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MORALITY BEFORE KNOWLEDGE

The climate change effects on the life of emperor penguins

CLARISSA GABRIELLE TOMBENG[1]*, YUNITA ISMAIL MASJUD[1]
[1] *Environmental Engineering, Faculty of Engineering, President University, Bekasi, Jawa Barat, 17530, Indonesia*
*Correspondence: clarissagtombeng@gmail.com

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ABSTRACT
Background: Emperor penguins are one of the species that their life a affects by climate change. They are part of the ecosystem. As a human, we need to know about the condition of the other living things as the effects of this climate change. This journal review wants to prove that the life of emperor penguins are in danger from any aspect because of climate change. Based on a study, the researcher tries to protect the penguins and does several methods to protect them. The researcher also uses the future climate projections to know the condition in the future. Some of the research used the thermal effects test, and observe the model habitat suitability. If the global emissions continue to increase, there is look like no future for emperor penguins. We need to know that every little thing of our action towards this climate change affects the other living things. Therefore, as a human, we need to be more aware of what happens around us. This research objective is to explore more about how climate change affects the emperor penguins' life and why we should care about it. **Methods:** This research used the literature review method. Two concept approaches were used in this journal review. **Findings:** The first is about the habitat, life cycle, and how the emperor penguins lived. The second is about the impact and what changes in their life. The result showed that there is a change in the life of emperor penguins, and their existence is endangered due to climate change effects. **Conclusion:** Emperor penguin is a part of our ecosystem. As a part of this earth, we need to know what is going on around us. We need to know that not only our life that affects by climate change but also the other living things. We could know what kind of actions that we can take to help the emperor penguins' life so they will not decline in the future which can affect life on this earth.

KEYWORDS: climate change; climate projections; emperor penguins.

1. Introduction

Nowadays, we are living in a world that has a significant change in every aspect including nature. We know that our earth is trying to fight climate change because climate change keeps happening and become a climate emergency day by day. Climate change already impacting our lives, not only that but this issue also impacts the whole living things on our earth. In this journal review, we will discuss the effect of climate change on the ecosystem in the habitat of emperor penguins. Antarctica is a continent that has several climate zones in the world. Climate change in Antarctica is already harming the environment and the animal that live in that area. Many species live there such as emperor penguins. Emperor penguins are iconic examples of a species threatened by future climate change. The International Union for the Conservation of Nature classifies the emperor penguin as near threatened species and currently is under consideration and observation.

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In this review, we assess how the life of emperor penguins affects by climate change. First, we try to observe and review what is the correlation of The Paris Agreement with the existence of the emperor penguin. We try to review how emperor penguin colonies under new climate change scenarios meet the Paris agreement objectives. We review the potential outcomes of climate change and try to see the possible approaches for the effective management of this uniques species, Emperor penguin. We try to observe how they face the challenge happened by climate change. We know that emperor penguins depend on stable fast ice to breed successfully. As the climate warms, sea ice thickness to an extent is expected to decrease, and negatively impacting many emperor penguins colonies. Based on the research, the emperor penguin is an Antarctic circumpolar sea ice obligate species that rely on sea ice throughout its life cycle.

This journal review has a purpose to give us knowledge about what is going on between climate change and how should we react to this situation. We know that the emperor penguin is endangered species that we have to take care of.

We need to know that the need for legal recognition and enhanced precautionary management for emperor penguins is now urgent, particularly given the continued increases in GHG emissions. We try to review the analysis and discussion about fundamental concepts with the climate risk assessments for species, including the selection of climate models and GHS emissions scenarios to evaluate the climate threads. These concepts were applied to the emperor penguin as a case study. This journal review's purpose is to show us the impact of climate change on the emperor penguin's life as one of the endangered species. As a human, we have to know what kind of role that we can take in this issue.

2. Methods

To give a clear explanation for the reader, in this journal review there are several methods that we have already taken a look at. In this journal review, we use several resources from journals such as Elsevier, google scholar, Wiley library, etc. We try to analyze from the theory that has been given in the journal and try to compare from the other source.

2.1 Climate Scenarios

These mitigation scenarios are unique in that they were explicitly designed to meet the global temperature change targets set in the Paris Agreement. While the previous scenarios considered a variety of human activities and the consequent greenhouse gas emissions, they did not explicitly consider the effects of climate change. As a result, the Paris Agreement targets do not lead to a global temperature rise of 1.5 or 2 degrees Celsius. By 2100, the average temperature will have risen. From this method, they compare the resulting emperor penguin population projections obtained with these two new Paris scenarios to obtained from a usual climate scenario that represents a future in which greenhouse gas emissions. By using climate simulations with these new Paris Agreement scenarios, they can directly consider the avoided impacts for emperor penguins in the temperature mentioned before.

2.2 Sea Ice Projections

From our review, this method said that the climate model simulations used in that study are produced from the CESM using the Community Atmosphere Model version 5. All simulations use the identical climate model and the Paris target simulations are branched from the CESM-LENS simulations in 2006 and run from 2006-2010. They use a journal's approach to determine the seasonal sea ice conditions means for each colony during the four seasons of the emperor penguin's life cycle. For the first time, they show how these distinct climate ensembles can project sea ice in Antarctica.

2.3 Dispersal Scenarios

Because emperor penguins have only been marked at one location and no recapture has occurred at other colonies, individual dispersal habits are poorly understood. Emperor penguins were thought to be largely philopatric until recently. Recent research has discovered some genetic homogenization within emperor penguin colonies, implying substantial connectedness in these populations due to individual migration between colonies. Furthermore, new research reveals that emperor penguin colonies can migrate to ice shelves and even establish new colonies.

2.4 Life Cycle of the Emperor Penguins

The emperor penguin has a long breeding cycle, beginning in the Austral winter and finishing about a year to raise its single young; it is the only warm-blooded Antarctic bird that breeds in the winter and is thus uniquely adapted. Emperor penguin colonies can be found along the continent's coasts, with nearly all of them on fast ice, which is sea ice kept in place by geological features and grounded icebergs.

However, colonies can form on ice shelves, icebergs, and even land when fast ice is present for an inadequate period or is subjected to continuous winds that cause early ice break up. Emperor penguins depend upon stable fast ice throughout their breeding period. Emperors spend much of their time frequenting the pack ice-covered ocean, both during breeding season and post-breeding. Throughout their annual cycle, emperor penguins rely upon the availability of prey.

2.5 Niche Modeling

To model habitat suitability for breeding emperor penguins and explore their sea ice niche concerning colony sites, seasons, and sexes, they used the “ecological niche factor analysis”. Two units are describing the availability and the utilization weights of the resource unit by the penguins. The principle of the ENFA analysis is to first compute the marginality vector. This vector gives the direction and the magnitude from which the distribution of habitat use differs from the distribution of the habitat available on average. Then the cloud of resource units is projected on the hyperplane orthogonal to the marginality vector.

3. Result and Discussion

Based on the research and review that we have already taken a look at from our resource, there are several discussions from the topic and the data that we already see. Based on the observations from the sea ice projections in the Antarctic, they already analyze that population growth rates are largely influenced by the Antarctic sea ice conditions during the laying season. While there are climatological biases in the Eastern Weddell during the nonbreeding season, the population growth rate's sensitivity to sea ice conditions during the nonbreeding period is modest. While the growth rate's sensitivity to sea ice conditions throughout the rearing season is generally high, it varies greatly by colony and period.

Talking about the emperor penguin populations projections, the most endangered colonies in Queen Maud, Enderby, and Kemp Land will likely experience a complete loss of sea ice during the critical laying season. Emperor penguins will persist if the Paris Agreement objectives are met, with two main refuges in the Ross and Weddell Seas (in this case). Based on this source, the global demographic assessment of the potential impacts of meeting the Paris Agreement for an iconic species threatened by future climate change shows that global climate policy can halt future projected declines of emperor penguins in ways that their intrinsic biological properties do not. The Paris Agreement climate targets

lead to dramatically larger populations of emperor penguins than baseline climate scenarios irrespective of dispersal or density dependence. From this study, the adaptive capacity of emperor penguins is unknown but is likely limited because they have long life spans, delayed maturity, and low reproductive rates, coupled with low genetic diversity. The biological capacity for emperor penguins to cope with climate change through adaptation or dispersal to suitable habitats is therefore likely to be minimal.

The current era of rapid environmental change is projected to negatively impact the emperor penguin, particularly by changing the extent, formation, and persistence of sea ice, especially fast ice. Current projections have modeled the impact of future climate change on the demographic parameters of adult emperor penguin populations. The influence of sea ice will not only be important in terms of a platform for breeding, but projected sea ice loss may also have important consequences for food resources. With sea ice loss, emperor penguin responses will probably also be strongly dependent on the relationship between sea ice and food resources. Emperor penguins rely extensively on seasonal fast ice, rendering them vulnerable to variations in wind speed, fast ice extent, and duration, as well as uncommon storm events, all of which are influenced by climate change.

Based on research using fine-scale sea ice products, we can see that emperor penguins spent time foraging in ephemeral polynya openings instead of large/yearly persistent coastal polynyas. This study also found that emperor penguins spent time diving and foraging at a short distance from the fast ice edge and the continental slope. The next is we have to know that there is sentinel2, a powerful tool for discovering and monitoring the distribution of emperor penguin colonies. After consideration of the distribution of the newly reported colony locations, it is evident that future climate change Is likely to affect them, based on projections for nearby colonies.

From another resource, a study shows that the longer the current GHG emissions level continues, the more certain that sea ice loss and climate-driven signals in population dynamics become. By 2050, the emperor penguin will be in danger of extinction throughout a significant portion of its range regardless of emission scenario. This study recommends that emperor penguins should be listed as threatened under the ESA. An ESA listing would provide emperor penguins with important benefits, in addition to ensuring that US Federal agencies' activities do not jeopardize the species or their habitat. Ultimately, the most important action to ensure the continued viability of emperor penguins is to rapidly reduce GHG emissions to limit further warming. Near-term climate policy decisions during this decade that successfully achieve the Paris Agreement targets would provide refugia for the emperor penguin, halting dramatic global population declines. Moreover, the emperor penguins also signal how well global society is acting to control GHG emissions. The future of emperor penguins and all biota on earth depends upon the decisions that we made today.

4. Conclusion

Emperor penguins are considered as the indicators of climate change in the Southern Ocean because they are highly sensitive to environmental conditions in multiple stages of their annual life cycle and across large spatial extents. Based on the journal that we review, we conclude that the emperor penguin is vulnerable to altered wind regimes, rising temperatures, changes in fast ice extent and duration, and melting sea ice, based on current literature and projected levels of climate change associated with increasing GHG emissions, and should be given an IUCN Red List threat status of Vulnerable at the very least. Then, we know that only a reduction in anthropogenic GHG emissions will reduce the environmental threats to the emperor penguin, and the emperor penguin has the potential to be seen as an exemplar of how species might be protected under future climate change scenarios. The world is in the midst of a severe climate crisis, and we must act quickly to avert the worst consequences; as a result, global society must listen to science and adapt to the situation. Natural systems provide ecosystem services that enable humanity to survive and thrive.

Sustaining these systems today necessitates suitable legislative frameworks based on the greatest available scientific data to preserve them. Long-term ecological research is essential for documenting ecological responses to environmental change and providing solid science.

To predict population viability and species persistence in a future environment is warming, interdisciplinary science is also required. Such expenditures in science provide information that must now be used to influence legal frameworks because knowledge comes with responsibility. As a human, we already know the conditions that happen between climate change situations and emperor penguin's life. We already know several important things that affect them, and what can we do about it. We need to keep aware of everything happening around us and try to keep updating ourselves about the situation. We can try to take part start by acknowledging this issue. We hope that the emperor penguins can survive in the future and there is a change within this situation.

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References

Fretwell, P. T., & Trathan, P. N. (2020), Discover of new colonies by Sentinel2 reveals good and bad news for emperor penguins. British Antarctic Survey, 7(2). https://doi.org/10.1002/rse2.176

Jenouvrier, S., Che-Castaldo, J., Wolf, S., Holland, M., Labrousse, S., LaRue, M., Wienecke, B., Fretwell, P., Barbraud, C., Greenwald, N., Stroeve, J., & Trathan, P. N. (2021). The call of emperor penguin: Legal responses to species threatened by climate change. Global Change Biology Wiley, 27(20). https://doi.org/10.1111/gcb.15806

Jenouvrier, S., Holland, M., Iles, D., Labrousse, S., Landrum, L., Garnier, J., Caswell, H., Weimerskirch, H., LaRue, M., Ji, R., & Barbraud, C. (2019). The Paris Agreement objectives will likely halt future declines of emperor penguins. Global Change Biology Wiley, 26(3). https://doi.org/10.1111/gcb.14864

Labrousse, S., Fraser, A., Sumner, M., Tamura, T., Pinaud, D., Wienecke, B., Kirkwood, R., Ropert-Coudert, Y., Reisinger, R., Jonsen, I., Porter-Smith, R., Barbraud, C., Bost, C., Ji, R., & Jenouvrier, S. (2019). Dynamic Fine-Scale Sea Icescape Shapes Adult Emperor Penguin Foraging Habitat in East Antarctica. AGU 100 Advancing Earth and Space Science, 46(20). https://www.researchgate.net/publication/335848755_Dynamic_Fine-Scale_Sea_Icescape_Shapes_Adult_Emperor_Penguin_Foraging_Habitat_in_East_Antarctica

Labrousse, S., Iles, D., Viollat, L., Fretwell, P., Trathan, P. N., Zitterbart, D. P., Jenouvrier, S., & LaRue, M. (2021). Quantifying the causes and consequenses of variation satellite-derived population indices : a case study of emperor penguins. Original Research. https://doi.org/10.1002/rse2.233

Labrousse, S., Orgeret, F., Solow, A., Barbraud, C., Bost, C., Sallée, J., Weimerskirch, H., & Jenouvrier, S. (2019). First odyssey beneath the sea ice of juvenile emperor penguins in East Antarctica. Inter-Research Science Publisher, 609, 1-16. https://doi.org/10.3354/meps12831

Mohammad, A. (2019). Antarctica Climate Change and How it affecting the species living there especially penguins. Journal of University Studies for inclusive Research, 2(3). https://usrij.com/wp-content/uploads/2020/01/Antarctica-Climate-Change-and-how-it-affecting-the-species-living-there-especially-penguins..pdf

Schmidt, A., & Ballard, G. (2020). Significant chick loss after early fast ice breakup at a high-latitude emperor penguin colony. Antarctic Science, 32(3), 180-185. https://doi.org/10.1017/S0954102020000048

Trathan, P., Wienecke, B., Barbraud, C., Jenouvrier, S., Kooyman, G., Le Bohec, C., Ainley, D., Ancel, A., Zitterbart, D., Chown, S., LaRue, M., Cristofari, R., Younger, J., Clucas, G., Bost, C., Brown, J., Gillet, H., & Fretwell, P. (2020). The emperor penguin - Vulnerable to projected rates of warming and sea ice loss. Biological Conservation, 241, 108216. https://doi.org/10.1016/j.biocon.2019.108216

Wege, M., Salas, L., & LaRue, M. (2021). Ice matters : Life-history strategies of two Antarctic seals dictate climate change eventualities in the Weddel Sea. Global Change Biology Wiley. https://doi.org/10.1111/gcb.15828

Zagrai, A., & Hassanalian, M. (2020). Thermal Effects of Penguins' Colors on Their Swimming Efficiency Possibility of a New Generation of Biologically Inspired Systems. AIAA Propulsion and Energy Forum, 2020-3661. https://doi.org/10.2514/6.2020-3661

Biographies of Author(s)

CLARISSA GABRIELLE TOMBENG, Environmental Engineering, Faculty of Engineering, President University.

- Email: clarissagtombeng@gmail.com
- ORCID:
- Web of Science ResearcherID:
- Scopus Author ID:
- Homepage:

YUNITA ISMAIL MASJUD, Environmental Engineering, Faculty of Engineering, President University

- Email: yunitaismail@president.ac.id
- ORCID: 0000-0002-3297-8850
- Web of Science ResearcherID:
- Scopus Author ID: 57205019607
- Homepage: