Evidence appendix and limitations

Companion to *Healthy People, Healthy Oceans*, version 2.2. 4 November 2026.

What was done

This release uses targeted primary-source discovery and a local citation-recovery exercise. It does not represent completion of the larger screening programme outlined in RESEARCH_PROGRAMME.md. A publishable narrative discussion can be bounded without being falsely labelled systematic. The revised manuscript has 38 numbered sources, including original research, environmental reviews, scientific risk assessments and context sources. The bibliography is not a count of independent clinical trials. Sources retained for the human-health technical supplement also appear in the main bibliography.

Seven archived conversations were scanned locally: nine unique explicit scholarly URLs and 578 keyword-matching lines/contexts were extracted. This was machine-assisted retrieval, not a full reading of roughly 462,000 words. Keyword windows overlap and are not 578 independent findings. Private records were not submitted to external research engines. Private extraction files are excluded from the public PDF.

Numerous archived citations survive only as generated reference markers without a resolvable source URL. Those markers cannot establish verification. Branch sessions may duplicate content; repetition does not strengthen evidence. The recovered nine links concern a wider health-protocol literature, not nine direct tests of the complete sunlight–mitochondria–cancer hypothesis. Dai and Sinha were reconstructed/located as related primary studies; their presence should not be misrepresented as a direct URL recovered from each original session.

Search approach and access

Targeted web searches located original journal articles and PubMed records. Queries included: “Sun-D trial 2025 sunscreen vitamin D”; “Nambour sunscreen randomized trial baseline characteristics diet body mass index”; “Dai 2018 magnesium vitamin D randomized trial calcium magnesium ratio 2.3”; “Sinha 2013 vitamin D mitochondrial oxidative function”; “sunscreen oxybenzone coral Science 2022 phototoxicity glucoside”; “sunscreen absorption Matta 2020”; “zinc oxide nanoparticles sunscreen human skin volunteers”; and “clothing vitamin D photosynthesis”. Earlier searches examined mitochondrial respiration in melanoma, nicotinamide trials and sunscreen aquatic risk. Search date: 4 November 2026.

Web search rankings and result snippets are not an exhaustive database sample. No defensible PRISMA record counts or comprehensive search-sensitivity claims can be made. Publisher/PubMed content was retrieved where possible; some PMC and publisher pages returned access challenges. Abstract-based results are suitable for cautiously describing reported designs and findings, not certifying every methodological detail. The full screening, formal bias assessment, corrections/retractions audit and complete conflict-of-interest extraction remain outside this release.

Claim-to-source ledger

Manuscript claim	Sources	Evidence level / release limitation
COP31 context and public invitation	1–2	Public post and official event information; only visible public comments, not complete authenticated discussion.
Larger reef pressures	3	NOAA context; paper does not quantify relative global contributions.
Fabric can inhibit vitamin D photochemistry	4	Experimental mechanism; no universal deficiency or cancer estimate.
SCC tumour counts differ from first-person incidence	5	Original randomised study record; no inference that all skin cancers respond identically.
Melanoma results and uncertainty	6	Original journal results; few events and long follow-up.
Vitamin D action spectrum	7	Human photobiology; no personalised exposure threshold.
High-SPF effect on vitamin D	8	Randomised trial, original abstract results; deficiency is exploratory.
Oral supplementation and sunlight are distinct comparisons	9	Randomised comparison identified; no claim of superiority or equivalence for cancer.
VITAL overall incidence result	10	Randomised trial; overall endpoint, not proof every subgroup has no effect.
Magnesium–vitamin D interaction	11	Original trial; metabolite outcome, not demonstrated skin-cancer prevention.
Improved muscle oxidative function after deficiency treatment	12	Twelve-person longitudinal study; no randomised causal estimate or skin-cancer endpoint.
Mitophagy/mtDNA response following UVB	13	Immortalised cell model; clinical mediation unproven.
Direct DNA photochemistry	14	Cells/purified DNA/oligonucleotides; lesions are not tumours.
Mitochondrial capacity can support melanoma cells	15	Tumour/cell experimental evidence; normal-cell and tumour contexts differ.
Nicotinamide results differ across host settings	16–17	Separate randomised trials; rate of new cancers, not necessarily fraction of people affected. Not vitamin D trials.
Organic-filter systemic absorption	18	Pharmacokinetic RCT; does not estimate cancer incidence.
Intact particles versus dissolved zinc	19–20	Short human/ex vivo studies; cannot certify every product, damaged-skin scenario or long-term outcome.

Manuscript claim	Sources	Evidence level / release limitation
Oxybenzone phototoxic metabolites	21	Laboratory organism mechanism; not global attributable reef mortality.
Need for ecological risk assessment	22–23	Reviews; source experiments require individual assessment for quantitative regulatory decisions.
Six stewardship proposals	Author synthesis	Proposed actions and study designs; not claimed to be experimentally validated interventions.

Statistical checks

Sun-D: 139/304 = 45.72%; 115/312 = 36.86%; crude difference = 8.86 percentage points. Denominators refer to final samples, not all randomised participants. The manuscript rounds this to approximately 8.8 percentage points using published rounded percentages. The reported model-based prevalence ratio is not reproduced by simply dividing rounded percentages; the manuscript therefore does not quote or reverse-engineer it. The continuous outcome is an adjusted between-group effect, not a claim of absolute decline in every participant.

Nambour melanoma: the overall HR interval includes 1; its invasive-subset interval does not. Do not call the former proof of no effect or combine subset significance into a universal cancer-prevention claim. Hazard ratios are not absolute risk reductions. No number-needed-to-treat is manufactured from them.

SCC: tumour rate and people with a first tumour are separate endpoints. Do not switch denominators or claim prevention of all skin cancers from a tumour-count result.

Nicotinamide: rate reduction is not a percentage-point reduction in people developing cancer. The transplant null trial has limited precision and stopped early. It does not prove identical outcomes in every patient.

Vitamin D and mitochondria: a small before-and-after improvement supports plausibility but not the entire causal pathway. No pooled effect or mediation percentage is calculated.

Interactions to investigate next, if the paper is expanded

Record actual evidence for diet, adiposity, diabetes, inflammatory state, stress and mineral status instead of using them as interchangeable proxies. Distinguish confounders, mediators and effect modifiers; indiscriminate adjustment can introduce bias. Search effects in both directions: UV may affect mitochondria, mitochondrial state may affect response, and tumour metabolism can differ from normal tissue. Defining 'healthy mitochondria' requires tissue-specific measurements rather than a general wellness label.

Release status

Complete narrative review draft and companion documents; not independently reviewed or comprehensive. Suitable for Juan's substantive review and a clearly labelled discussion-paper release after he accepts authorship and wording. It must not be represented as Harvard Business Review publication, PhD research, clinical guidance or WWF endorsement. A formal publishability certificate is not implied. No outreach or posting has occurred.

Marine-focused revision

Added sources 24–34 and moved detailed human-health discussion into a separate technical supplement. Primary abstracts for PMIDs 30516955, 30458376, 30904653, 29801220 and 26487337 were retrieved via Europe PMC and preserved in MARINE_PRIMARY_RECORDS_v2.json. Exact exposure concentrations must not be compared across compounds as if interchangeable. ACS full text for source 29 was blocked; only its indexed description was used. WWF sources support ecosystem relevance, not endorsement of this paper. The paired human-exposure/vitamin D hypothesis remains untested in the retrieved evidence. No quantitative synergistic effect is claimed.

Catchment-to-reef addition, version 2.2

Sources 35–38 support the added transport/fate section. Source 35 is a chapter of source 22, not an independent study. The new studies were checked through original bibliographic abstracts and indexed descriptions; no full hydrodynamic recalibration or independent model validation was performed. The five-stage assessment is an author-directed synthesis, not a tested protocol. It distinguishes unmeasured possibilities from demonstrated interactions and explicitly allows higher or lower predicted exposure. The paper does not assert that specialist models generally fail or that all river deltas accumulate filters. Climate attribution remains outside scope.