invasive species as one item among many.

I know its stated that "other human impacts are not the subject of this report, we must assume human-impacted landscapes on at least the current level" (1.3.3). This can be reasonable as a scoping decision, but it's asserted rather than justified, and it's in some tension with 1.4.1's framework, which gives land-use equal visual billing with climate as an input arrow. Worth clarifying explicitly: is land-use change (a) a fixed background condition held constant, or (b) an active interacting variable being assessed? The document currently reads as both simultaneously. While interaction effects are conceptually acknowledged and reasonably well-integrated into the causal framework, but land-use isn't backed by a dedicated review question or search term, which carries the risk of the "acknowledged in principle, thin in method" pattern.
See also this citation: (Death by thousand cuts) that highlights the complexity of the problem.
https://doi.org/10.1073/pnas.2023989118

VKMs response and changes
Very good point and despite the text being shortened we hope this is now better reflected in the protocol text throughout. It certainly will be in the report. Land use is an active interacting variable being assessed, as per the operationalized ToR specifying giving weight to interactions with other man-made impacts on insect populations and the overarching goal to prioritize information useful to the client (the Norwegian Environmental Agency), whose room for intervention is not so much the climate change itself as its interactions with other human activities.
We have not explicitly changed the search terms to reflect this but have made sure that land use change is considered as an important context (as shown in the conceptual model) and is now incorporated in to the data extraction as an important effect modifier.

Although they are relevant, there are a rather high number (60+?) specific questions — which sits awkwardly against the stated approach of purely (or more) narrative (non-quantitative) synthesis

with limited time. It could be worth explicitly tiering these into "core" vs. "addressed if evidence allows," so scope of report versus time given doesn't become a problem later.

VKMs response and changes
Yes. We agree that the list is rather comprehensive. These are questions that are relevant to address as answers to the terms of reference. Likely, available information will not allow us to address all questions.

On chapter 2:
In section 2.1.1.2 (Exposure), "habitat change" appears but there's no explicit "land use" or "land-use change" term in the Boolean string — meaning studies about land-use–climate interactions could be under-retrieved unless they happen to also use climate-specific vocabulary.*

Note that your benchmark test identifies three terminology gaps but doesn't resolve them; the protocol should states explicitly that "beta diversity," "cold tolerance/desiccation resistance," and "non-native/alien species" terms would lead to too many inputs, but does not resolve the lack of finding these benchmark papers if left out.

English-language restriction is reasonable for feasibility but could this be a limitation for a Norway/Scandinavia-specific assessment? Might be worth a sentence acknowledging this more specifically as a limitation (currently it's mentioned almost in passing).

A subset of records will be independently double-screened" yet no percentage or sample-size target is given. Specify this (e.g., 10% of records, or all records at full-text stage) for reproducibility.

VKMs response and changes
The Boolean string will be further refined before the search and changes reported in the “deviations from protocol” section of the main report. We only show the Benchmark testing for WoS, but in other search platforms these benchmarks are returned (e.g. lens.org). Again we will fully report this in the final report with any deviations from the protocol clearly indicated.

Screening has been better described in the report now: “P*rior to formal screening, reviewers will undertake a calibration exercise using a sample of records to ensure a consistent interpretation of the eligibility criteria. Disagreements will be discussed and the screening guidance refined where necessary. Screening will begin with a calibration exercise in which two reviewers independently screen the same initial set of records at both the title-and-abstract and full-text stages. Agreement and the reasons for disagreement will then be discussed, and the eligibility criteria and accompanying guidance clarified where necessary. Further overlapping batches will be independently screened until a consistently high level of agreement is achieved (Cohens Kappa over 0.7). Screening consistency will subsequently be checked using periodic duplicate-screened samples throughout each screening stage, with additional calibration undertaken if new ambiguities or declining agreement are identified. Disagreements will be resolved through discussion and, where necessary, by consensus within the project group. The numbers of records double-screened and the resulting agreement rates will be reported transparently*.”

All limitations in the search methodology will be reported in full in the final report in a section called “Limitations”.

On chapter 3:
I think the The "race between climate shift and ecosystem succession" framework (Figures 2–3) is a genuinely useful, well-illustrated concept, and grounding it in Holocene succession dynamics is a nice touch.

VKMs response and changes
Thank you

Now, I wonder if identified geographic dispersal constraints are overlooked in this climate-race framework analysis. Chapter 3.1's "race" framework (Figures 2–3) models the problem entirely as a within-landscape succession-lag issue — climate zones move fast, forests/habitats mature slowly, species get stranded because their local habitat isn't ready. What it doesn't model is the biogeographic connectivity problem: species shifting their range northward from continental Europe have to physically reach Scandinavia in the first place, and Norway is poorly connected for that purpose.

This matters, as Scandinavia is obviously connected to mainland Europe by only a narrow corridor, essentially through the heavily modified landscape of Denmark/Jutland and the southern Sweden, rather than a broad continuous front. A species expanding its range northward through Germany or Poland has to funnel through this bottleneck before it can even begin colonizing Norway if it manages crossing the Kattegat into Sweden (or hitch a ride on a boat). This is a dispersal-limitation problem, not a habitat-readiness problem. This is exactly the well-documented pattern behind postglacial recolonization lags in Fennoscandia. As many species that are climatically suitable for Norway still haven't fully recolonized since the last ice age purely due to dispersal limitation, not habitat unsuitability. The same bottleneck logic applies going forward under climate-driven range shifts, not just to the historical Holocene recolonization.

I would suggest to add a short subsection or paragraph in 3.1 (perhaps as a companion to Figure 3) explicitly framing Norway/Scandinavia as a peninsula with a narrow continental corridor, distinguishing dispersal-limitation from succession-limitation as two compounding brakes on range tracking. Consider a supplementary figure showing the Jutland/Baltic corridor as a bottleneck, parallel to the existing succession-race diagram; species have to clear two filters (get through the corridor, then find mature habitat) not one.

This also has a search-strategy implication: terms like "range expansion," "colonisation," "biogeographic barrier," or "dispersal limitation" aren't obviously covered by the current exposure/outcome term lists, so it's worth checking whether the benchmark search would actually retrieve this literature. I think this could be a good complement to the mountain/elevation and forest-succession examples already used, as right now the document's spatial imagination is very "vertical" (elevation gradients, succession over time) but not "horizontal" (geographic isolation, corridor width), and both matter for a peninsula like Norway/Sweden.

VKMs response and changes
This is a very interesting set of points. We have chosen to answer it through a stronger integration of the general point of landscape connectivity barriers and land use rather than focusing specifically on

the transport across the Kattegat/Skagerrak. This is mostly because barrier effects are species specific; some species that probably could have been in Norway hasn't reached here after the last ice age yet, whereas the bluetongue virus outbreak along the Norwegian coast in 2024 demonstrated that even small insects like biting midges can be blown across from Denmark (or longer) and still be actively seeking blood meals (infecting cattle and sheep in the process) for further breeding upon arrival just hours or days later. Moreover, most of the focus in the report is on insects already found in Scandinavia, and the dispersion dynamics also apply to species from southern Swedish lowlands to arctic parts of Finnmark, meaning the first crossing into Norway/Scandinavia is only one of many rivers, lakes, fjords, valleys, and agricultural or urban belts that present barriers to species reallocation. Thus, the Skagerrak wasn't singled out in the protocol, but it is obviously an important water barrier and will be explored and integrated in the main report. So while only briefly mentioning the ocean as a barrier from Europe, the specific as well as general point is clearly received and hopefully now better reflected in the text. The comment and point is scertainly remembered for the main report!

On chapter 4:

The four-part decomposition of climate-projection uncertainty (emissions → concentrations → forcing → downscaling) is a nice, precise structure that will serve the report well. I do think the chapter is somewhat thin relative to its importance; about a page total for a topic this central to a "scientific opinion" document. It could benefit from working this out more. For instance, it doesn't explicitly state how uncertainty will actually be communicated in the final report; e.g., will you use IPCC-style calibrated language ("likely," "high confidence"), qualitative High/Medium/Low tags (as in Appendix 2), or something else? It would be best to connect explicitly to the "confidence in evidence" approach described in 2.3.2 and to Appendix 2's bias-rating scheme as of now they read as three separate, unlinked systems.

VKMs response and changes

The four-part decomposition has been expanded to a five-part for clarity and better integration with the IPCC framework, and the point has been extended relative to the length of the protocol. The connection to the "confidence in evidence" approach has been made clearer between the main text, 2.3.2. and Appendix 2, and further operalization connecting the confidence in evidence to calibrated probability language as well as error types is planned.

General comments and suggestions:

Overall, I consider this is a genuinely strong draft for a protocol stage (even if status is "Utkast"). I particularly like the methods chapter with the honest "the benchmark-search transparency". I have not seen this often, the scope is realistic, and the conceptual framework in Ch.3 is a intellectual contribution rather than a filler exercise. The reference list is current and well-integrated.

VKMs response and changes

Thank you. Yes, for a project of this broad scope and sprawling literature that nevertheless must be contained within the current constraints on time, resources and user needs we felt the need to work on the conceptual approach

Note that "we suspect a landscape-level shift towards more disturbance-prone communities..." is already a conclusion (or at least direction towards conclusion), which you may want to avoid. For a

protocol you may want to avoid presenting substantive ecological arguments and even (limited) conclusions and stick to evaluation evidence. (Or present this more as ""working hypotheses to be tested").

VKMs response and changes
Good point. The relevant text has been removed and reframed.

Again, the Table 2's ~60 sub-questions and the seven example ecosystems (3.2) are a lot of ground for a narrative synthesis with no meta-analysis and a small project team. This isn't necessarily wrong, but the protocol would benefit from explicit prioritization/tiering logic: Which questions are core deliverables vs. "if evidence allows" so scope doesn't silently balloon during the actual review.

VKMs response and changes
That is entirely true. The protocol work will be a valuable help, but it is not the end of the story, and further work refining and specifying scope, framing and methods is ongoing and will be a crucial part of the work on the report itself. We have no shortage of challenges ahead of us, and we hope we can call upon the author of these very valuable and helpful comments to contribute again as we go along. The project group will be in touch.

From NIBIO (Bjørn Aril Hatteland)

On chapter 1:
1.3: Important to emphasize cascading effects due to various interactions; host-plant and herbivorous insects, parasitoids-hosts etc. Thus the literature review should be aimed also to find how much knowledge is actually available to predict indirect changes due to various cascading effects.
In table 2, under 3b it would be nice to add "e.g. by natural enemies" when mentioning "pest regulation". This should also be mentioned in terms of general changes in phenology, food webs, overwintering conditions, etc. The term "natural enemies" is often used, and also used in Norway, when referring to predators, parasitoids, parasites, etc. that is part of natural biological control. Often these species are native species and thus also more explicitly may be linked to natural and semi-natural habitats providing pest control as an ecosystem service.

VKMs response and changes
VKM appreciates the good comments. The focus on interactions has been made more explicit in the text and the term term natural enemies has been added to the list (Appendix 1). The general points of cascading effects and ecosystem services are carried over into the main report work, including by drawing on experts in insect-plant interactions

The questions under section 3b (in table 2) in the protocol cover relevant topics related to herbivory, biological control, and pest outbreaks. However, it may be worth considering whether these topics could be specified in greater detail to support a more systematic assessment of how climate change may affect herbivorous insects, their host plants, and their interactions with natural enemies, as well as the implications for ecosystem functions and ecosystem services.

VKMs response and changes
The protocol is itself length constrained and, as noted by another reviewer, exhibits a tension between the already rather high number (60+?) of specific questions against the stated approach of purely (or more) narrative (non-quantitative) synthesis with limited time. We have therefore kept the existing table fairly unchanged for now but note both perspectives and particularly the questions mentioned as to be answered in the main report.

On chapter 3:
Consider including one more insect group for mountains in 3.2. An insect group like beetles that is more affected by fragmentation of specific plants/habitats that decrease because of changes in vegetation (e.g. plant species disperse higher in altitude, trees, bushes increase…)

VKMs response and changes
Apollo-butterflies and alpine ground beetles (Carabidae) are now included in 3.2

General comments and suggestions:
Insects are, as the authors also know, highly diverse both at higher taxonomic levels but also within different groups. It can also be useful to stress the differences between highly specialized species depending on one/few hosts, either its specialized parasitoids of specific host insects or its herbivores or pollinators of specific plants, and more generalist species such as polyphagous predators or herbivores. It is already mentioned in the draft, for instance habitat-specialists regarding genetic

diversity, but we think its also worth keeping in mind for many aspects and the often complexity of factors affecting different species having cascading effects on others due to specific or less specific interactions.

Also, even though the protocol is not intended to be directly related to plant health and food production, effects of climate change on pests could be more emphasized. This also includes alien species, which may have effects both on natural systems as well as being pests. Increased challenges with pests due to climate change may lead to higher use of chemical pesticides which again may also have negative effects on other insects.

Although this falls somewhat outside the current scope of the mandate, VKM may also consider whether climate-driven changes in insect populations could have implications for future monitoring, preparedness, and management measures. Such aspects may be relevant when discussing the broader consequences of climate change on insect populations and their ecological interactions.

VKMs response and changes
This comment is kept in mind for the work with the report as it underlines important points. In particular, the point about implications for monitoring has been discussed and discussions about identifying useful indicators will be part of the main work

From NMBU (Sigmund Hågvar)

General comments and suggestions:
Vi mangler en systematisk verneplan for insektfaunaen. Verneområdene bør være klimarobuste, altså store, med topografi og vannsystemer som hindrer full ødeleggelse ved brann eller stormfelling. Høydegradienter tillater arter å finne igjen sitt klima ved å vandre oppover i stedet for å vandre nordover. Verneområder for viktige enkeltarter bør etableres i artens nordlige utbredelsesområde. Kulturlandskapet må få tilbake mye av den opprinnelige mosaikken. Helt generelt favoriseres insektfaunaen av variasjon i naturtyper. Noen har spesielle krav, bl.a. mange arter villbier som trenger en kombinasjon av nektarrike blomster og sandjord, gjerne sydvendt.

Se ellers bok om Insect Conservation, red. Hågvar & Ødegaard, forlag InTech, fritt nedlastbar.

VKMs response and changes
VKM takker for innspillet og anerkjenner viktigheten av å bevare intakte økosystemer, samt opprette verneområder i artenes nordligste utbredelsesområder som et tiltak for å redusere de negative effektene av klimaendringer.

From Norges Birøkterlag (Bjørn Dahle)

General comments and suggestions:
On page 15, it states that 'the assessment focuses primarily on native insect species occurring in Norway'. We strongly recommend including honey bees (Apis mellifera) in this assessment. Honey bees were probably native to parts of Norway during the medieval warm period. Despite the negative impact of an introduced parasitic mite (Varroa destructor) and the viruses it vectors, several populations of free-living honey bees exist in Europe. As the focus on breeding honey bees that are resistant to the mite increases, the number of free-living honey bee colonies is expected to grow. The western honey bee is also an insect species that may affect other pollinator species, and the distribution of honey bees, either as free-living or managed colonies, may change profoundly during this century.

VKMs response and changes
Currently, honeybees found in Norway are all managed and it is questionable whether honeybees have ever been part of Norwegian biodiversity (VKM et al. 2024). In that sense assessing the effects of climate change on this species is beyond the scope of this report. We will, however, include studies on honeybees if they provide relevant information on climate sensitivity and responses to future climate scenarios, that can improve our assessments of other, less studied, species. However, the potential for establishing free-living populations from Europe or currently native will be kept in mind as a potential effect of the interactions between climate and other human activities,

From Statens Vegvesen (Elin Johanne Slettum)

General comments and suggestions:
Statens vegvesen støtter arbeidet med å sammenstille kunnskap om klimaendringenes effekter på insekter i Norge. Vi vurderer det som særlig positivt at protokollen legger vekt på både direkte og indirekte klimaeffekter, økosystemfunksjoner og samspill med andre påvirkningsfaktorer. Vi anbefaler at den endelige rapporten legger særlig vekt på betydningen av landskapskonnektivitet, samvirkende effekter mellom klima og andre arealpåvirkninger, samt identifisering av praktisk anvendbare tiltak som kan styrke arters og økosystemers robusthet mot klimaendringer. Videre bør sentrale kunnskapshull og usikkerheter synliggjøres på en måte som gjør resultatene relevante for forvaltning og planlegging.

Vi vil også vise til Direktoratsgruppen for oppfølging av norsk handlingsplan for naturmangfold, som ledes av Miljødirektoratet, samt det pågående arbeidet med Tiltaksplan for ville pollinerende insekter 2021–2028. Vi ser en fordel av at disse ulike arbeidene ses i sammenheng. Statens vegvesen vil videre peke på sektorens arbeid med areal- og naturregnskap og vurdering av naturgoder og økosystemtjenester i plan- og utredningssammenheng. Kunnskap om insekters betydning for økosystemfunksjoner som pollinering og biologisk mangfold er relevant for utviklingen av kunnskapsgrunnlaget for naturregnskap og vurderinger av konsekvenser for naturmangfold. Heldekkende kartgrunnlag for naturtyper, leveområder og økologiske sammenhenger er viktig verktøy for å kunne vurdere insektenes funksjon i økosystemene og betydningen av arealendringer og klimaendringer. Slike data er også sentrale i arbeidet med areal- og naturregnskap, hvor målet er å synliggjøre utviklingen i naturverdier, naturgoder og økosystemtjenester over tid, samt danne grunnlag for valg av løsning for å minimere virkning. Kunnskap om insektenes leveområder og utbredelse er en viktig del av dette kunnskapsgrunnlaget. Vi vil også nevne forskningssamarbeidet med NINA; GreenPlan.

VKMs response and changes
VKM takker for det praktiske og konstruktive innspillet. Vi vil legge stor vekt på betydningen av landskapskonnektivitet, samvirkende effekter mellom klima og andre arealpåvirkninger, samt identifisering av praktisk anvendbare tiltak, noe vi håper kommer enda tydeligere frem i den reviderte protokollteksten såvel som videre operasjonalisering.

Vi setter pris på påminnelsen om Direktoratsgruppen for oppfølging av norsk handlingsplan for naturmangfold, Tiltaksplan for ville pollinerende insekter, NINAs overvåkningsprosjekter og andre aktuelle aktører, og vil søke samarbeid for å bidra til at disse arbeidene ses i sammenheng også med