October 11, 2019

Humboldt County Planning Commission
Planning and Building Department
3015 H St. Eureka, CA 95501

RE: Comments on Memo Supplements to Cultural and Botanical Reports for the Humboldt Wind Project

He'bla'lo (Greetings),

This letter is to reiterate Wiyot Tribe comments on findings from the Cultural Resources Phase 1 Inventory and the Botanical Inventory for the Humboldt Wind Energy Project, based on supplemental findings from 2019 in areas not previously inventoried or presented within the DEIR. The Wiyot Tribe have vehemently expressed opposition to this wind development proposal due to the cultural and biological diversity found within the project and surrounding areas. Environmental impacts and impacts to tribal cultural resources (TCRs) and areas potentially eligible for listing under the National Register of Historic Places (NRHP), and the Bear River Ridge (***Tsakiyuwit***) cultural and ethnobotanical landscape would be significant (Impact 3.6-3).

Recently identified sites DN01 and DN02 (Stantec 2019) add to the body of evidence that ***Tsakiyuwit*** was an actively used cultural landscape by Indigenous peoples, including the Wiyot and other groups pre-historically. These two sites are also located within the designated Wiyot ethnobotanical landscape, which further validates the value of the ridge as a TCR. Site DN02 is quite large with two potential house pits and 27 artifacts discovered, including Borax Lake pattern projectiles, and "cumulatively, approximately 200 +/-flakes were observed, with varying colors including reddish-brown, red, brown, grey, tan, grey-green, lavender, orange, pink and rainbow colored cryptocrystalline silica (CCS) and quartzite. Tools observed included: six flake tools, ten projectile points; six bifaces; four core tools, and one awl", which contribute to significance of the site (Eidsness pers. comm 2019). While the memo notes that the site is outside the impact area of the project, it is immediately adjacent to Monument Road, the primary access road for the project, which has a potential expanded project footprint of 200 feet across. While Stantec assumes that the site has low integrity, it is likely that there is a buried deposit (Eidsness pers. comm 2019). With the density of known sites found along ***Tsakiyuwit***, it is likely that other lithic scatters and sites are present sub-surface, which would be impacted by the project turbine foundations, string roads, and primary road expansion. Without the schematics of the proposed road improvements, we are not able to fully evaluate impacts. Due to the number of truck trips per turbine, the potential for additional road and construction complications, combined with the unstable geology of the area, it is likely that more sites will be exposed and impacted. This is significant in that the area has both Tuluwat and Borax Lake pattern artifacts, which gives emphasis to the cultural and archaeological value of the ridges. This site is potentially eligible for listing under the National Register of Historic Places/California Register of Historic Places (NRHP/CRHP) under Criterion D "Information Potential" due to the density and types of artifacts found at the site.

The expanded botanical report does not include several areas which were also not surveyed during the 2018 report, nor does it explain why areas were not surveyed, other than claiming "no access". Additionally, there is no mention to the natural communities and vegetation alliances and associations present within the 2019 survey areas. This is significant in the project area is a large ecological transect extending over 30 miles from the coastal zone and coastal prairies in the west, to the oak woodlands and grasslands around Bridgeville in the east, encompassing one of the more diverse regions of California. Evaluation of sensitive natural communities within all portions of the project should be available for review by the Tribes, agencies, and the public.

As noted in the Wiyot Tribe's comments during the Assembly Bill No. 52 (AB 52) consultation process, the Tribe made clear the importance and richness of the cultural and natural values and resources found on Bear River Ridge, ***Tsakiyuwit***, a hugely significant component, piece, and defining feature of the larger Wiyot cultural landscape, a protected tribal cultural resource (TCR) in the State of California under the California Environmental Quality Act (CEQA). The site has been noted as a "high prayer spot" by Wiyot Tribal chairman, Ted Hernandez. The environmental, physical, and spiritual impacts that up to sixty (60), six-hundred foot-tall (600 ft.) wind turbine generators (WTGs) and the combined road and infrastructure expansion would have upon the cultural landscape and cultural sites of the Wiyot Tribe, and greater community, are un-mitigatable, and it is the recommendation of the Tribe that the project be denied, and the County select the "No Project" alternative. The "No Project" alternative is also noted in section 6.4 of the DEIR to be the environmentally superior alternative, re-affirming the position of the Wiyot. The position for "No Project" was reiterated by a unanimous vote at the June 10, 2019 Wiyot Tribal Council meeting.

The commanding view from ***Tsakiyuwit*** provides a vantage of virtually all of Wiyot ancestral territory, and as such, has been presumed by Tribal elders to have been a high prayer spot (Ted Hernandez, pers. comm 2019). In retrospect, ***Tsakiyuwit***, can be viewed from the rest of Wiyot ancestral territory, including Table Bluff and the Humboldt Bay area. The impact from sixty 600 foot-tall wind turbines would, for a likely many generations, alter the spiritual and sacred viewshed of the Wiyot cultural landscape, and there is no possible way to mitigate the impacts that this project would have upon the rights of the Wiyot Tribe. For even longer, the large concrete pads will forever impact the hydrology of the ridge crest. Recent power outages and extreme wildfire conditions in northern California highlight the danger of remote transmission lines along this gen-tie route, which could jeopardize the massive carbon storage within the Humboldt Redwoods State Park and the Van Duzen River corridor forests. This is unacceptable.

The Tribe recommends that the project be denied on the grounds of un-mitigatable impacts to ***Tsakiyuwit***, its culturally important sites, flora, fauna, and the remainder of Wiyot territory that is within its viewshed. The Wiyot Tribe have experienced mass genocide and been robbed of most of their sacred lands around Humboldt Bay and the lower Eel River. Much of their ancestral land has been developed, or the native vegetation types they helped to shape and tend, converted to alien pasture grasses and weeds. In the spectrum of impacted landscapes, ***Tsakiyuwit*** has persisted to the present as an iconic gem of native coastal prairie, that still holds the signs of the Wiyot's caretaking and stewardship. Thank you for your time, consideration, and concern regarding our concerns over the magnitude of this development project.

Rra'dutwas (with kindness)

Adam N. Canter,
Tribal Botanist, GIS, and THPO Cultural Assistant
Table Bluff Reservation
1000 Wiyot Dr., Loleta, CA 95551
adam@wiyot.us 707-733-5055

From: Tom Wheeler <tom@wildcalifornia.org>
Sent: Thursday, September 12, 2019 7:51 AM
To: Ford, John <JFord@co.humboldt.ca.us>
Subject: Joint letter re: Terra-Gen

Dear John,

Attached please find a joint letter from the North Coast conservation community about the necessary changes and conditions for the Terra-Gen project. These largely mirror the comments EPIC submitted earlier this summer.

Please let us know if you have any questions about this letter. Thank you for your openness throughout this process.

--
Tom Wheeler
Executive Director and Staff Attorney
Environmental Protection Information Center
145 G Street Suite A
Arcata, CA 95521
Office: (707) 822-7711
Cell: (206) 356-8689
tom@wildcalifornia.org
www.wildcalifornia.org

"If EPIC had not undertaken its lonely efforts on behalf of the Marbled Murrelet, it is doubtful that the species would have maintained its existence throughout its historical range in California." - Judge L. Bechtle, *Marbled Murrelet v. Pacific Lumber Co.*

epic

Sent via email on date shown below

September 27, 2019

Director John Ford
Humboldt County Planning Department
3015 H St
Eureka, CA 95501

Dear Director Ford,

On behalf of the Environmental Protection Information Center (EPIC), please accept these comments concerning recently published science on the decline of hoary bats in the Pacific Northwest, likely because of wind energy development. This new science may affect the Planning Department's consideration of the proposed Humboldt Wind Project.

Rodhouse et al. (2019) investigated potential bat populations declines in the Pacific Northwest for both the little brown bat and the hoary bat. Based on eight years of survey data, Rodhouse et al. found evidence of region-wide summertime decline for the hoary bat since 2010 yet no apparent decline for little brown bats. As the study concluded, given the conservative construction of the survey, such evidence of decline is "alarming." The study's authors theorize that the most likely cause for this decline is fatalities from wind energy facilities.

This study is important because it provides support for the modeled population decline presented in Frick et al. (2017). Frick et al., using population models, estimated that the population of hoary bats could decline by as much as 90% in the next 50 years because of existing wind energy projects.

Rodhouse et al. (2019) further reinforces the DEIR's conclusion that the Humboldt Wind Project is likely to result in significant impacts to hoary bats. As the DEIR recounts:

> [H]oary bats have been captured in exceptionally high numbers, especially during the fall, at the Humboldt Redwoods State Park study site approximately 4 miles from the project site. This discovery of what may be fall swarming behavior of hoary bats has not yet been documented anywhere else, it could represent a vital life history component for this species, and it may demonstrate a seasonal concentration of mating hoary bats from all over western North America.

> Locating a wind farm so close to this unique concentration of hoary bats may increase the mortality of this species if they use or are attracted to the project site following construction.
>
> Although threats associated with the proposed project are similar for the other bat species found in the area, the high hoary bat mortality rates associated with wind farms and the exceptionally high numbers of hoary bats documented near the project site provide substantial evidence that the project could cause a large number of hoary bat fatalities on an annual basis over the 30-year life of the project. Because little empirical demographic and population data exist for the species, it is difficult to evaluate the significance of such high fatality. Recent contradictory genetic studies have indicated that hoary bats may reproduce within local populations with a small effective size, or that all North American hoary bats may represent a large and well-mixed population. If the former, the proposed project would have the potential to eliminate a high proportion of a local population of hoary bats over a long period of time. If the latter, the proposed project would have the potential to create a population sink for a large and widespread population over a long period of time. Either would be an adverse effect that could cause a wildlife population to drop below self-sustaining levels or threaten to eliminate an animal community. This impact would be potentially significant. (DEIR at 3.5-135–136 (internal citations omitted)).

EPIC is concerned that the Humboldt Wind Project, as described in the DEIR, is likely to further contribute to the decline of the hoary bat. Given the likely significant impact, the county has an obligation to adopt all feasible mitigation measures to reduce the impact of the project. Thankfully, operational curtailment can significantly reduce hoary bat mortality with minimal power loss and has been adopted at other project sites. EPIC continues to insist that operational curtailment be included as a required mitigation measure.

Should you have any questions or concerns, please do not hesitate to contact me at tom@wildcalifornia.org or (707) 822-7711. Thank you for your attention to our concens.

Sincerely,

Thomas Wheeler

Thomas Wheeler
Executive Director and Staff Attorney

Attachments: Rodhouse, T. J., Rodriguez, R. M., Banner, K. M., Ormsbee, P. C., Barnett, J., & Irvine, K. M. (2019). Evidence of region-wide bat population decline from long-term monitoring and Bayesian occupancy models with empirically informed priors. *Ecology and Evolution.*

CC: Natalynne DeLapp, Terra-Gen
Kevin Martin, Terra-Gen
Nathan Vajdos, Terra-Gen

Gordon Leppig, California Department of Fish and Wildlife
Michael van Hattem, California Department of Fish and Wildlife
Jennifer Olson, California Department of Fish and Wildlife

From: Nathan Madsen <n84now@gmail.com>
Sent: Thursday, August 22, 2019 8:57:12 PM
To: Ford, John <JFord@co.humboldt.ca.us>
Subject: TerraGen

John,

I hope this finds you well.

I am attaching the Joint letter to this email as it more or less accurately represents my views on the TerraGen wind project.

Though I generally am a strong proponent of alternative "green" energy, this is the wrong project for all the right reasons. Simply put we are never going to "save the planet" by spoiling our last incredibly precious, biologically sensitive, and as of yet unspoiled locations. This is one of those locations.

Please do support a diverse power generative program with rooftop solar (power infill if you will) and other alternative projects. For example, those rooftop solar installations would benefit from north side wind generation using alternative bird-friendly harnessing techniques. They come in a variety of alternative to blade driven turbines. Also, micro-hydro is a great alternate option and could be done with rooftop rain catchment if we prefer not to tamper with the creeks. If we do use creek sourced hydro power then we should use headwaters regions i.e. above fish and other sensitive species habitat and implement biota friendly water intake systems.

Just a few ideas as alternatives to the proposed project. The next phase of human development needs to model a distributed power model where production is localized and sited appropriately.

The current proposal is unfortunately placed in one of the most precious bird meccas of our region. Simply poor siting for the wrong project.

In Stong Support of Clean Energy; Not this Project,

Nathan Madsen, Esq.
n84now@gmail.com
(707) 223-2565
P.O. Box 128
Petrolia, CA 95558

From: McQuillen, Kassandra <Kassandra.McQuillen@ttu.edu>
Sent: Wednesday, October 30, 2019 1:25 PM
To: Shortridge, Tricia <TShortridge@co.humboldt.ca.us>
Cc: serc@humboldt.edu
Subject: Humboldt Wind Energy Project

Hello Ms. Shortridge. I am an HSU alumni and former Eureka resident. I happened upon the Humboldt Wind Energy Project today while searching for information on offshore wind projects on the west coast. I am not an instructor at the National Wind Institute at Texas Tech University and have a fair bit of experience with land-based wind development in California. I have worked with Terra-Gen on wind energy projects quite a bit in Kern County.

I have a fondness for Humboldt County and thought I would make sure that the county is protecting its landowners and properties and asking the right questions of the developers. I negotiated many landowner lease agreements with Terra Gen and those agreements often omit the decommissioning and/or remediation bond requirements. Terra Gen will form an LLC to construct and operate the project. Once the project passes its useful (profitable) life, that LLC will dissolve and there will be no funds for the remediation of the project and Humboldt County will be left with the blight and no funds to clean up. This is happening across the U.S. right now as local communities realize once the wind site is no longer profitable, the developer and operator will leave. Just google "abandoned wind farms". There are 80,000 wind turbines in the U.S. these days and this is going to be a big issue in the coming decades.

Specific issues to address to protect Humboldt County include:

1. Posting of a decommissioning bond sufficient to pay for remediation (currently minimum of $200,000+ per turbine with only $60,000 scrap value.) Just ask Terra Gen what the plan is for this. Make sure you set up a fund or bond to be paid out by the LLC at certain stages of the project - usually after years 10, 15 and 20. Request assurances of ability to pay.
2. Wind turbine blades are not recyclable. The current practice is to cut them into smaller sections and put them in landfills. Modern blades (3 per turbine) are 200-300 feet in length. Imagine what the county will do with 300 football field length chunks of fiberglass composite? Are the county landfills prepared for this?
3. Wind turbines are known to have fatigue, performance problems and wear down more quickly when placed on ridge lines. Ask Terra Gen for data on their Alta projects in Kern County to see the operations and maintenance issues involved with ridge-sited turbines. The industry frowns upon this practice as irresponsible. The wildlife impacts are often far greater in mountainous regions as well.
4. Good luck and feel free to call me to discuss this if you'd like. I am not against wind energy development and I understand the crisis PG&E has caused in Humboldt County, but wind projects must be sited responsibly.
5. All of these concerns flow over into the offshore wind projects as well.

Hopefully you have addressed these issues and I am just being a meddling former resident.

Best regards,

Kassandra McQuillen, J.D.

Instructor

National Wind Institute

Texas Tech University

https://www.depts.ttu.edu/nwi/education/BSWE/index.php

National Wind Institute, Room 104A

From: Jesse Noell <noelljesse@gmail.com>
Sent: Friday, August 30, 2019 12:16 PM
To: Lippre, Suzanne; McGuigan, Connor; Madrone, Steve
Subject: Front End Loading by TerraGen's DEIR

Hi Suzanne, Connor, and Steve:

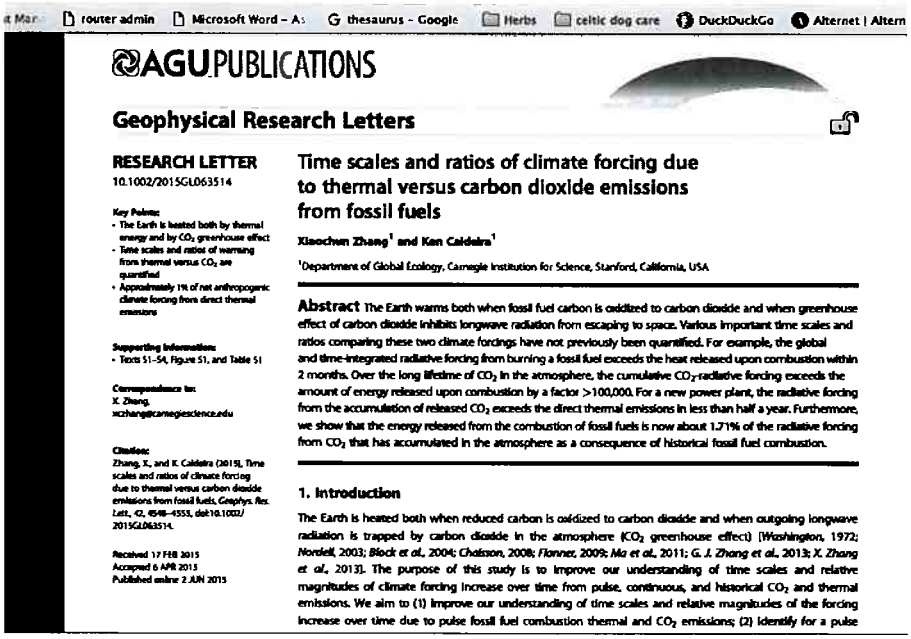
My comments regarding the DEIR and project impacts use the terms "front end loading" and "heat engine". I would like to elaborate to include the meaning of climate forcing into my use of front end loading in my comments, so that the Planning Commission provides an apt response to my comments.

My point is that a proper impact analysis would compare the corresponding effects and impacts of other feasible alternatives. In point, the long term climate forcing by generating Humboldt's electricity using solar panels on rooftops will be different (likely much less) than by construction of TerraGen's proposed wind project.

Here is a study regarding climate forcing https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1002/2015GL063514

See below:

/agupubs.onlinelibrary.wiley.com/doi/pdf/10.1002/2015GL063514



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AGU PUBLICATIONS

Geophysical Research Letters

RESEARCH LETTER
10.1002/2015GL063514

Key Points:
- The Earth is heated both by thermal energy and by CO_2 greenhouse effect
- Time scales and ratios of warming from thermal versus CO_2 are quantified
- Approximately 1% of net anthropogenic climate forcing from direct thermal emissions

Supporting Information:
- Texts S1–S4, Figure S1, and Table S1

Correspondence to:
X. Zhang,
xczhang@carnegiescience.edu

Citation:
Zhang, X., and K. Caldeira (2015), Time scales and ratios of climate forcing due to thermal versus carbon dioxide emissions from fossil fuels, Geophys. Res. Lett., 42, 4548–4553, doi:10.1002/2015GL063514.

Received 17 FEB 2015
Accepted 6 APR 2015
Published online 2 JUN 2015

Time scales and ratios of climate forcing due to thermal versus carbon dioxide emissions from fossil fuels

Xiaochen Zhang[1] and Ken Caldeira[1]

[1]Department of Global Ecology, Carnegie Institution for Science, Stanford, California, USA

Abstract The Earth warms both when fossil fuel carbon is oxidized to carbon dioxide and when greenhouse effect of carbon dioxide inhibits longwave radiation from escaping to space. Various important time scales and ratios comparing these two climate forcings have not previously been quantified. For example, the global and time-integrated radiative forcing from burning a fossil fuel exceeds the heat released upon combustion within 2 months. Over the long lifetime of CO_2 in the atmosphere, the cumulative CO_2-radiative forcing exceeds the amount of energy released upon combustion by a factor >100,000. For a new power plant, the radiative forcing from the accumulation of released CO_2 exceeds the direct thermal emissions in less than half a year. Furthermore, we show that the energy released from the combustion of fossil fuels is now about 1.71% of the radiative forcing from CO_2 that has accumulated in the atmosphere as a consequence of historical fossil fuel combustion.

1. Introduction

The Earth is heated both when reduced carbon is oxidized to carbon dioxide and when outgoing longwave radiation is trapped by carbon dioxide in the atmosphere (CO_2 greenhouse effect) [*Washington*, 1972; *Nordell*, 2003; *Block et al.*, 2004; *Chalson*, 2008; *Flannet*, 2009; *Ma et al.*, 2011; *G. J. Zhang et al.*, 2013; *X. Zhang et al.*, 2013]. The purpose of this study is to improve our understanding of time scales and relative magnitudes of climate forcing increase over time from pulse, continuous, and historical CO_2 and thermal emissions. We aim to (1) improve our understanding of time scales and relative magnitudes of the forcing increase over time due to pulse fossil fuel combustion thermal and CO_2 emissions; (2) identify for a pulse

Hope this helps,

Jesse Noell

From: Jesse Noell <noelljesse@gmail.com>
Sent: Friday, October 11, 2019 11:56 AM
To: mmarshall@redwoodenergy.org; Madrone, Steve; McGuigan, Connor; Lippre, Suzanne
Subject: What is the cost to underground Humboldt Wind Project transmission lines?

Dear RCEA Board and Humboldt County Planning Commission regarding Humboldt Wind Project:

Does RCEA's contract for Humboldt Wind power make economic sense without underground transmission lines? Who pays the insurance costs if the lines are not put underground? How much of this cost burden will the ratepayer assume? How much would a Humboldt County solar rooftop with V2G (vehicle to grid) battery system cost? Why is Humboldt Wind the least damaging alternative?

PGE's 134,000 miles of high voltage lines x $5 million per mile = $100 Billion
see https://www.sfchronicle.com/bayarea/article/Underground-power-lines-don-t-cause-wildfires-12295031.php

Based on the SF Chronicle's estimate, the cost to underground the Humboldt Wind lines---25 miles = $125 million; who pays? If the ratepayer pays, can the ratepayer afford it or will implementation of Humboldt Wind Project assure that grid abandonment results?

Thank you for your consideration. I look forward to hearing your response to these questions soon. As a ratepayer I am directly affected.

Jesse Noell

From: Jesse Noell <noelljesse@gmail.com>
Sent: Tuesday, August 20, 2019 6:01 PM
To: Lippre, Suzanne
Subject: Fwd: https://greenmountainpower.com/bring-your-own-device/

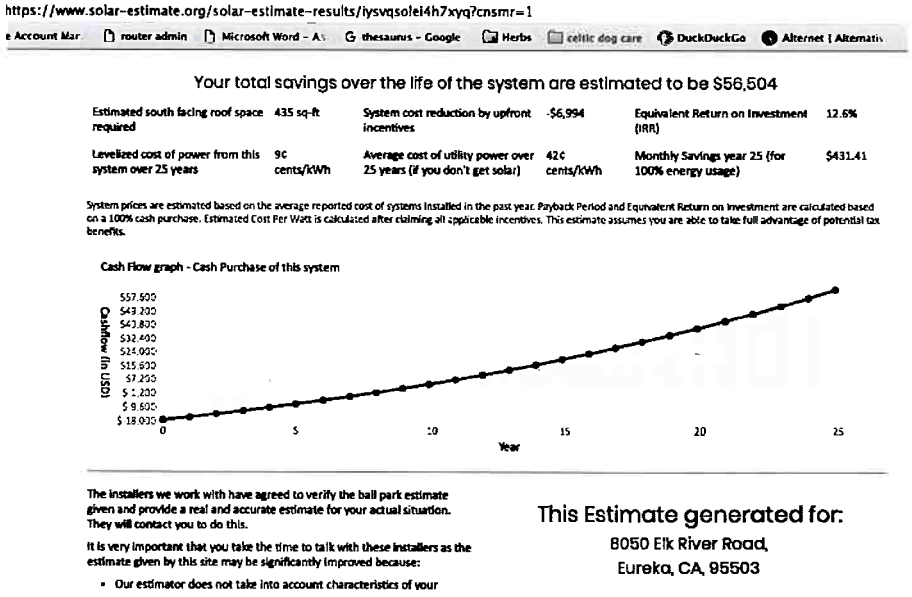
Hi Suzanne, Would you please provide this information and links and comment to the Planning Commission re: Humboldt Wind Project?

I found the Humboldt Wind Project DEIR to be wildly misleading and inaccurate, furthermore Terra Gen is a solar installer so should have compared the impacts of the project to a Humboldt Solar Project in its determination of cumulative impacts and effects. It appears that RCEA as utility, the Planning Commission as planner, and the County Supervisors all have a fiduciary responsibility to assure that ratepayers the lowest carbon footprint project, and that other impacts are avoided or mitigated to the maximum. Overriding economic considerations require this, no?

---------- Forwarded message ---------
From: **Jesse Noell** <noelljesse@gmail.com>
Date: Tue, Aug 20, 2019 at 5:30 PM
Subject: https://greenmountainpower.com/bring-your-own-device/
To: McGuigan, Connor <cmcguigan1@co.humboldt.ca.us>, Madrone, Steve <smadrone@co.humboldt.ca.us>

Hi Connor and Steve,
Does Humboldt County offer these kinds of services to reduce our citizens' carbon footprint while providing battery to grid?
https://greenmountainpower.com/bring-your-own-device/

I recently got this quote, and it substantiates resilient rooftop as being the low cost and low impact leader, while keeping large amounts of "saved" money in the local economy--- instead of exporting profits from selling wind to local rate payers to wall street:


https://www.solar-estimate.org/solar-estimate-results/iysvqsolei4h7xyq?cnsmr=1

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Your total savings over the life of the system are estimated to be $56,504

Estimated south facing roof space required	435 sq-ft	System cost reduction by upfront incentives	-$6,994	Equivalent Return on Investment (IRR)	12.6%
Levelized cost of power from this system over 25 years	9¢ cents/kWh	Average cost of utility power over 25 years (if you don't get solar)	42¢ cents/kWh	Monthly Savings year 25 (for 100% energy usage)	$431.41

System prices are estimated based on the average reported cost of systems installed in the past year. Payback Period and Equivalent Return on Investment are calculated based on a 100% cash purchase. Estimated Cost Per Watt is calculated after claiming all applicable incentives. This estimate assumes you are able to take full advantage of potential tax benefits.

Cash Flow graph - Cash Purchase of this system

The installers we work with have agreed to verify the ball park estimate given and provide a real and accurate estimate for your actual situation. They will contact you to do this.

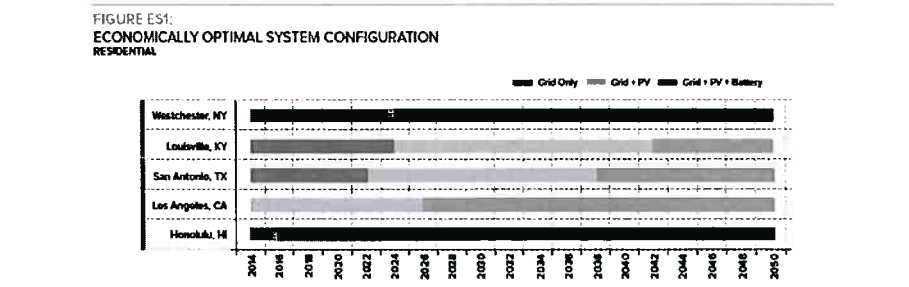
It is very important that you take the time to talk with these installers as the estimate given by this site may be significantly improved because:

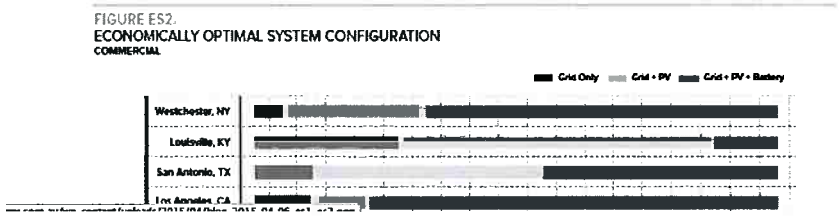
- Our estimator does not take into account characteristics of your

This Estimate generated for:
8050 Elk River Road,
Eureka, CA, 95503

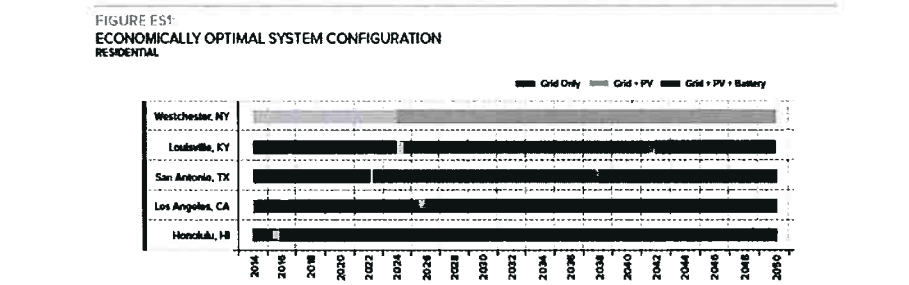
In 2015, Rocky Mtn. Institute analyzed grid defection trends and predicted that rooftop solar / battery wins:

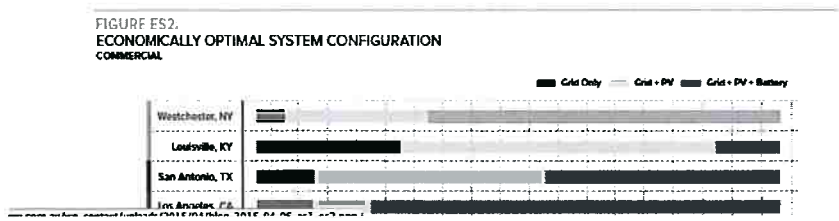
https://reneweconomy.com.au/solar-and-storage-and-the-economics-of-load-defection-20064/





https://reneweconomy.com.au/solar-and-storage-and-the-economics-of-load-defection-20064/





Solar rooftop/battery would also cut vehicle fossil fuel footprint and transmission line forest burn footprint:

Jan 23, 2019

Amid Pacific Gas & Electric Bankruptcy, Rooftop Solar Could Help The Power Grid Fight Wildfires

By: Todd Davidson

Columns appearing on the service and this webpage represent the views of the authors, not of The University of Texas at Austin.

while helping PGE adapt to the future economy:

But in the process of litigating liabilities, local utilities and ratepayers might discover that rooftop solar has additional value that has been previously underestimated.

One of the weak-links that increases wildfire liability is long distance electricity transmission. Any electricity generation system placed in remote locations, including natural gas, hydro, and nuclear power plants, could be subject to increased liability if transmission lines pass through heavily forested areas.

In fact, even utility-scale solar (i.e. large collections of solar panels) would be subject to the same concerns since fields of photovoltaic panels require an open plot of land, moving the system to remote locations. Underground transmission lines could help address the liability concern, but digging is expensive and might offset the benefits of reduced liability.

The fact that rooftop solar is located coincident with the consumption of electricity means that it does not require large, high voltage transmission lines that run through forests (or, at least, it could mean fewer lines). The reduction in transmission lines could reduce liability for companies that manage electricity generation and transmission. The lower liability could improve credit ratings and build additional public support, both of which could improve the economic viability of rooftop solar in comparison to conventional power generation solutions.

The liability that PG&E is facing arises from decades old power lines that are strung across central and northern California. A falling tree branch or high winds can down a power line, producing sparks and igniting a blaze that can destroy thousands of acres and endanger local

From: SUZANNE ATIYEH <pinkpainting@icloud.com>
Sent: Saturday, October 5, 2019 8:30 AM
To: tom@wildcalifornia.org; john_e_hunter@fws.gov; CEQAResponses <CEQAResponses@co.humboldt.ca.us>; Bohn, Rex <RBohn@co.humboldt.ca.us>; sbonfield@environmentamericas.org
Cc: Becky Borden <Beckyborden917@gmail.com>
Subject: Terra-gen wind project in Humboldt Co. California

In a recent review of a book that addresses the pros and cons of climate engineering it says:

"Science and technology should instead serve the more pragmatic goals of increasing societal resilience to weather risks, improving regional air quality and driving forward an energy technology transition. Seeking to reset the planet's thermostat is not the answer."

Not that the most current topic is about climate engineering, but the recent focus has been on the EMOTIONAL reaction to any change whatsoever in the climate. We have taken our eye off the ball.
We have to be proactive, not frozen with fear making stupid choices.
We have to shift our attention to what the right choices are.
No matter what, the climate WILL change.

We should NOT let panic numb us to the industry that wants to waltz in and act like they are doing us a favor. Or we will live to regret it. Terra-Gen is taking advantage of our pure fear.

We have to utilize the best and certainly available technology.
Not just what someone with a lot of funding brings us, that has an expensive ad campaign, and tells us it's cool, and a "Win, Win."
They are offering destructive old technology in order to take advantage of our wind to makes lots of money.

And they are dangling "millions" of dollars in front of us via radio spots, knowing we have a delicate economy.

And they WILL kill off birds in one of the most avian important areas of the continent.

We should not be fooled by what is obviously comparable to an expensive political campaign against birds who have no money and no voice.

It's a company who wants our wind. Bottom line.

Most sincerely,
Suzanne E. Atiyeh
(503) 345-0835

S. E. A.

From: ninacolor@humboldt1.com <ninacolor@humboldt1.com>
Sent: Tuesday, September 17, 2019 11:06 AM
To: CEQAResponses <CEQAResponses@co.humboldt.ca.us>
Subject: Response to the wind project

Dear CEQAR,

Please do not proceed with your wind project as the estimated death toll of birds is horrifying!
It's impossible to justify this known scenario of slaughter to innocent birds.

Climate change is real but we have no idea of how it will change. Climate has changed for hundreds, thousands, millions of years.

The birds will learn to adapt just as all living creatures have done for millions of years.

We all evolve.

Sincerely, Nina Groth

From: Jane Hartford <jehartford9@gmail.com>
Sent: Thursday, September 12, 2019 10:06 AM
To: Ford, John <JFord@co.humboldt.ca.us>; Johnson, Cliff <CJohnson@co.humboldt.ca.us>; Planning Clerk <planningclerk@co.humboldt.ca.us>; CEQAResponses <CEQAResponses@co.humboldt.ca.us>; rsundberg@co.humboldt.ca.us; Wilson, Mike <Mike.Wilson@co.humboldt.ca.us>; Hayes, Kathy <KHayes@co.humboldt.ca.us>; Fennell, Estelle <EFennell@co.humboldt.ca.us>; Bass, Virginia <VBass@co.humboldt.ca.us>; Bohn, Rex <RBohn@co.humboldt.ca.us>
Cc: Frank Bacik <FBacik@townofscotia.com>; Leslie Marshall <lesliem@planwestpartners.com>
Subject: HRC & Terra Gen's proposed Humboldt Wind Project

Dear Supervisors, John & Cliff,

Please see the attached coalition letter from EPIC that was recently sent to John Ford via email.

None of the major environmental organizations in Humboldt County want this wind project on Bear River Ridge because of the unmitigated environmental damage to human communities, and to at-risk wildlife.

As you know, the Wiyot Tribe is strongly opposed to this project on their ancient sacred land on this Ridge, as are the most impacted communities of Scotia and Rio Dell.

Because the tree-line on the ridge is only 100 ft in height, and the proposed turbines are 650 ft high, the visual impact of this proposed project would be seen from Ferndale, Fortuna, Hwy 101 and beyond, completely destroying the natural beauty here for the foreseeable future for thousands of people--not to mention the unmitigated noise pollution before, during and after this proposed project.

As I have mentioned to you several times before, HRC & Terra Gen should move this proposed project to a more appropriate location (perhaps offshore of Petrolia).

Sincerely,

Jane Hartford
PO Box 143
Scotia, CA 95565

epic environmental protection information center
keeping northern california wild since 1977

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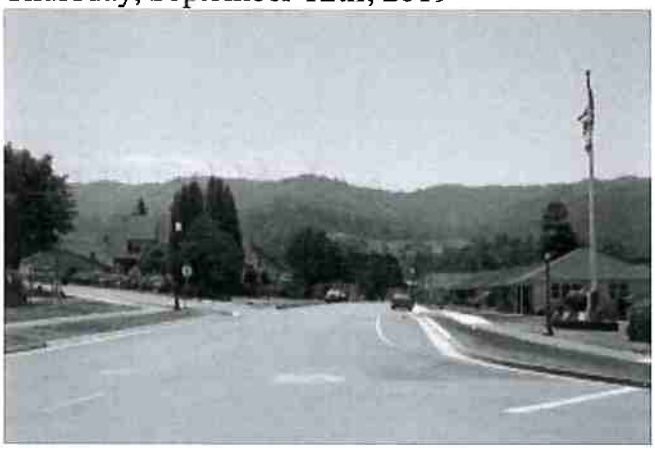
Coalition Letter to Terra-Gen

By Tom Wheeler
Thursday, September 12th, 2019



Simulation showing what the view from Scotia would look like after large turbines are installed atop Monument Ridge. Photo courtesy of Terra-Gen.

Editor's Note: The letter below was sent to Planning Director Ford and reflects the opinion of the major conservation organizations of the North Coast. Our organizations are not opposed to wind energy development but recognize that such development much include proven mitigation measures to reduce impacts to wildlife. The project, as conceived in the draft environmental impact report, lacks these measures and is therefore incomplete. A final environmental impact report is expected at the end of September.

Sent via email to jford@co.humboldt.ca.us on date shown below

September 11, 2019

Director John Ford
3015 H St
Eureka, CA 95501

Dear Director Ford,

On behalf of the Environmental Protection Information Center, Northcoast Environmental Center, Humboldt 350, California Native Plant Society, Redwood Region Audubon, and Redwood Chapter of the Sierra Club,

please accept this letter on the proposed Terra-Gen wind project.

Our organizations urge rapid action at the local, national and international scale to address our climate crisis. In Humboldt, emissions associated with electricity use account for approximately 13% of total county carbon emissions, according to the county's forthcoming Climate Action Plan. We encourage the development of clean energy projects but recognize that wind energy development can have detrimental impacts to the natural environment. In most circumstances, these impacts can be minimized and mitigated to acceptable levels through sound planning, siting, and imposition of the best available technology. Here, as acknowledged in your draft environmental impact report, given the largely undeveloped landscape and presence of at-risk species, the Humboldt Wind Project will have significant impacts to the environment. At present, these impacts have not been minimized or mitigated to an acceptable level. While some of our organizations support the "No Project" alternative, others could support a modified project. Should the project move forward we unanimously insist that the following conditions be met:

- Move Turbines Off Bear River Ridge. The turbines on Bear River Ridge are the most impactful, both to the environment and to human communities. Bear River Ridge is home to Humboldt's isolated and unique population of horned larks, sits entirely within the Cape Mendocino Grasslands Important Bird Area, and is home to the majority of the rare plant species in the project area. What's more, the area is culturally significant to the Wiyot Tribe, who have voiced their opposition to placing turbines at this sensitive location.
- Minimize and Mitigate Impacts to Ecosystems and Sensitive Species. It is imperative to complete all survey protocols before the EIR concludes to best understand the nature and magnitude of wildlife impacts. Regardless of design, the project is likely to result in the "taking" of sensitive species and will impact overall ecosystem function. That said, these impacts can be minimized through smart design. The best way to minimize impacts is to stop operation when sensitive species are present or during survey-defined high-risk periods. Operational curtailment is an industry-standard approach to mitigating wildlife impacts and is a part of other Terra-Gen projects. Where impacts can't be minimized, such as the conversion of forests to brushfields, the project should compensate by fully mitigating these unavoidable impacts.
- Provide Adaptive Management Throughout the Life of the Project. Wind energy is still in its infancy and we can expect significant technological advances throughout the life of the project (30 years). As technology advances, and our ability to reduce impacts and increase efficiency increases, the project should adopt emerging technologies and adapt to changing conditions. The project needs to include an adaptive management program that works to continually refine the project to reduce operational impacts. Adaptive management requires strong data. To that end, it is imperative to modify existing mortality monitoring to include canine-assisted searches or other emerging detection technology to ensure that adaptive management uses the best available data and that mortality data be collected throughout the life of the project. In providing adaptive management, the county needs to guarantee a neutral and transparent process for determining necessary project modifications.
- Reduce Sediment Impacts to the Maximum Extent Practicable. The project will require significant ground disturbance, a known cause of sediment pollution and landslides. Our organizations are concerned about the impact of this sediment pollution. To the maximum extent practicable, all ground disturbance should occur outside the wet weather period, defined as Oct. 15 to May 15. Further efforts should also be made to reduce impacts from the Gen Tie line, such as by using existing power right of ways and other steps to reduce new ground disturbance and forest fragmentation.

Thank you for your attention to our concerns. Should you have any questions, please do not hesitate to contact us at (707) 822-7711 or tom@wildcalifornia.org.

Sincerely,

Thomas Wheeler
Executive Director
Environmental Protection Information Center

Larry Glass
Executive Director
Northcoast Environmental Center

Mary Sanger
350 Humboldt

Alicia Hamman
Interim Executive Director
Friends of the Eel River

Carol Pearson Ralph
President
North Coast Chapter
California Native Plant Society

Hal M. Genger
Redwood Region Audubon Society

Gregg Gold
Chair
North Group Redwood Chapter Sierra Club

This entry was posted on Thursday, September 12th, 2019 at 5:00 am and is filed under Blog.

« EPIC Wishes Happy Trails to Rob DiPerna

From: Sherri Daignault <momofmayhem14@gmail.com>
Sent: Tuesday, August 20, 2019 11:02 AM
To: CEQAResponses <CEQAResponses@co.humboldt.ca.us>
Subject: Wind turbines

I am a resident of Rio Dell, and I oppose these wind turbines. After much research I have concluded they're not healthy for the environment or the people. Regardless of what you're saying about these things being able to put out the fires they cause or that you would be paying for more training for fire departments that's all irrelevant. These are bad. Bad for our planet!! I oppose this project with every fiber of my being and I oppose on the behalf of my children and their well beings. I oppose on the behalf of my entire extended family and 98% of my town. No. Just NO.

Sent from my iPhone

From: Christopher Dunnbier <prawnckd@gmail.com>
Sent: Saturday, August 17, 2019 3:00 PM
To: CEQAResponses <CEQAResponses@co.humboldt.ca.us>
Subject: Comment on Humboldt Wind Energy Project

Dear Project Planner,

Dear Planning Director Ford,

I am very concerned about the proposed wind project from Humboldt Wind, LLC. While climate change is a serious threat to Humboldt County, poorly sited and developed wind projects can cause drastic environmental impacts. As the DEIR makes clear, the project is likely to result in death of numerous special-status species, such as the marbled murrelet, and may cause population-level impacts to once-numerous species, such as the hoary bat.

In turn, the DEIR fails to take adequate measures to avoid, minimize, and compensate for these significant impacts. The DEIR must be revised to incorporate additional mitigation measures to reduce impacts below a level of significance.

These include, among other things, proper siting of wind turbines to avoid impacts, operational curtailments during high-risk periods, and incorporation of deterrence technologies. These project changes are reasonable, having been adopted at other wind projects elsewhere in California and the United States, and would reduce impacts to wildlife. Furthermore, the County needs to insist on a robust and meaningful adaptive management program to continue to monitor and minimize impacts throughout the life of the project.

Thank you for the opportunity to comment on this very important matter.

Sincerely,

Sincerely,
Christopher Dunnbier
PO Box 691
Healdsburg, CA 95448

From: Ken Miller <tamer1@suddenlink.net>
Sent: Saturday, September 28, 2019 2:10 PM
To: Alicia Hamann <alicia@eelriver.org>; Chris Beresford <thegang7@pacbell.net>; CJ Ralph <cjralph@humboldt1.com>; dan sealy <rangerdans@msn.com>; Gary Falxa <garyfalxa@gmail.com>; Jennifer Kalt <jkalt@humboldtbaykeeper.org>; Larry Glass <larryglass71@gmail.com>; margaret.gainer@gmail.com; Richard Kreis <rgkreis@gmail.com>; Tom Wheeler <tom@wildcalifornia.org>; Bella Waters Joan Tippetts <bella@yournec.org>; Carol Ralph <theralphs@humboldt1.com>; Gregory O'Connell <gregoconnell7@gmail.com>; Marisa D'arpino <marisa_nativecalifornian@yahoo.com>; Harriet Hill <harrieth6@gmail.com>; Gregg J. Gold <greggjgold@aol.com>; Ned Forsyth <nedforsyth48@gmail.com>; Dave Imper <dimper@suddenlink.net>; Adam Canter <adam@wiyot.us>; Scott Frazer <genescottf@gmail.com>
Cc: Ford, John <JFord@co.humboldt.ca.us>
Subject: TS OpEd Response to Coalition Letter

FYI

A coalition of environmental groups has issued a letter supporting a "mitigated" TerraGen (TG) wind factory proposed for Monument and Bear River Ridges (https://www.wildcalifornia.org/blog 9/12)

Why is such a coalition letter necessary, since Fish & Wildlife has already requested similar mitigations in their June comments and the Final Environmental Report should address many concerns?

The sign-on letter is clearly intended to reassure the wildlife and other agencies, the Planning Commission and Board of Supervisors, that no local enviro groups will oppose a "mitigated" project, much less sue. TerraGen has lobbied for a similar "mitigated project."

Signers were convinced that project approval is inevitable and that this was their chance to improve it, but the effect of the sign on letter is to ensure approval.

Could TerraGen have invented, or orchestrated, a better PR strategy?

There has never been such an industrial wind facility in terrain anywhere resembling this location, or in the midst of such unique biodiversity. So the letter includes "adaptive management" to reduce operational impacts, but makes no mention of Scotia, Rio Dell, or other Eel River residents' opposition based on their legitimate un-mitigable fears of wildfires, night-time lights, infrasound, flicker, erosion and

landslides, water quality and quantity, industrial traffic, visual and industrial blight, property values, and rural feel. We expect TerraGen to disregard people's concerns, but not our enviros.

The letter asks for turbines to be moved off Bear River Ridge, sacred to the Wiyot. But adjacent to Monument, Bear River Ridge is the most commercially viable site for wind turbines in the County. There will be "adaptive" (economic) pressure to eventually extend turbines to Bear and elsewhere in concert with Redwood Coast Energy Association's (RCEA) plan to expand onshore wind-generated electricity and transmission capacity, before offshore in 2030.

600 foot tall turbines with an aerial sweep of 4.5 acres create turbulence and warming many miles downwind, yet the heightened risk of wildfires is ignored in their letter and given short shrift in the Draft Environmental Report, despite the 2018 updated CEQA emphasis on wildfire evaluation.

TerraGen's electricity may reduce our carbon footprint by 4.7%, but 60% of our emissions come from transportation, and this TerraGen project does nothing to alleviate those; nor does it make us resilient in the event of grid shutdowns or emergencies. Solar does both.

And that 4.7% may well be offset in the medium term because of TerraGen's greenhouse gas (GHG) emissions during the 2-year construction, right into our 10-year

climate emergency window. These emissions have been significantly underestimated, including modeling vehicle emissions assuming flat terrain, with the effects exacerbated by huge ongoing annual losses of carbon sequestration from associated logging, vegetation, and soil disruption.

TerraGen's numbers only look good when divided by the 25-30 year presumed life of the facility, or when compared to those from our PGE plant, but not when compared to the minimal GHGs from wholesale public and private distributed solar energy.

Buying expensive electricity from the grid, forever, even if it comes in part from TerraGen, will not enrich our population (the $2m in annual taxes amounts to $15/person), incentivize anyone to acquire an electric vehicle (EV), nor necessarily result in reduced energy usage from our PGE plant.

RCEA and Schatz have all the solar programs, but their singular focus on utility scale onshore wind and upgraded transmission lines deprives us of soliciting the subsidies and incentives, carbon reduction, and energy resilience that over 250 US mayors are exploiting in order to massively solarize their communities, because of economics and resilience.

Increasingly affordable solar systems paired with electric vehicles (EV) pay for themselves in a few years. Maintenance-free EVs provide mobile storage for nighttime

or emergency electricity supply. Little new infrastructure is required, GHG emissions are minimal and job creation is maximal (TerraGen creates only 15 specialized jobs). Solar shares our energy wealth rather than concentrating it.

Best of all, solar means secure resilience when the grid goes dark:

"Renewable energy microgrids pair onsite resilience with global sustainability. Microgrid storage can help smooth the effects of intermittent power generation and increase overall grid stability. (http://schatzcenter.org/microgrids/)

" Greta Thunberg stated: "Changing one disastrous energy source for a slightly less disastrous one is not progress....Creative accounting will not help us. In fact, it's the very heart of the problem."

Without explanation, the enviro letter acknowledges "... some of our organizations support the "No Project" alternative." Perhaps these anonymous organizations recognize the wisdom of the Wiyots and Greta Thunberg "

From: Tom Wheeler <tom@wildcalifornia.org>
Sent: Friday, September 27, 2019 4:34 PM
To: Ford, John <JFord@co.humboldt.ca.us>
Cc: Kevin Martin <kmartin@terra-gen.com>; Natalynne DeLapp <ndelapp707@gmail.com>; Nathan Vajdos <NVajdos@terra-gen.com>; Olson, Jennifer@Wildlife <Jennifer.Olson@wildlife.ca.gov>; Michael.vanHattem@wildlife.ca.gov; Gordon.Leppig@wildlife.ca.gov
Subject: New science concerning hoary bats

Dear John,

Attached please find a letter from EPIC concerning new science that may impact the Department's review of the Humboldt Wind Project. As EPIC has maintained, operational curtailment is a reasonable and necessary mitigation measure to reduce the expected significant impacts to hoary bats from the Humboldt Wind Project.

Please let me know if you have any questions.

Best,
Tom

--
Tom Wheeler
Executive Director and Staff Attorney
Environmental Protection Information Center
145 G Street Suite A
Arcata, CA 95521
Office: (707) 822-7711
Cell: (206) 356-8689
tom@wildcalifornia.org
www.wildcalifornia.org

"If EPIC had not undertaken its lonely efforts on behalf of the Marbled Murrelet, it is doubtful that the species would have maintained its existence throughout its historical range in California." - Judge L. Bechtle, *Marbled Murrelet v. Pacific Lumber Co.*

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DOI: 10.1002/ece3.5612

ORIGINAL RESEARCH

Ecology and Evolution WILEY

Evidence of region-wide bat population decline from long-term monitoring and Bayesian occupancy models with empirically informed priors

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[2]Human and Ecosystem Resiliency and Sustainability Lab and Northwestern Bat Hub, Oregon State University-Cascades, Bend, OR, USA

[3]Department of Mathematical Sciences, Montana State University, Bozeman, MT, USA

[4]Willamette National Forest, Springfield, OR, USA

[5]Mid-Columbia River National Wildlife Refuge Complex, U.S. Fish and Wildlife Service, Burbank, WA, USA

[6]Northern Rocky Mountain Science Center, US Geological Survey, Bozeman, MT, USA

Correspondence
Thomas J. Rodhouse, National Park Service, Oregon State University-Cascades, 1500 SW Chandler Ave., Bend, OR 97702, USA.
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Present address
Patricia C. Ormsbee, Human and Ecosystem Resiliency and Sustainability Lab, Oregon State University-Cascades, 1500 SW Chandler Ave., Bend, OR 97702, USA

Funding information
Oregon Department of Fish and Wildlife, Grant/Award Number: ORPIN # ODFW-2903-16; Pacific Northwest Cooperative Ecosystem Studies Unit, Grant/Award Number: P15AC01598; US National Park Service; US Fish and Wildlife Service; US Forest Service; US Bureau of Land Management; US Geological Survey

Abstract

Strategic conservation efforts for cryptic species, especially bats, are hindered by limited understanding of distribution and population trends. Integrating long-term encounter surveys with multi-season occupancy models provides a solution whereby inferences about changing occupancy probabilities and latent changes in abundance can be supported. When harnessed to a Bayesian inferential paradigm, this modeling framework offers flexibility for conservation programs that need to update prior model-based understanding about at-risk species with new data. This scenario is exemplified by a bat monitoring program in the Pacific Northwestern United States in which results from 8 years of surveys from 2003 to 2010 require updating with new data from 2016 to 2018. The new data were collected after the arrival of bat white-nose syndrome and expansion of wind power generation, stressors expected to cause population declines in at least two vulnerable species, little brown bat (*Myotis lucifugus*) and the hoary bat (*Lasiurus cinereus*). We used multi-season occupancy models with empirically informed prior distributions drawn from previous occupancy results (2003–2010) to assess evidence of contemporary decline in these two species. Empirically informed priors provided the bridge across the two monitoring periods and increased precision of parameter posterior distributions, but did not alter inferences relative to use of vague priors. We found evidence of region-wide summertime decline for the hoary bat ($\hat{\lambda} = 0.86 \pm 0.10$) since 2010, but no evidence of decline for the little brown bat ($\hat{\lambda} = 1.1 \pm 0.10$). White-nose syndrome was documented in the region in 2016 and may not yet have caused regional impact to the little brown bat. However, our discovery of hoary bat decline is consistent with the hypothesis that the longer duration and greater geographic extent of the wind energy stressor (collision and barotrauma) have impacted the species. These hypotheses can be evaluated and updated over time within our framework of pre–post impact monitoring and modeling. Our approach provides the foundation for a strategic evidence-based

conservation system and contributes to a growing preponderance of evidence from multiple lines of inquiry that bat species are declining.

KEYWORDS
acoustic recording units, Chiroptera, extinction risk, monitoring, North American Bat Monitoring Program, population decline, trend, ultrasonic acoustic detectors

1 | INTRODUCTION

Evidence-based conservation of at-risk species is challenged by lack of information about population trends over time, particularly for those species that are cryptic and difficult to survey. In situations where directly counting individual organisms is infeasible, occupancy modeling of detection/nondetection survey data provides an alternative to abundance models for detecting regional-scale population declines (Jones, 2011; MacKenzie et al., 2002; Noon, Bailey, Sisk, & McKelvey, 2012). Multi-season occupancy models (e.g., MacKenzie, Nichols, Hines, Knutson, & Franklin, 2003; Royle & Kery, 2007) support inferences about changing occupancy probabilities and dynamic site turnover parameters over time. These parameters reflect changes in species distribution but are also expected to reflect the underlying latent changes in population size (Gaston et al., 2000; Holt, Gaston, & He, 2002; Zuckerberg, Porter, & Corwin, 2009) and extinction risk (Noon et al., 2012), albeit with some amount of elasticity (e.g., Kery & Royle, 2016; Royle & Kery, 2007; Steenweg, Hebblewhite, Whittington, Lukacs, & McKelvey, 2018). When harnessed to a Bayesian inferential paradigm, this modeling framework offers considerable flexibility for regional conservation monitoring programs that need to update prior model-based understanding with new data as they become available (e.g., Dorazio & Johnson, 2003; Ellison, 2004). Rather than starting anew after each cycle of data collection, model-fitting, evaluation, and inference, Bayes theorem allows for previous modeling results, in the form of posterior probability distributions, to be used as prior probability distributions that formally represent best-available understanding about model parameters (Crome, Thomas, & Moore, 1996; Hobbs & Hooten, 2015; McCarthy & Masters, 2005). With new data, this prior understanding can in turn be updated and represented as new, updated posteriors, with an expectation that clarity about population distribution and abundance, in the form of precision, will increase over time (Morris, Vesk, McCarthy, Bunyavejchewin, & Baker, 2015). In this way, the empirically informative Bayesian inferential paradigm, when harnessed to replicate geographically extensive large-sample encounter surveys, provides a way to "scaffold", or build upon, prior knowledge to improve conservation decision-making.

This scenario is exemplified by a bat monitoring program in an ~440,000 km^2 region of the Pacific Northwestern United States (Figure 1) in which the occupancy modeling results from 8 years of monitoring, which ended in 2010 (Rodhouse et al., 2012, 2015), require updating with new survey data gathered during 2016–2018 for contribution to the North American Bat Monitoring Program (NABat; Loeb et al., 2015). There is urgency to this opportunity to scaffold upon prior information because bat populations in the region are facing potentially catastrophic declines (e.g., O'Shea, Cryan, Hayman, Plowright, & Streicker, 2016) from the recent arrival of the bat disease white-nose syndrome (Lorch et al., 2016) and the rapidly expanding footprint of the wind power industry (Arnett et al., 2016). The cumulative impacts by these novel threats are likely exacerbated by accelerated environmental changes (Jones, Jacobs, Kunz, Willig, & Racey, 2009; Jung & Threlfall, 2016), including global entomofauna die-off (Sanchez-Bayo & Wyckhus, 2019), which is particularly worrisome given that the majority of North American bat species are insectivorous. In general, there is a global paucity of empirical knowledge about bat population trends and fewer still that evaluate trends over broad regions and long time periods (Jones et al., 2009). But there is growing evidence that many species are experiencing evolutionarily unprecedented, massive declines (O'Shea et al., 2016). Our emphasis on geographically extensive regional inference is noteworthy because bats are so vagile that a local-scale decline, for example one detected within a small national park, is difficult to interpret and use to motivate conservation without broader context (e.g., via replication elsewhere).

Here, we ask whether there is evidence of regional summertime decline in the northwestern United States after three additional years of surveys for two vulnerable species, the little brown bat (*Myotis lucifugus*) and the hoary bat (*Lasiurus cinereus*). We focus on the little brown bat because it has been listed as threatened in Canada (Committee on the Status of Endangered Wildlife in Canada (COSEWIC), 2013) and considered for similar protection in the United States (Federal Register, 2015) following precipitous declines in eastern North America from white-nose syndrome (Dzal, McGuire, Veselka, & Fenton, 2011; Frick et al., 2010) and because the disease was first confirmed in the northwestern portion of our study region (Figure 1) in 2016 from a dead little brown bat (Lorch et al., 2016). We focus on the hoary bat because it is the most frequently encountered species in carcass recoveries at wind power generation facilities in many regions of North America and thought to be at risk of widespread decline (Arnett et al., 2016; Cryan & Barclay, 2009; Frick et al., 2017). We build upon the same dynamic occupancy model used by Rodhouse et al., (2015) and use their 2010 posterior estimates to create empirically informed priors as a way to formally incorporate best-available information about occupancy parameters into an updated assessment of decline.

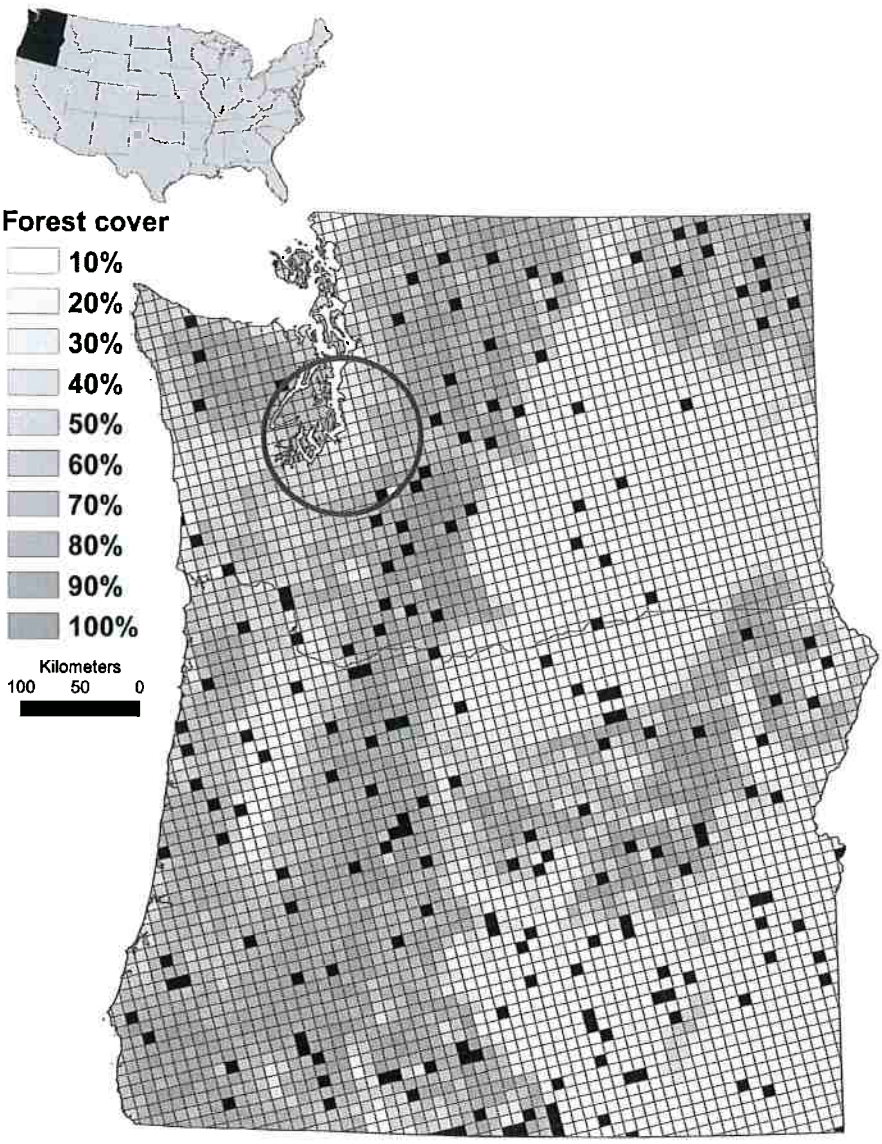

FIGURE 1 The study area, Oregon and Washington, USA, overlaid with the grid-based sampling frame, average % forest cover of each frame sample unit (grid cell), and the 190 sample units surveyed during 2016–2018 (black squares) that follow a spatially balanced master sample design. The area where white-nose syndrome has been confirmed circa 2019 is circled in red

2 | METHODS

2.1 | Study area and biogeographic gradients

We monitored bats during summer (June–September) via coordinated acoustic surveys across Oregon and Washington states, in the northwestern region of the United States (Figure 1). The region is divided in half by the north–south trending Cascade Range that creates a distinct rain shadow over the eastern half of the region and a west-to-east forest cover gradient that is a dominant biogeographic influence on bats (Figure 1). The forest cover gradient in the region is strongly correlated with net primary productivity ($\rho = 0.7$) and moderately so with precipitation and elevation (Rodhouse et al., 2012, 2015). The little brown bat and hoary bat range widely across the region and are found in all habitat types but are associated with forested landscapes more than nonforested shrub steppe (Hayes, 2003; Kalcounis-Rüppell, Psyllakis, & Brigham, 2005; Rodhouse et al., 2015). Forests and also topographic roughness (*SD* of elevation) provide the keystone structures (sensu Tews et al., 2004; e.g., live and dead standing trees, crevices in large cliffs) used by bats for summer and winter roosting that are additional biogeographic drivers of bat distributional patterns in the region (Humphrey, 1975; Pierson, 1998; Rodhouse et al., 2015). Forest cover (% of sample unit classified as any forest type), elevation (sample unit mean), 30-year mean annual precipitation (sample unit mean), and topographic roughness (*SD* of sample unit elevation) were included as occupancy model covariates both during initial modeling by Rodhouse et al., (2015) and in the present study.

2.2 | Study survey design

Our study protocol is described in detail by Rodriguez et al. (2019). We used a grid-based sampling frame of 100-km^2 square cells mapped across the study area to structure surveys and analyses (Figure 1). In 2003–2010 (Period 1), a combination of capture and acoustic surveys was conducted across the region in 241 grid

cells (see Rodhouse et al., 2015, p. 1404). In 2016–2018 (Period 2), acoustic surveys were conducted in 190 grid cells, informed by a statistical power analysis (Banner, Irvine, Rodhouse, Donner, & Litt, 2019; Figure 1). During Period 1, grid cells were selected using a combination of constrained simple random sampling and nonrandom contributions from land management agencies and researchers using compatible methodology (see Rodhouse et al., 2015 for additional details). During Period 2, grid cells were selected using the NABat spatially balanced (via the Generalized Random Tessellation Stratified design; Rodhouse et al., 2012; Rodhouse, Vierling, & Irvine, 2011; Stevens & Olsen, 2004) randomized master sample (Larsen, Olsen, & Stevens, 2008; Loeb et al., 2015). Approximately 80% (n = 155) of the 190 grid cells surveyed during Period 2 were chosen following the spatially balanced order of the master sample. Twenty per cent were chosen from the Period 1 legacy sample in order to provide spatio-temporal overlap between the two periods. This was less than the rule-of-thumb threshold suggested by Irvine, Rodhouse, Wright, and Olsen (2018) that, if exceeded, would require a more complex likelihood weighting in subsequent modeling in order to mitigate for an unrepresentative sample. This large (n = 190) and spatially balanced random sample is representative of the region of interest and supports robust scope of inference.

Spatially replicated within-season (June–September) single-night surveys were conducted in grid cells. Multiple-night replicates were avoided in order to maintain backward compatibility with the Period 1 revisit design and because Wright, Irvine, and Rodhouse (2016; and others, see Hayes, 1997) found evidence of serial correlation suggesting a lack of independence in bat activity among consecutive nights. Numbers of within-season revisits ranged from 1 to 12 per season in Period 1 and were standardized to four visits during Period 2. Surveys during Period 1 consisted of mist net capturing and/or recording of bats with Pettersson D240x and D500x ultrasonic detectors (Pettersson Elektronik) along watercourses. Survey method was included as a detection model covariate during initial modeling by Rodhouse et al. (2015). Period 2 surveys were conducted only by recording bats with Pettersson D500x ultrasonic detectors. Duration of surveys varied during Period 1 from 2 hr to overnight, but lasted all night during Period 2. Duration was included as a detection model covariate for the Period 1 model. Survey date was included as a detection model covariate for both periods. Species identification methods from captures and bat call recordings used during Period 1 were described in detail by Rodhouse et al., (2015), but included the use of version 3 of the Sonobat software program (Sonobat; https://sonobat.com/) to process and assign call files to species and ad hoc manual verification by a single expert (J. Szewczak). During survey Period 2, all call files were processed and assigned to species using version 4 of Sonobat and also verified manually by a single expert (R. Rodriguez) but that followed the REMOVE workflow strategy outlined by Banner et al. (2018, p. 6147) to remove all false-positive identification error from the data set prior to analysis so that the standard (false-negative only) occupancy model could be used. Manual verification was conducted specifically to eliminate false-positive errors by carefully examining highest-quality call files used to make species detection decisions from each survey (e.g., focusing only on the few decision-pivotal call files per species per survey night). Only the unambiguous call files assigned to little brown bat and hoary bats were used as evidence for detection. This REMOVE verification strategy is inherently conservative and elevates false-negative error but our false-negative errors (detection probabilities) were still acceptable (>40%, see Section 3) to obtain unbiased occurrence model parameter estimates.

2.3 | Statistical analysis

We analyzed survey data from Period 2 only, using the results (specifically the estimated posterior mean and precision from occupancy model parameters) from Period 1 to construct empirically informative priors. Detection history matrices containing 190 rows and 12 columns (four single-night visits per season) were constructed for Period 2, with matrix elements assigned a 1 for unambiguous detection or 0 otherwise. We used the same autoregressive multi-season occupancy model (Royle & Dorazio, 2008) for Period 2 as for Period 1 presented by Rodhouse et al., (2012, 2015). Drawing on the Royle and Dorazio, (2008) autoregressive parameterization of the dynamic occupancy model, the initial occupancy state $z(i,t)$ for sample unit (grid cell) i in the first year (t = 1) of sampling was modeled as.

$z(i,1) \sim \text{Bernoulli}(\Psi_{1i})$ for $i = 1,\ldots, n$, with $\text{logit}(\Psi_{1i}) = \beta_0 + \beta_1\text{ForestCover}_i + \beta_2\text{Elevation}_i + \beta_3\text{Precipitation}_i + \beta_4\text{Topographic Roughness}_i$. Subsequent survey years ($z[i,t]$ for t = 2 and 3) were modeled conditional on the previous state, $z(i,t)|z(i,t-1) \sim \text{Bernoulli}\{\pi_{ti}\}$, with $\text{logit}(\pi_{ti}) = a_t + b_t\, z(i,t-1) + \beta_1\text{ForestCover}_i + \beta_2\text{Elevation}_i + \beta_3\text{Precipitation}_i + \beta_4\text{Topographic Roughness}_i$. The four environmental covariates were mean-centered and standardized for computational efficiency and so that interpretation of derived parameters could be made at average environmental conditions (i.e., when coefficients were 0). The derived parameters $\phi_t = \text{logit}^{-1}(a_t + b_t)$ represented the probability of a unit remaining occupied by a species (e.g., survival) and $\gamma_t = \text{logit}^{-1}(a_t)$ the probability of a unit becoming newly occupied (e.g., colonization) for each given time step (t–1 to t). The occupancy probabilities in years $t = 2,\ldots,T$ were calculated recursively as $\Psi_t = \Psi_{t-1}\phi_t + (1 - \Psi_{t-1})\gamma_t$. We used the total unit occurrence growth rate over Period 2, $\lambda = \Psi_{2018}/\Psi_{2016}$, as our trend metric. Given mean-centering of covariates, λ is interpreted as an overall region-wide measure of net decline. Exploration of how derived parameter values vary along the environmental gradients could be accomplished by plugging in different covariate values (i.e., at high and low elevations), which we do by obtaining posterior distributions of $\Psi_{2018,i}$ for each of the 4,500 grid cells in the study region and mapping posterior means to show an updated species distribution map of region-wide occurrence probabilities for comparison with the 2010 map. We used a simpler detection model than Rodhouse et al. (2015), including survey date as a covariate but no additional covariates for method and duration, given the survey design standardization of those two variables during Period 2, where $y_j(i,t) \mid z(i,t) \sim \text{Bernoulli}\{p_{i,t}{}^* z(i,t)\}$and $\text{logit}(p_{i,t}) = \alpha_0 + \alpha_1\text{date}_{i,t}$.

TABLE 1 Posterior distribution means and standard deviations from Period 1 (2010) used as empirically informed priors for Period 2 (2016–2018) models

Parameters	Little brown bat	Hoary bat
β_0	3.53 ± 1.62	0.15 ± 1.15
α	0.14 ± 1.57	−0.68 ± 1.52
β	3.49 ± 1.76	4.32 ± 1.94
$\beta_{\text{elevation}}$	−0.29 ± 0.27	−0.52 ± 0.29
$\beta_{\text{precipitation}}$	1.59 ± 0.97	−0.41 ± 0.30
$\beta_{\text{topographic roughness}}$	0.00 ± 0.29	−0.08 ± 0.21
β_{forest}	0.46 ± 0.34	0.64 ± 0.26

Given the differences in the survey methodology and call processing and species identification workflow, we only used vague Normal(0,10) priors for detection-level parameters, effectively fitting our detection model without prior knowledge (i.e., from "scratch"). We used independent, empirically informed priors on the occupancy-level parameters [β, a_t, b_t]. Informative priors were specified as Normal distributions with mean and standard deviation based on the posterior distributions estimated from the final year (2010) of Period 1 models provided by Rodhouse et al., (2015; Table 1). We compared our results with the same model but where vague priors (Normal[0,10]) were used instead. Vague priors, also referred to as uninformative or weakly informative priors (Northrup & Gerber, 2018), are regularizing priors (Gelman, Simpson, & Betancourt, 2017) that stabilize the posterior distributions for parameters {β, a_{t-1}, b_{t-1}}

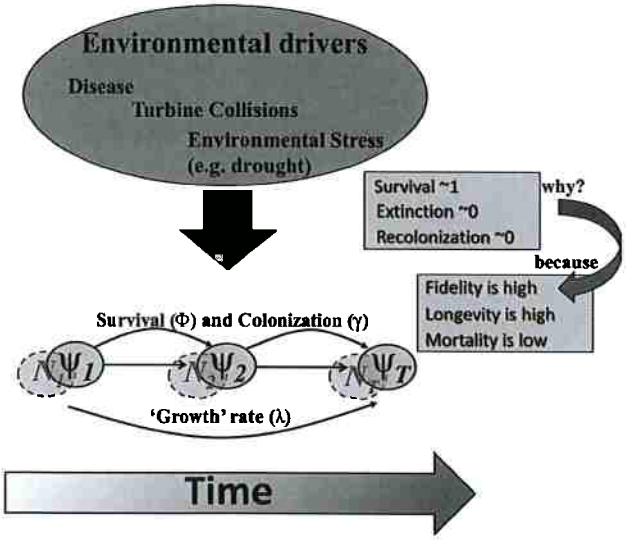

FIGURE 2 Conceptual diagram of occurrence state change (superimposed over latent abundance *N*) over time as a function of survival, recolonization, and extinction of sample unit occurrences from 1 year to the next. The net result of change can be characterized by the occurrence growth rate λ. The diagram outlines (right) hypothesized expectations for background rates of these parameters, drawing on knowledge of temperate-zone bat life history strategies, but suggests extrinsic environmental drivers (e.g., disease, top of diagram) may alter these background rates, elevating adult bat mortality rates

within a reasonable range on the logit scale but do not represent any substantive knowledge about their values a priori.

In Figure 2, we conceptualize this model parameterization as hypothesized inter-annual change in occurrence states (and in latent abundance), as a conditional Markov process governed by the dynamic rate parameters of sample unit occurrence survival (ϕ) and recolonization (γ), summarized by λ. We expect the background rates for these dynamic parameters to be stable and near 1 for ϕ and near 0 for γ because of the slow life history strategies of bats (low fecundity, adult longevity, and low adult mortality; Barclay & Harder, 2003; O'Shea et al., 2016; Promislow & Harvey, 1990) and high site fidelity (e.g., Barclay & Brigham, 2001; Lewis, 1995). We expect that novel extrinsic factors, particularly white-nose syndrome (for little brown bat) and widespread wind energy development and associated collision and barotrauma (for hoary bat) will influence those dynamic rate parameters (O'Shea et al., 2016), reflected in declining $\hat{\psi}$ and $\hat{\lambda} < 1$.

We used OpenBUGS 3.2.3 (Lunn, Spiegelhalter, Thomas, & Best, 2009), launched from R 3.5.1 (R Core Team, 2018) with the R2OpenBUGS library (Sturtz, Ligges, & Gelman, 2005) to implement Bayesian estimation of model parameters via Markov chain Monte Carlo (MCMC) samples from posterior distributions. Posterior summaries were based on 10,000 MCMC samples of the posterior distributions from three chains run simultaneously, thinned by a factor of 3, following an initial burn-in of 5,000 MCMC iterations. We assessed convergence of MCMC chains with trace plots and the Gelman-Rubin diagnostic,; convergence was reached for all parameters according to the criteria $|\hat{R}-1|<0.1$. We evaluated prior sensitivity by comparing inference and by examining vague and informative prior and posterior density plots. We evaluated model predictive performance with posterior summaries of the area under the curve of the receiver operating characteristic (AUC; Zipkin, Campbell Grant, & Fagan, 2012) and compare against summaries provided by Rodhouse et al., (2015). We evaluated evidence of residual spatial autocorrelation by estimating the Moran's *I* statistic for the occupancy residuals (Wright, Irvine, & Higgs, 2019) at distance thresholds from 10 km (adjacent neighbors) to 50 km. Our spatially balanced master sample design reduced spatial proximity of sample units, and we found no evidence of autocorrelation.

3 | RESULTS

Our results provide evidence of decline in net summertime regional hoary bat occurrence probability during 2016–2018 relative to 2010 (Figure 3a) but no evidence of decline for the little brown bat (Figure 3b). These conclusions were supported by both the empirically informed and vague priors models (Figures 3 and 4). Choice of prior did not influence overall conclusions for trend although empirically informed priors provided more precise estimates (posterior probabilities with narrower 95% credible intervals; Figures 3 and 4) and therefore strengthened evidence of hoary bat decline. Estimates of trend ($\hat{\lambda}$) during 2016–2018 for hoary bat was

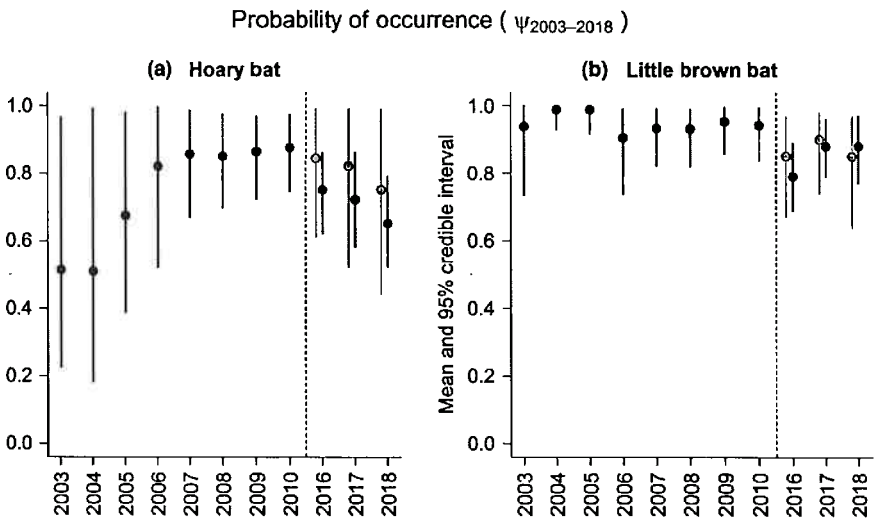

FIGURE 3 Posterior mean and 95% credible intervals for $\hat{\psi}$ from models fit to (a) hoary bat (*Lasiurus cinereus*) and (b) little brown bat (*Myotis lucifugus*) survey data. Comparisons are made for 2016–2018 between vague priors (gray) and empirically informative priors (black)

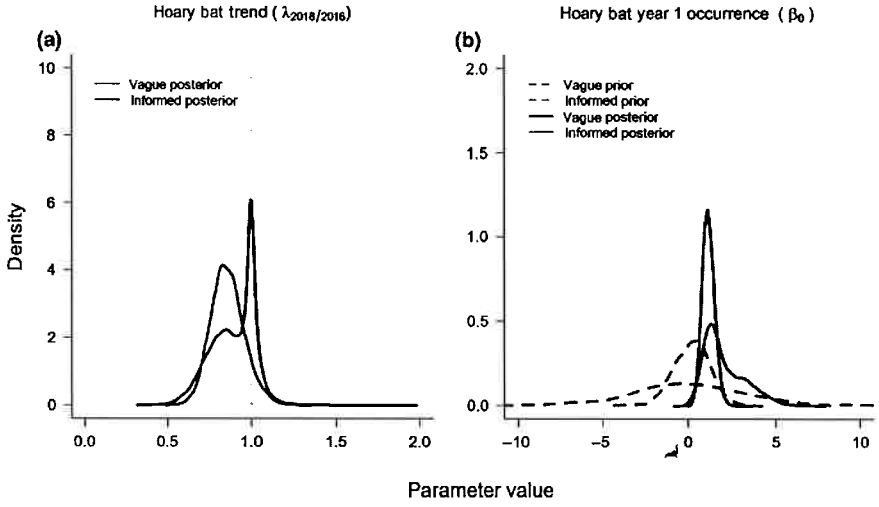

FIGURE 4 Comparison of empirically informed (red) and vaguely informed (black) priors and posteriors for hoary bat (left, a) trend and (right, b) year 1 occurrence probability (intercept parameter, logit scale; see Section 2 for auto-logistic parameterization and use of Normal priors)

0.86 ± 0.10 (0.89 ± 0.12 when vague priors were used; Figure 4a), an average annual rate of decline since 2010, manifesting a ≈2%/year decline in net occurrence probability (i.e., from $\hat{\psi}_{2010}$ = 0.87 to $\hat{\psi}_{2018}$ = 0.65), and $\hat{\lambda}$ = 1.1 ± 0.10 (1.01 ± 0.10 when vague priors were used) for little brown bat. Detection probabilities were stable among years within each period but increased from ~25% for both species in Period 1 (see Rodhouse et al., 2015) to ~40% for hoary bat and ~50% for little brown bat in Period 2.

Mapped hoary bat occurrence predictions illustrated the overall net decline in the region for this species between 2010 and 2018 (Figure 5). Predictive performance of the 2018 hoary bat occurrence probability model, as measured by AUC posterior summary, was 0.80 (95% credible interval 0.74–0.86), an improvement over the 2010 predictions (AUC = 0.75) achieved by Rodhouse et al. (2015). For reference, we overlaid published wind turbine locations (Hoen et al., 2018) on our hoary bat occurrence probability maps which showed that development has not substantially increased since 2010 and that development is concentrated in the center of the study region along the breaks of the Columbia River along the Oregon/Washington border (Figure 5). We did not update predictive maps for little brown bat given the evidence of no change since 2010 in occurrence probability (flat trend; Figure 3b and $\lambda \sim 1$).

Inferences on the effect sizes of the environmental covariates forest cover, elevation, precipitation, and topographic roughness did not vary for either species in direction and magnitude between Period 1 and Period 2 nor between vague and empirically informed prior models (Appendix S1). However, precision of estimated effect sizes increased when informative priors were used, strengthening the influence of forest cover on hoary bat occurrence. Strength of evidence for the positive influence of precipitation on little brown bat occurrence also increased in Period 2, illustrated by the right shift along the *x* axis in Appendix S1 (Figure S2d).

4 | DISCUSSION

We found evidence of decline for the summertime hoary bat population in the Pacific Northwest over the period 2003–2018, most notably since ~2007, but no evidence of decline during the same time period for the little brown bat. White-nose syndrome was first

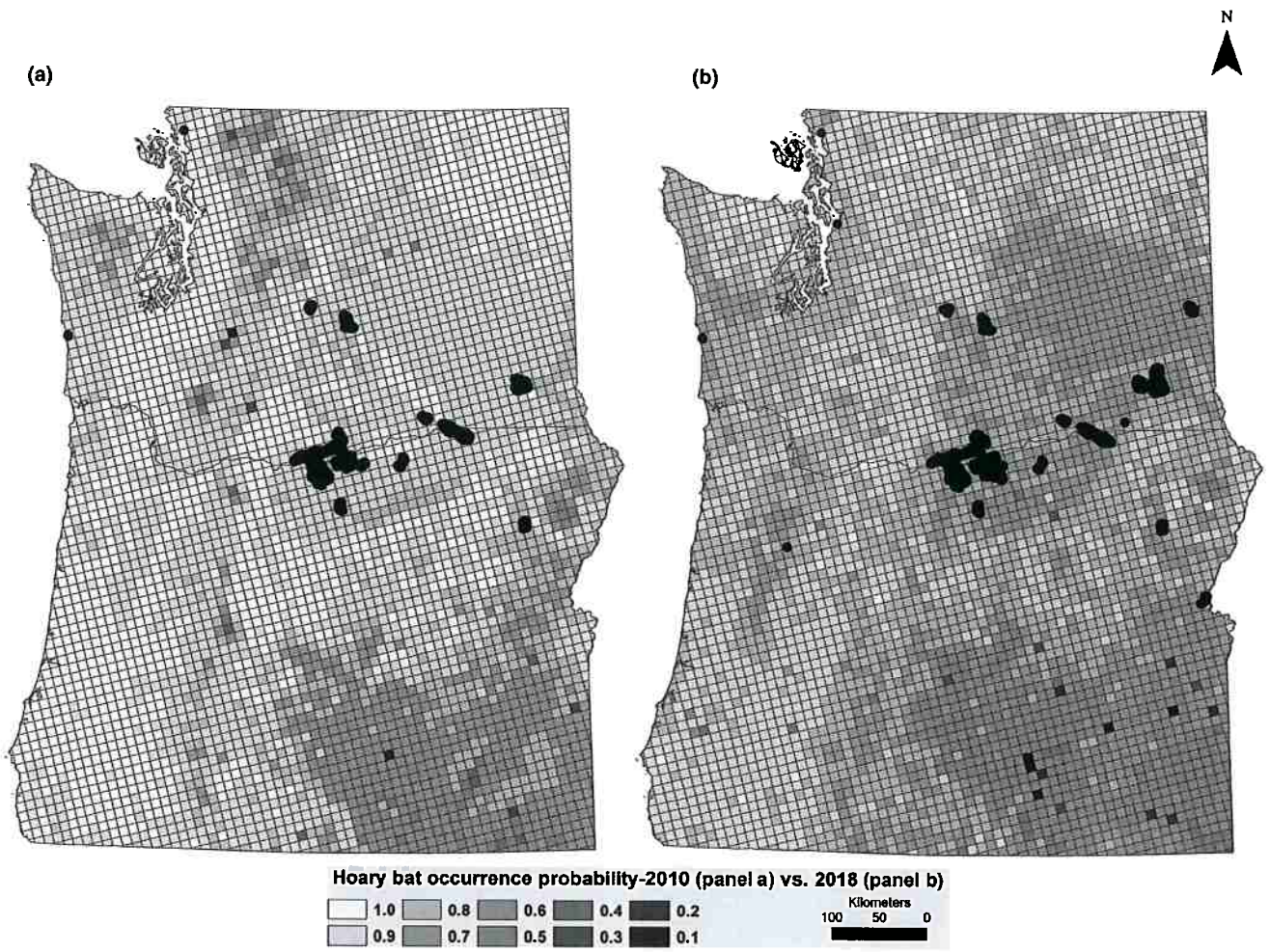

FIGURE 5 Comparative maps of 2010 (a, modified from Rodhouse et al., 2015) and 2018 (b) hoary bat predicted occurrence probabilities ($\hat{\psi}_i$). Wind energy turbines (Hoen et al., 2018) are shown with black symbols circa 2010 in (a) and circa 2018 in (b). cf. with continent-wide wind energy facility distribution at https://eerscmap.usgs.gov/uswtdb/ and also the Hayes et al. (2015) overlay of continental hoary bat seasonal migration distribution maps and wind facility distribution circa 2015

reported in the region in 2016 but has not yet resulted in widespread regional impact to the little brown bat as has occurred in eastern North America (Frick et al., 2015). At the time of data collection (2016–2018), reports of the disease within our study region had not yet spread outside of the Puget Sound region of NW Washington and had not yet been reported in surrounding states (Idaho, Montana, Nevada, California). Wind energy development, however, is much more extensive in western North America (although not conspicuously so within our study region relative to other regions of North America; cf. Figure 5 and Hayes, Cryan, & Wunder, 2015) and is likely to have caused many hoary bat fatalities over a longer period of time (e.g., since ~2000; Arnett et al., 2016; O'Shea et al., 2016). We emphasize that model uncertainty (e.g., wide credible intervals in early years of study), bat longevity, a 5-year gap in monitoring between Period 1 and Period 2, and only 3 years of additional data in Period 2 make these findings best considered as provisional evidence of decline that can guide conservation decisions, including the motivation to continue to allocate resources for further research and monitoring. However, given the laxity (curvature) in the occupancy–abundance relationship, evaluating population decline with occupancy models is inherently conservative, and our finding of hoary bat decline is alarming. Compelling empirical evidence of regional and range-wide bat decline is difficult to obtain and rarely reported, and our study is unique in geographic and temporal extent, with evident implications for potential hoary bat extirpation risk proposed by Frick et al. (2017) if our observed hoary bat trend continues. Likewise, if WNS continues to spread throughout the region and exhibit the same levels of morbidity as has been reported from eastern North America then our monitoring and modeling framework, with many years of pre-WNS prior information now available, provides the foundation for evaluating post-WNS host population impacts as a replicated before–after impact study.

The evidence for hoary bat population decline and for species–environment relationships (i.e., hoary bats and forest cover and little brown bats and precipitation) provided by our study was strengthened when empirically informed priors were used. This is

consistent with previous applications of informative priors to ecological research (e.g., Morris et al., 2015), and our study contributes a new demonstration of the utility of using informative priors to gain efficiencies in long-term studies and monitoring. Historically, concerns were raised about the subjectivity and potential biases of using informative priors in Bayesian analyses that exerted too much influence on posterior distributions (e.g., Dennis, 1996), but with contemporary computing power, it has become straightforward to examine the influences of prior specification strategies (e.g., Dorazio & Johnson, 2003; Morris et al., 2015; Northrup & Gerber, 2018). Informative priors increase effective sample size (e.g., Hobbs & Hooten, 2015; McCarthy et al., 2005), and in our study, this benefit was realized by spanning the gap in data collection between 2010 and 2016. Data gaps are a common challenge for long-term studies, and the improved ability to span gaps will be appealing to monitoring practitioners.

The overlay of wind turbine locations on our predictive hoary bat occurrence maps revealed that turbine density has not increased greatly over the course of study and, in general, is not very extensive relative to other regions of the country (cf. https://eerscmap.usgs.gov/uswtdb/viewer/). Hoary bat migration patterns are still not well described, and it remains unclear where the hoary bats that occur in our study region during summer monitoring are being killed (Cryan, 2003; Cryan & Brown, 2007; Hayes et al., 2015). Cryan (2003) and Hayes et al. (2015) developed maps of seasonal hoary bat occurrence patterns that suggest bats that occur in our region during summer could spend winters in and migrate through regions where turbine densities are much higher, offering a possible explanation for decline in the Northwestern United States. Although available evidence supports the working hypothesis that regional hoary bat decline is likely caused by elevated adult mortality from turbine collisions and barotrauma during fall migration, our results reflect net cumulative impacts, and a limitation of our study is the imprecision with which stressor impacts can be ascribed. In part, one solution to this limitation is to strive for broader regional and range-wide replication of coordinated monitoring as advocated via NABat by Loeb et al. (2015) and using the modeling framework demonstrated here. A second solution will be to close the information gap about bat migration and other bat natural history using novel methods such as transmitter suturing developed by Castle, Weller, Cryan, Hein, and Schirmacher (2015) that has revealed long-distance movements of hoary bats (Weller et al., 2016). A third solution will be to integrate geographically extensive coordinated acoustic surveys into a conservation information system that draws on multiple lines of evidence.

Toward this third solution, we envision that our monitoring and modeling approach can provide the base of a strategic conservation information system "pyramid" (Figure 6), as has been done similarly through the integration of focal apex sites and broad-scale occupancy modeling by the Amphibian and Reptile Monitoring Initiative (see https://armi.usgs.gov/program_design.php). Figure 6 illustrates the inherent trade-offs in surveying across geographic extents with large sample sizes and depth of information content from more focused intensive study that can be ameliorated through strategic

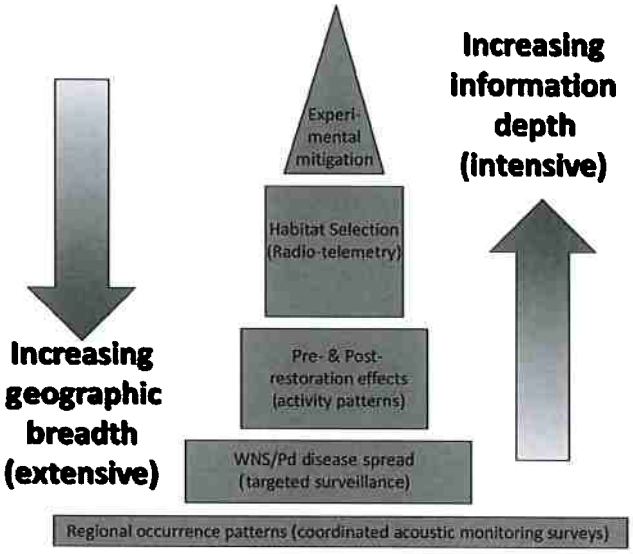

FIGURE 6 Conceptual diagram of an information pyramid that describes the inherent trade-off between geographic extent and informational intensity of monitoring and supporting research that can be integrated into a rich model-based information system for guiding evidence-based bat conservation. Our geographically extensive monitoring from coordinated acoustic surveys and modeling of those data provides a robust "base" of the pyramid that can help identify when and where targeted and more informationally deep studies can be effective. Intensive local-scale studies have been integrated into our grid-based monitoring framework to simultaneously pursue local and regional objectives

integration. For example, with respect to apparent hoary bat decline, our study, as a fundamental baseline, could be a catalyst for increased mitigation of wind turbine collisions via curtailment at low wind speed (Arnett, Huso, Schirmacher, & Hayes, 2011) and other actions (e.g., acoustic deterrence, Arnett, Hein, Schirmacher, Huso, & Szewczak, 2013). If done in a strategic manner (e.g., using experimental design), this can become a way to inform collective learning and adaptive management (Hayes et al., 2019). As another example, studies of the effects of forest thinning for forest fire fuels reduction on bats in the region's national parks (A. Chung-MacCoubrey and S. Mohren, National Park Service, personal communication) have been nested within NABat grid cells, creating an opportunity for data collected during more-informative but geographically less-extensive focal studies to contribute simultaneously to our periodic region-wide trend assessments. It is in this way that the coarse-grained grid-based NABat monitoring can become relevant at local-scales, building bottom-up engagement for a regional conservation program that requires top-down coordination.

For the present study, region-wide net hoary bat decline was hypothesized to be the result of fatalities at wind energy facilities outside the study region and during autumn (see Figure 4 in Hayes et al., 2015) unobserved by our study. We did not consider whether hoary bat occurrence trend over time might also co-vary over space along, for example, forest cover or elevation gradients, but our framework could support pursuit of these questions, particularly if the energy

facility footprint expands in the region along these environmental gradients (e.g., if predominantly in open agricultural and steppe landscapes) and compelling hypotheses about spatial variation in hoary bat decline are articulated. However, we find it more tangible at present that if WNS impacts on the little brown bat population become more widespread (i.e., from carcass recoveries throughout the region), a plausible hypothesis of an interaction between precipitation and little brown bat decline could be proposed because the disease has been reported to occur along precipitation and humidity gradients in eastern North America (Langwig et al., 2012) and our region has strong moisture gradients that may strongly influence disease spread and morbidity. This hypothesis could be evaluated with our empirical monitoring-data-model framework via inclusion of an interaction between the precipitation covariate (and other relevant covariates) and the dynamics of colonization and survival as b_t*z(i,t−1) + β_3Precipitation$_i$ + β_5Precipitation$_i$*z(i,t−1) (Royle & Dorazio, 2008).

In conclusion, empirically informed Bayesian modeling, fueled by large monitoring datasets that accumulate over time and that are underpinned by a robust survey design (e.g., our NABat spatially balanced master sample) provides a powerful and flexible foundation for building an adaptive, evidence-based conservation information system. The long-standing logistical challenges associated with studying bats that preclude directly estimating bat population sizes and demographic rates require the kinds of solutions that we demonstrate and discuss. Multiple lines of evidence, even if indirect, will be required to triangulate toward answers about the status and trends of bat populations.

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CONFLICT OF INTEREST

None declared.

AUTHOR CONTRIBUTIONS

TJR, RMR, PCO, JB, and KMI designed and implemented the study. RMR coordinated region-wide data acquisition. TJR conducted the modeling and KMB and KMI reviewed statistical procedures. TJR drafted the manuscript. All authors contributed to and edited the manuscript.

DATA AVAILABILITY STATEMENT

The dataset and corresponding BUGS modeling code are archived on the National Park Service Integrated Resource Management Applications (IRMA) portal at: https://irma.nps.gov/DataStore/Reference/Profile/2264920.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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From: Denise Sweaney
Sent: Thursday, June 13, 2019 4:05 PM
To: Ford, John
Subject: wind farm project

When I started reading about this project I thought it was a great idea, right up until I began to hear from many sources about the degradation this project will cause to this area. It far surpasses what it is layed out to 'fix'. I could go into details as noted in the City of Rio Dell letter, along with Mr. Baciks' letter from the Town of Scotia. However, you have their information with concerns noted as significant.
I hope you will take into consideration how this project will reflect on this area for our future. Again we are being 'mined' for resources to be used primarily in the south. Do we really want to continues this project, along with the 'mining' of the Eel River water, etc.? Please stop this plan that is simply not good for Humboldt County.
Thank you for letting me voice my concern against this project. MD Sweaney

From: alicia adrian <kudraridge@gmail.com>
Sent: Saturday, September 14, 2019 10:46 AM
To: Ford, John
Subject: Keep Turbines off Bird Migration Pathways

Hello Director Ford,

I agree that wind energy is preferable to fossil fuels but they do not need to be in major animal routes and not when they destroy ecosystems. Bear Ridge is a highly inappropriate location for many different species, some endangered and "protected." This area is so pristine and amazingly healthy. Please do not mar this beautiful place.

Please also work on your plan to minimize impacts to ecosystems and sensitive species. Promise us that you will continue to provide adaptive management while the turbines are in place. Make plans to minimize sediment impacts.

In short, do this the right way. The way that you'd be proud to tell our young people that you are changing the way we treat our Earth. We will not have an Earth if we destroy it and all that lives here. You are in a unique position to make a difference in the area that we live, please do so.

Sincerely,

Alicia Adrian
Blue Lake, CA