Hardhead Catfish Thermal Performance

Jenna Haupert and Chloe Cole. Alyssa Andres

Introduction

- As global temperatures continue to rise, it is vital to understand how different species will face the consequences.
- The Hardhead Catfish, *Ariopsis felis*, is one of many Gulf fish species affected by rising ocean temperatures due to climate change.
- *A. Felis* are a suitable model species because they are one of the only species in ecological studies found to be active and feeding at or above 34ºC.
- This study aims to determine the thermal tolerance of Hardhead Catfish in the Northern Gulf of Mexico using metabolic and behavioral studies.
- How *A. Felis* uses oxygen under different thermal conditions can reveal how long the it would be able to survive before experiencing symptoms such as disorientation and loss of equilibrium which can lead to death.
- Understanding *A. Felis* thermal tolerance is essential to see how their metabolic scope responds to rising water temperatures due to climate change.

Important Vocabulary

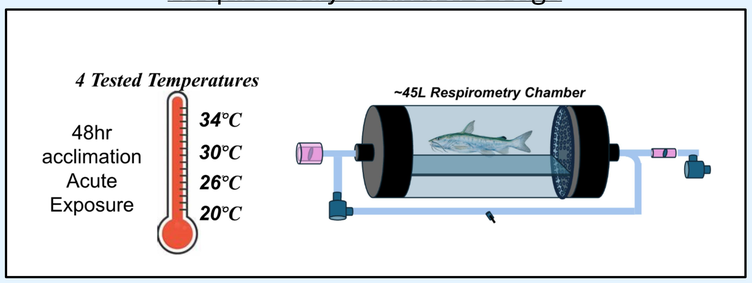
- **CT_{max}** is the temperature at which an organism's ability to control movement and behavior becomes disordered which can lead to death.
- **Maximum Metabolic Rate (MMR)**: highest metabolic rate measured.
- **Resting Maximum Metabolic Rate (SMR)**: lowest metabolic rate that sustains consciousness when organism is at rest.
- **MO2**: Metabolic rate of oxygen consumption.

Methods

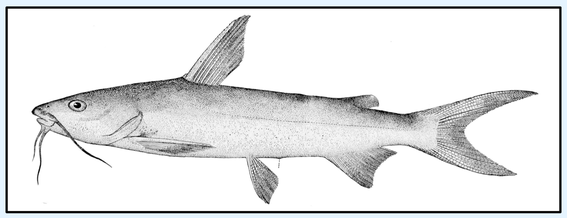
Procedures: Intermittent respirometry was used to measure maximum and resting metabolic rate

1. Subject was acclimated to tested temperature (20, 26, 30, 34ºC) for 48 hours.
2. Subject was manually chased to exhaustion.
3. Subject is placed in the respirometry chamber and MMR is recorded immediately.
4. Subject goes through a period of rest for 24 hours and SMR is calculated using the average of the lowest of MO2 vales.

Respirometry Chamber Design



Data-Analysis: Aerobic and Metabolic Scope at Different Temperatures



Hardhead Catfish, *Ariopsis felis*

Results

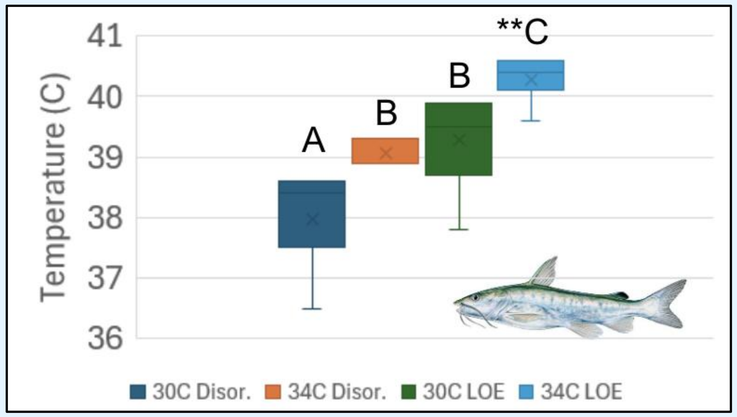


Figure: HCT Box and whisker plot denoting min, max, median, and quartiles of CTmax metrics across temperature. Letters indicate significant differences. Current samples sizes between 5-8 individuals per temp. Letters indicate significant differences in temperature treatments between individuals.

Conclusion

- CTmax was shown to change depending on the acclimation temperature.
- Short term acclimation can increase A. felis threshold for what temperature starts to negatively affect neurological performance but only up to a certain point.
- These findings can help assist future studies in understanding thermal tolerance and can even help local and global fisheries continue to support their communities with a better grasp of how their animals can thrive as the climate continues to change.
- There is still much to learn about thermal tolerance in marine species, especially since climate changes can be very extreme and unpredictable.
- Future research will look at 14-day thermal acclimation, larger sample sizes, analysis of heat shock proteins, and even different species like pompano and bonnetheads.

References: Seibel, B. A., Andres, A., Birk, M. A., Burns, A. L., Shaw, C. T., Timpe, A. W., & Welsh, C. J. (2021). Oxygen supply capacity breathes new life into critical oxygen partial pressure (*p*crit). *Journal of Experimental Biology*, *224*(8). https://doi.org/10.1242/jeb.242210 . Waite, E. R. (1917). *Ariopsis felis syn. Arius felis*. Records of the Australian Museum; Ramsay, E. P. (Edward Pierson). Retrieved 2024, from https://commons.wikimedia.org/w/index.php?curid=586863.
Norin, T., & Clark, T. D. (2016). Measurement and relevance of maximum metabolic rate in fishes. Journal of Fish Biology, 88(1), 122-151.
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Chabot, D., Steffensen, J. F., & Farrell, A. P. (2016). The determination of standard metabolic rate in fishes. Journal of Fish Biology, 88(1), 81-121.
The determination of standard metabolic rate in fishes - Chabot - 2016 - Journal of Fish Biology - Wiley Online Library,
Clark, T., Sandblom, E., & Jutfelt, F. (2013) Aerobic scope measurements of fishes in an era
of climate change: respirometry, relevance and recommendations. J Exp Biol 216:27712782. doi: https://doi.org/10.1242/jeb.084251, Lutterschmidt, W. I., & Hutchison, V. H. (1997). The critical thermal maximum: history and critique. Canadian Journal of Zoology, 75(10), 1561–1574. https://doi.org/10.1139/z97-783

Acknowledgments: FSU Provost Postdoctoral Fellowship Program, FSU Coastal and Marine Laboratory staff, FSU/MISS 2024 interns, FSU Directed Independent Study students, FSU provost postdoctoral fellowship, Dr. Grubbs, FSU Undergraduate Research program.

Hardhead Catfish Thermal Performance

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Introduction

As global temperatures continue to rise, it is vital to understand the ways in which different species will face the consequences.

•*Ariopsis felis*, the Hardhead Catfish, is one of two saltwater catfish species that is subject to the rising ocean temperatures.

•Commonly found in coastal habitats such as the Gulf of Mexico.

The thermal performance and metabolic activity of *A. felis* was investigated using respirometry CT_{max} (Critical Thermal Maximum) trials.

•CT_{max} is the temperature at which an organism's ability to control movement and behavior becomes disordered and can lead to death.

The purpose of this study is to determine the thermal tolerance of Hardhead Catfish in the Northern Gulf of Mexico using metabolic and behavioral studies and examining various metabolic measures. This question is essential to see how Hardhead Catfish's metabolic scope responds to rising water temperatures due to climate change.

A. Felis are a good model species because they are one of only species in ecological studies active and feeding at or above.

Methods

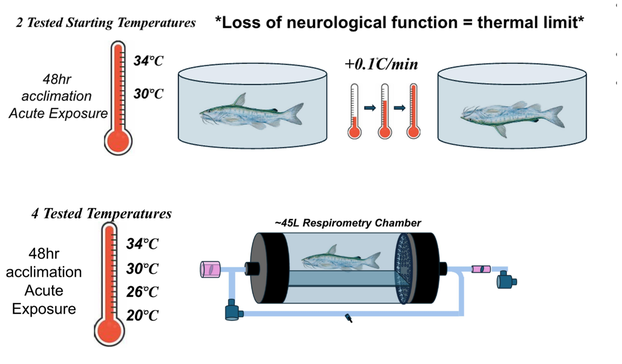
Procedures:

Trials were conducted using Respirometry Chambers to determine how much oxygen was being used by the subject over 24 hour period at different activity levels and tempters The two main steps were as follows:

- The subject would be manually chased to exhaustion over a period of about 10 minutes.
- The subject would then be placed in the chamber over varying measures of time depending on whether an acute or chronic trial was being conducted.

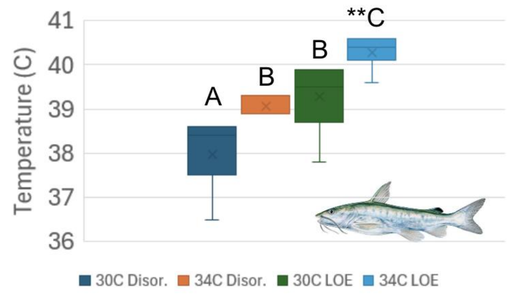
Data-analysis: aerobic scope and metabolic, critical temputure. Not oxygen

The data determined here is the temperature at which the subject can continue to function without normal oxygen levels. The end temperature at which bodily functions start to fail is the Critical Thermal Maximum (CT_{max}), and it is measured during periods of decreased oxygen when the animal is forced to perform only the most basic and vital functions (P_{crit}).



Results

Graphs + captions Incoming!



Conclusion

Trends have shown that the temperature at which *A. felis* begin to experience a decline in metabolic activity is (*blank*).

This indicates that the thermal performance of the Hardhead Catfish may suffer over time as a result of climate change.

Future studies

References:

Acknowledgments: FSU Provost Postdoctoral Fellowship Program, FSU Coastal and Marine Laboratory staff, FSU/MISS 2024 interns, FSU Directed Independent Study students, FSU provost postdoctoral fellowship, Dr. Grubbs, FSU Undergraduate Research program.

Hardhead Catfish Thermal Performance

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Abstract

The Hardhead Catfish (*A. felis*) is one of many Gulf Coast fish species that is subject to rising ocean temperatures tolerance and climate change. While *A. felis* is a very robust species, it is still vital to understand the ways in which they respond to stress. One way to learn more about their thermal tolerance is to observe CTmax (critical thermal maximum) values to better comprehend their aerobic scope. The trials on this project were conducted using respirometry chambers in which the animal's oxygen use was measured at different temperatures over 24 hours. The animal would be chased to exhaustion and then put into the chamber after having previously been acclimated to the temperature of the tanks. The maximum metabolic rate would be recorded immediately and after 5 hours or a period of rest, the average metabolic rate was observed. The animal's use of oxygen under different thermal conditions can reveal how long the animal would be able to survive before experiencing symptoms such as disorientation and loss of equilibrium which can lead to death. There is still much to learn about thermal tolerance in marine species, especially since the ways in which the climate is changing can be very extreme and unpredictable. These strides however can aid the continuous research in understanding that thermal tolerance and can even help local and global fisheries continue to support their communities with a better understanding of how their animals can thrive as the climate continues to change.

Introduction

As global temperatures continue to rise, it is vital to understand the ways in which different species will face the consequences. *Ariopsis felis*, the Hardhead Catfish, is one of two saltwater catfish species that is subject to the rising ocean temperatures. They are a good model species because they are one of only species in ecological studies active and feeding at or above 34ºC. The thermal performance and metabolic activity of *A. felis* was investigated using respirometry CT_{max} (Critical Thermal Maximum) trials.

The purpose of this study is to determine the thermal tolerance of Hardhead Catfish in the Northern Gulf of Mexico using metabolic and behavioral studies and examining various metabolic measures. This question is essential to see how Hardhead Catfish's metabolic scope responds to rising water temperatures due to climate change.

Methods

Definitions

- **CT_{max}** is the temperature at which an organism's ability to control movement and behavior becomes disordered and can lead to death.
- **Maximum Metabolic Rate (MMR)**: highest metabolic rate measured.
- **Resting Maximum Metabolic Rate (SMR)**: lowest metabolic rate that sustains consciousness when organism is at rest.

Procedures: intermittent respirometry was used to measure maximum and resting metabolic rate

1. Subject was acclimated to tested temperature (20, 26, 30, 34ºC) for 48 hours.
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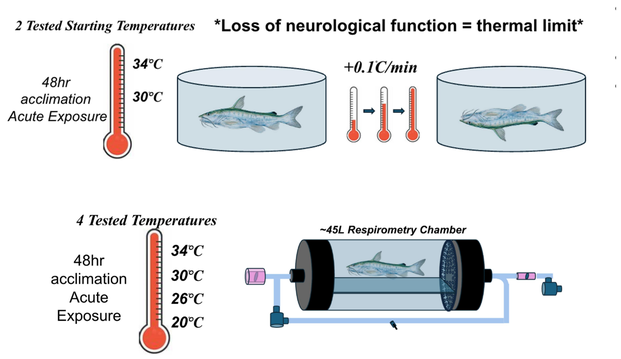

Data-Analysis: Aerobic and Metabolic Scope at Different Temperatures

Results

Graphs + captions Incoming!

Conclusion

Trends have shown that the temperature at which *A. felis* begin to experience a decline in metabolic activity is (*blank*).

This indicates that the thermal performance of the Hardhead Catfish may suffer over time as a result of climate change.

These findings can help aid the future studies in understanding thermal tolerance and can even help local and global fisheries continue to support their communities with a better understanding of how their animals can thrive as the climate continues to change.

References:

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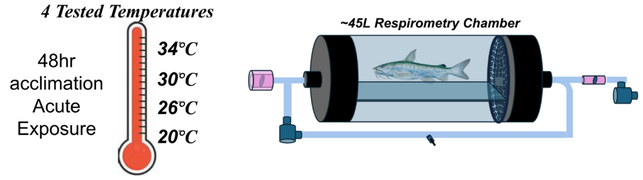
Introduction

As global temperatures continue to rise, it is vital to understand the ways in which different species will face the consequences. *Ariopsis felis*, the Hardhead Catfish, is one of two saltwater catfish species that is subject to the rising ocean temperatures. They are a particularly good model species to use for this type of study because they are one of only species to be active and feeding at such high temperatures in ecological studies performed in the same area. The purpose of this study is to determine the thermal tolerance of Hardhead Catfish in the Northern Gulf of Mexico by measuring their metabolic scope using respirometry Critical Thermal Maximum trials. CT_{max} is the temperature at which an organism's ability to control movement and behavior becomes disordered and can lead to death. This question is essential to see how Hardhead Catfish's metabolic scope responds to rising water temperatures due to climate change.

Methods

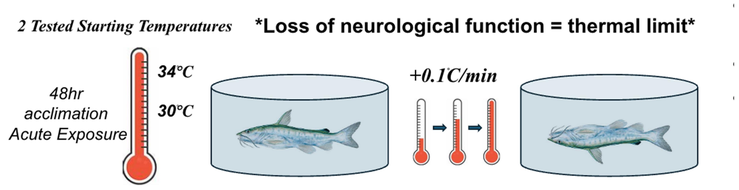
Procedures:

Trials were conducted using respirometry chambers to determine how much oxygen was being used by the subject over 24-hour period at different activity levels at 20ºC, 26ºC, 30ºC, and 36ºC. First the subject was acclimated to its respective temperature for a 48-hour period. Then the subject would be manually chased to exhaustion over a period of about 10 minutes. The subject would then be placed in the chamber. Maximum metabolic rate was measured immediately after the subject was placed in the chamber and then after 5 hours or undisturbed rest, average metabolic rate was measured.



Data-analysis: Aerobic Scope and Metabolic, critical temperature.

The data determined here is the temperature at which the subject can continue to function without normal oxygen levels. The end temperature at which bodily functions start to fail is the Critical Thermal Maximum (CT_{max}), and it is measured during periods of decreased oxygen when the animal is forced to perform only the most basic and vital functions (P_{crit}).



Results

My research team is currently working on processing the data collected in trials preformed last semester. We will have the processed results before the symposium and will present it in graphs.

Conclusion

Once we have the data we will discuss at what temperature A. felis begin to experience a decline in metabolic activity. The results could indicate that the metabolic performance of the Hardhead Catfish may suffer over time as climate change increases the temperature of the Northern Gulf of Mexico. The results of this study could influence future metabolic research preformed on a wider range of fish species. Currently the research lab is planning on running trials with spotted sea trout, pompano, and bonnethead sharks.

References:

Acknowledgments: FSU Provost Postdoctoral Fellowship Program, FSU Coastal and Marine Laboratory staff, FSU/MISS 2024 interns, FSU Directed Independent Study students, FSU provost postdoctoral fellowship, Dr. Grubbs, FSU Undergraduate Research Program.

Intro

As global temperatures continue to rise, it is vital to understand the ways in which different species will face the consequences.

- *Ariopsis felis*, the Hardhead Catfish, is one of two saltwater catfish species that is subject to the rising ocean temperatures.
- Commonly found in coastal habitats such as the Gulf of Mexico.

The thermal performance and metabolic activity of *A. felis* was investigated using CT_{max} (Critical Thermal Maximum) trials.

- CT_{max} is the temperature at which an organism's ability to control movement and behavior becomes disordered and can lead to death.

The purpose of this study is to determine the thermal tolerance of Hardhead Catfish in the Northern Gulf of Mexico using CT_{max} trials and examining various metabolic measures. This question is essential to see how Hardhead Catfish's metabolic scope responds to rising water temperatures due to climate change.

Methods

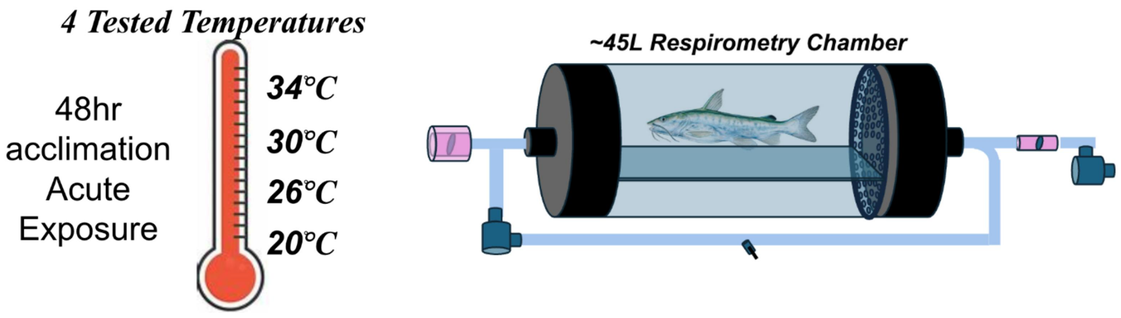
Participants:
The subjects of the study were *Ariopsis felis*, the Hardhead Catfish collected from the Northern Gulf of Mexico.

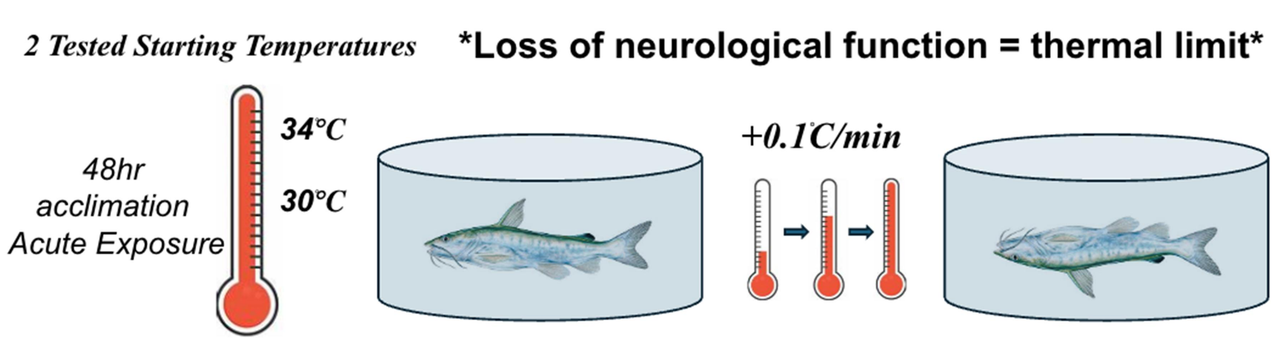
Materials/Measures: What did they measure?
We measured each subject's metabolic rate at exhaustion and during a period of rest. Metabolic rate was measured by analyzing the rate of oxygen consumption.

Procedures:
Trials were conducted using Respirometry Chambers to determine how much oxygen was being used by the subject at different points under certain conditions. The two main steps were as follows:
-The subject would be manually chased to exhaustion over a period of about 10 minutes.
-The subject would then be placed in the chamber over varying measures of time depending on whether an acute or chronic trial was being conducted.

Data-analysis:
The data determined here is the temperature at which the subject can continue to function without normal oxygen levels. The end temperature at which bodily functions start to fail is the Critical Thermal Maximum (CT_{max}), and it is measured during periods of decreased oxygen when the animal is forced to perform only the most basic and vital functions (P_{crit}).

Methods (Pictures)





Results/ Conclusion

This project started before my partner and I joined and the project and will continue after we depart, so results are subject to change.

- Trends have shown that the temperature at which *A. felis* begin to experience a decline in metabolic activity is (*blank*).

This indicates that the thermal performance of the Hardhead Catfish may suffer over time as a result of climate change.

References

- By Edgar R. Waite - Records of the Australian Museum Australian Museum; Ramsay, E. P. (Edward Pierson), d. 1917, ed URL, Public Domain, https://commons.wikimedia.org/w/index.php?curid=586863

Ask Alyssa

- Is there anyone/ any particular organization you want us to Acknowledge?
    - FSU Provost Postdoctoral Fellowship Program, FSU Coastal and Marine Laboratory staff, FSU/MISS 2024 interns, FSU Directed Independent Study students, FSU provost postdoctoral fellowship, Dr. Grubbs, FSU Undergraduate Research program.
- The Metabolic rate graph with raw data.
- Data to make results graphs.
- Approve/ edit introduction and methods.

Abstract

The Hardhead Catfish (*A. felis*) is one of many Gulf Coast fish species that is subject to rising ocean temperatures as a result of climate change. While *A. felis* is a very robust species, it is still vital to understand the ways in which they respond to stress. One way to learn more about their thermal tolerance is to observe CTmax (critical thermal maximum) values to better comprehend their aerobic scope. The trials on this project were conducted using respirometry chambers in which the animal's oxygen use was measured at different temperatures over 24 hours. The animal would be chased to exhaustion and then put into the chamber after having previously been acclimated to the temperature of the tanks. The maximum metabolic rate would be recorded immediately and after 5 hours or a period of rest, the average metabolic rate was observed. The animal's use of oxygen under different thermal conditions can reveal how long the animal would be able to survive before experiencing symptoms such as disorientation and loss of equilibrium which can lead to death. There is still much to learn about thermal tolerance in marine species, especially since the ways in which the climate is changing can be very extreme and unpredictable. These strides however can aid the continuous research in understanding that thermal tolerance, and can even help local and global fisheries continue to support their communities with a better understanding of how their animals can thrive as the climate continues to change.

Intro work

- As global temperatures continue to rise, it is vital to understand the ways in which different species will face the consequences.
- The Hardhead Catfish, *Ariopsis felis*, is one of many Gulf Coast fish species that is subject to rising ocean temperatures as a result of climate change.
- *A. Felis* are a good model species because they are one of the only species in ecological studies found to be active and feeding at or above 34ºC.
- The purpose of this study is to determine the thermal tolerance of Hardhead Catfish in the Northern Gulf of Mexico using metabolic and behavioral studies and examining various metabolic measures. This question is essential to see how Hardhead Catfish's metabolic scope responds to rising water temperatures due to climate change.

The Hardhead Catfish (*A. felis*) is one of many Gulf Coast fish species that is subject to rising ocean temperatures tolerance and climate change. While *A. felis* is a very robust species, it is still vital to understand the ways in which they respond to stress. One way to learn more about their thermal tolerance is to observe CTmax (critical thermal maximum) values to better comprehend their aerobic scope.

Conclusion work

- Trends have shown that the temperature at which *A. felis* begin to experience a decline in metabolic activity is (*blank*).

This indicates that the thermal performance of the Hardhead Catfish may suffer over time as a result of climate change.

- These findings can help aid the future studies in understanding thermal tolerance and can even help local and global fisheries continue to support their communities with a better understanding of how their animals can thrive as the climate continues to change.

- The animal's use of oxygen under different thermal conditions can reveal how long the animal would be able to survive before experiencing symptoms such as disorientation and loss of equilibrium which can lead to death. There is still much to learn about thermal tolerance in marine species, especially since the ways in which the climate is changing can be very extreme and unpredictable. These strides however can aid the continuous research in understanding that thermal tolerance and can even help local and global fisheries continue to support their communities with a better understanding of how their animals can thrive as the climate continues to change.

- Trends have shown that the temperature at which *A. felis* begin to experience a decline in metabolic activity is (*blank*).
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