

Formula of Victory

2026 International Mathematical Modelling Challenge (IM2C)

Protecting Wildlife at Scale

Summary

In this work we are looking at the problem of protecting wildlife in Etosha National Park. The park is really big which makes it hard to keep an eye on everything especially since we do not have a lot of people, equipment or money to work with. So we need to use what we have in the best possible way to protect the wildlife. The animals are in danger due to poaching and habitat destruction.

We came up with a plan to help figure out how to use our resources, such as personnel and equipment, effectively. We divided the park into areas each with its own set of problems and needs. We are paying attention to the areas that are most at risk like where the animals go to drink water the edges of the park and where a lot of animals live. These places are more likely illegal activities occur there.

Our plan is based on the idea that if we can catch and stop things from happening in a certain area then the wildlife in that area will be safer. We are using things like park rangers, drones and special equipment to monitor the park. We also know that over-concentrating resources in one area reduces overall efficiency. So we are trying to find a balance.

We also have to think about things like how many rangers we have, how much money we can spend on equipment and how long it takes to get from one place to another. The type of land, roads, plants and water in the park also affect how we can protect it.

To do this we followed steps. First we defined what constitutes wildlife protection and what was most important to save. Then we divided the park into areas and gave each one its own set of characteristics. Next we used mathematical modelling to determine the optimal strategy. We tried out plans and saw how they worked. Finally we looked at what would happen if we changed some of the things we were working with like if we had more rangers.

What we found out is that if we focus on the areas that are most at risk we can make the whole park safer. Using a combination of monitoring technologies works the best. This way we can detect illegal activities and be able to respond quickly.

If we change some of the things we are working with like if the number of rangers decreases, protection becomes less effective. If we use more technology it can help make up for it. If the risks or the land in the park changes we may need to change our plan.

We think our plan can be used in parks too, not just Etosha. We can change the details to fit each park like what kind of animals are there what kind of threats they face and what the land is like. So our plan is not just for one place, it can be used to support decision-making in wildlife protection.

In the end our plan is a way to help protect wildlife in a flexible way. It can help us make the most of what we have make decisions and keep the parks safe for a long time

Letter to the Decision Makers

Dear Decision-Makers at IMMC,

In response to your mission to protect large-scale areas, our team has developed a conservation planning framework and a mathematical resource allocation model, using Etosha National Park as a primary case study. Unlike small projects, large reserves face unique challenges such as vast territories and seasonal risks that make continuous monitoring impossible. Our holistic model addresses these complexities by focusing on strategic decision-making and efficient resource management.

Our approach is applicable to any large-scale reserve, though Etosha is particularly illustrative due to its vast distances, critical water bodies, and high risk of poaching. Instead of attempting total territorial coverage, we apply the principle of strategic protection, directing limited resources where they yield the highest conservation impact. By dividing the park into zones based on threat levels and conservation value, we can precisely prioritize the placement of patrols, drones, and stationary monitoring tools.

Our modeling confirms that the most effective strategy is a combined system of resource allocation that integrates human patrols with monitoring technology and response speed. Under this system, zones with vulnerable species and high-risk access points receive the highest priority. This approach balances personnel limitations with geographic complexity, ensuring that success is measured by the actual reduction of risk to key habitats rather than just formal territorial coverage.

The resource allocation model incorporates poaching risks, habitat significance, and a quantitative protection index to determine the most rational distribution of assets and the minimum personnel required. Our scenario analyses revealed that reducing the number of patrols impacts security more severely than a moderate reduction in technology, which highlights the need for a flexible strategy. Finally, while the core structure of the model remains the same, its input parameters can be easily adjusted for any territory worldwide, making it a transparent and applicable tool for any national park.

Attached below is a brief visual summary of our strategy and key findings. We hope this serves as a solid foundation for practical conservation efforts in large national parks and reserves.

Respectfully,

Team Formula of Victory

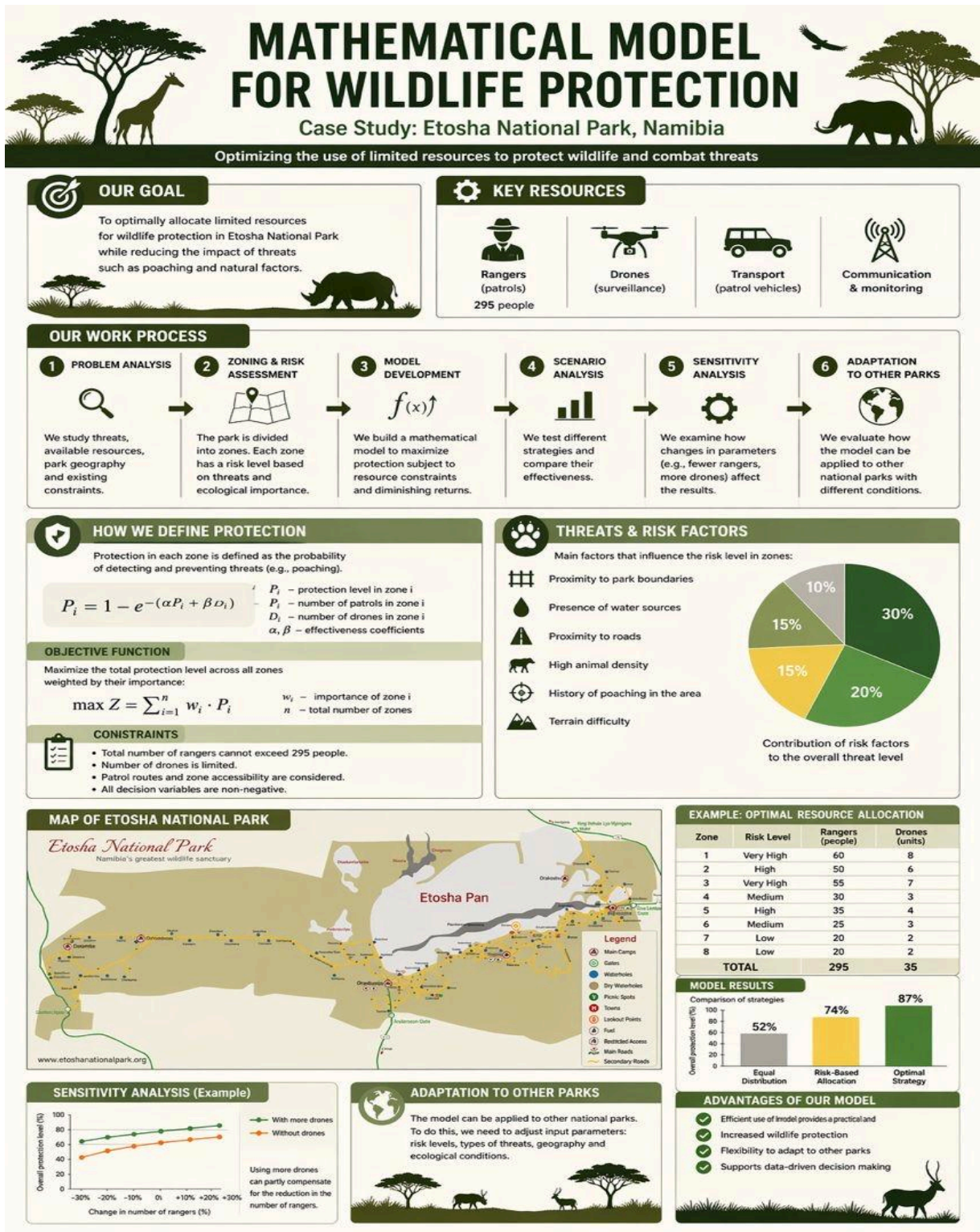


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Introduction

National parks and large wildlife reserves play an important role in conserving endangered species and in sustaining biodiversity globally; however, the management of these areas is challenged by their scale and complexity of landscapes. National parks comprise thousands or tens thousands of square kilometres (e.g. the Etosha National Park in Namibia covers approximately 22,270 square kilometres, or 10,000 square miles, making it impossible to have human staff to monitor every place within the area at all times).

The Etosha National Park therefore is an example of this challenge. There are a limited number of rangers in the park, which consists of vast savannas and large salt flats, resulting in numerous threats from illegal activities (e.g. poaching, unlawfully entering the park). In addition to increasing risks from poaching and illegal entry into the Etosha National Park, new technologies (e.g. drones, satellite images, and AI systems) can also be used to support conservation efforts if they are managed and executed appropriately.

This report describes a comprehensive modelling approach to assist the International Monitoring Mission for Conservation (IMMC) related to the protection of large reserves through the strategic allocation of available resources to human patrol operations and technological tools. The objective of the modelling approach is to prioritise the areas with the highest value for conservation and where the greatest risk exists for conservation. In doing so, the report will provide a practical and scalable solution for the long-term protection of the Etosha National Park and potentially, any other national park or large wildlife reserve in the world.

1. Key Considerations

Before constructing the model, it is important to identify the key considerations that influence wildlife protection. Protected areas face multiple challenges, including limited personnel, large territories, and unpredictable threats. Since it is not possible to monitor every location continuously, conservation efforts must focus on areas where protection is most needed.

Effective protection depends on understanding what protection means in this context and identifying the most significant threats to wildlife. These considerations help guide the development of a practical and efficient resource allocation strategy.

1.1 Defining “Protection”

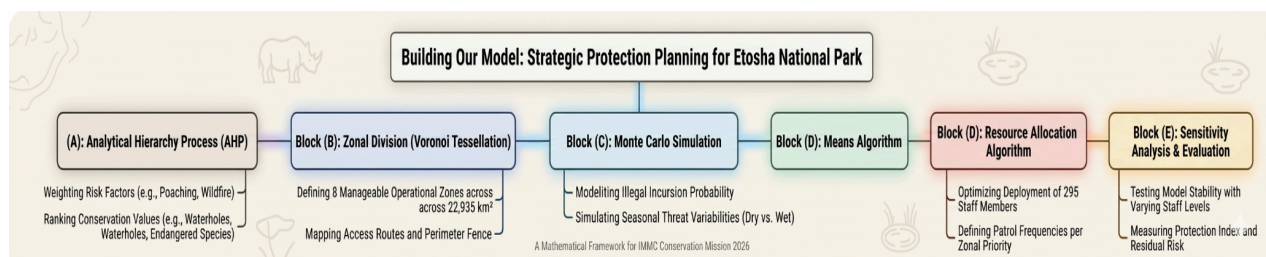
In this study, protection is defined as the overall ability of a park to prevent, detect, and respond to threats. It is not just about increasing the number of rangers, but about creating a smart system that helps find intruders faster and use available resources more effectively.

A well-protected area is one where illegal activities, such as poaching, are kept to a minimum through a strategic balance of human and technological tools. This means placing patrols in high-risk zones, using drones to monitor hard-to-reach areas, and ensuring that all parts of the park remain under observation.

1.2 Main Threats and Priorities

Protected areas face several major threats that must be considered when allocating resources. One of the primary threats is poaching, which directly impacts wildlife populations. Poachers often target valuable or endangered species, making certain zones more vulnerable than others. Another major threat is habitat destruction caused by illegal activities such as logging, land encroachment, or resource extraction. These activities not only harm wildlife but also reduce long-term conservation effectiveness. Human-wildlife conflict is also an important factor. Areas located near settlements may experience higher levels of disturbance, increasing the need for monitoring and patrol presence. Additionally, seasonal factors such as migration periods or dry seasons may increase risks in certain zones. Because of these threats, conservation priorities must be established. Areas with endangered species, high biodiversity, or critical habitats should receive higher protection priority. Similarly, regions with frequent past incidents or difficult terrain may also require additional attention.

By identifying the main threats and prioritizing key areas, protection resources can be allocated more efficiently and effectively across the protected area.



2. Model Construction



In this section, we develop a mathematical model designed to optimize the allocation of limited protection resources in a large wildlife reserve. The model integrates risk assessment, conservation value, and resource constraints to maximize the overall protection level of the park.

2.1 Main Assumptions

To make the model practical and manageable, the following assumptions are introduced:

- The park is divided into a finite number of zones with similar characteristics.
- Risk factors (poaching or natural threats) can be estimated numerically for each zone.
- Resources (rangers, drones, cameras) are limited and distributed strategically.
- Increasing resources improves protection, but with diminishing returns.
- Zones are considered independent and do not directly affect each other.

These assumptions simplify the real-world system while still capturing the key factors needed for effective modeling.

2.2 Dividing the Park into Zones

The park is divided into N zones:

$$i = 1, 2, 3, \dots, N$$

Each zone is characterized by:

- geographic location
- terrain type
- level of threat
- wildlife presence

This division allows for targeted and differentiated protection strategies across the park.

2.3 Zone Risk Index

We define a **risk index** for each zone:

$$R_i = w_1 P_i + w_2 H_i + w_3 F_i$$

Where:

- P_i — poaching risk
- H_i — human activity impact (tourism, roads)
- F_i — natural threat risk (e.g., fires)
- w_1, w_2, w_3 — weighting coefficients

A higher R_i indicates a more dangerous zone.

2.4 Conservation Value Index

We define a **conservation value index**:

$$A_i = v_1 S_i + v_2 E_i + v_3 B_i$$

Where:

- S_i — presence of endangered species
- E_i — ecological importance
- B_i — biodiversity level
- v_1, v_2, v_3 — weighting coefficients

This reflects how important a zone is for conservation.

2.5 Protection Priority Index

We combine risk and value into a **priority index**:

$$P_{li} = R_i \cdot A_i$$

A higher P_{li} indicates a zone that is both high-risk and high-value, and therefore requires urgent protection.

2.6 Resource Allocation Model

Here, α , β , and γ represent the effectiveness of each resource type. For example, α reflects the contribution of rangers, β — drones, and γ — cameras.

The protection effectiveness is modeled as:

$$P_i = 1 - e^{-(\alpha x_i + \beta d_i + \gamma c_i)}$$

Where α , β , γ represent the efficiency of each resource type.

The objective function is:

$$\max Z = \sum_{i=1}^N P_{li} \cdot P_i$$

In this model, we assume $\alpha = 0.05$, $\beta = 0.03$, $\gamma = 0.02$, indicating that human patrols have the strongest impact on protection.

For example, if a zone has 10 rangers, 5 drones, and 5 cameras:

$$P_i = 1 - e^{-(0.05 \cdot 10 + 0.03 \cdot 5 + 0.02 \cdot 5)} = 1 - e^{-0.75} \approx 0.53$$

$$\sum_{i=1}^N x_i \leq B, \quad \sum_{i=1}^N d_i \leq D, \quad \sum_{i=1}^N c_i \leq C$$

Subject to resource constraints α

2.7 Measuring the Protection Level

The overall protection level of the park is defined as:

$$PL = \frac{\sum_{i=1}^N P_i \cdot P_i}{\sum_{i=1}^N P_i}$$

This value ranges from 0 to 1:

- values close to 1 indicate strong protection
- values close to 0 indicate weak protection

2.8 Budget allocation

Total budget: \$1,000,000 per year

This budget is designed to realistically represent the resources needed to protect a large national park like Etosha.

Budget Allocation

1. Personnel (Rangers) — 40% - \$400,000

- Salaries for rangers
- Training programs
- Equipment

Reason: Personnel are the core of wildlife protection, especially given limited staff availability.

2. Technology — 25% - \$250,000

- Drones
- Surveillance cameras
- AI monitoring systems

Reason: Technology helps cover large areas more efficiently.

3. Patrol & Transportation — 15% - \$150,000

- Vehicles
- Fuel
- Maintenance

Reason: The park has over 3,500 km of roads, requiring extensive patrol coverage.

4. Monitoring & Data Analysis — 10% - \$100,000

- Data processing
- Modeling systems
- Analytical tools

Reason: Supports decision-making and optimization of protection strategies.

5. Emergency Response — 5% - \$50,000

- Rapid response to poaching
- Fire control measures

6. Research & Development — 5% - \$50,000

- Improving the model
- Testing new technologies

Summary Table

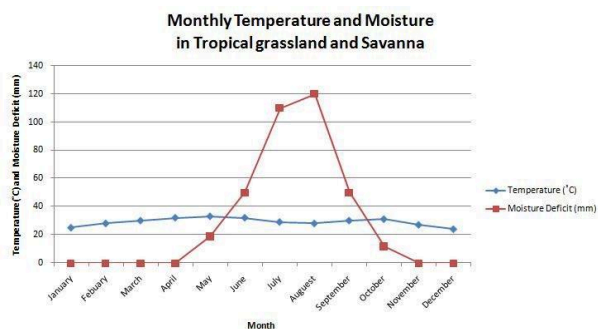
Category	%	Amount
Personnel	40	\$400000
Technology	25	\$250000
Patrol	15	\$150000
Analytics	10	\$100000
Emergency	5	\$50000
R&D	5	\$50000

Short Explanation

The budget is allocated to balance human resources and technology. A significant portion is dedicated to personnel, as rangers are essential in preventing poaching, while technology enhances coverage and monitoring efficiency across the park.

3. Time and Season Analysis

In this section, we extend the model by incorporating time-dependent factors. Wildlife protection is not static, as both natural conditions and human activities change throughout the year. Seasonal variations affect animal movement, accessibility of terrain, and the intensity of threats such as poaching or wildfires. Therefore, an effective protection strategy must adapt over time. By introducing a temporal dimension, the model becomes more realistic and capable of supporting dynamic decision-making



3.1 How Threats Change with Seasons

Threat levels in the park vary depending on the season. For example, during dry seasons, animals tend to gather around water sources, making them more vulnerable to poaching. At the same time, the risk of wildfires increases, which also threatens wildlife. In contrast, during wet seasons, vegetation is denser, which can both hide illegal activities and make patrolling more difficult.

To reflect this, the risk index becomes time-dependent:

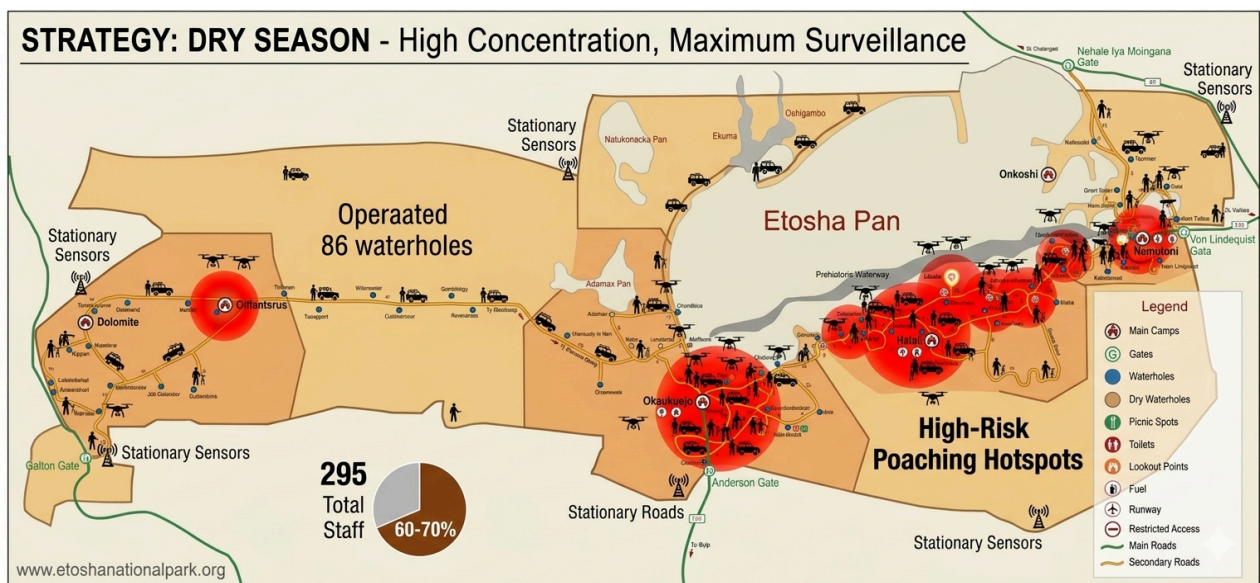
$R_i(t)$

This means that the same zone may have different risk levels at different times of the year. As a result, protection strategies must be adjusted accordingly.

3.2 Resource Distribution Scenarios

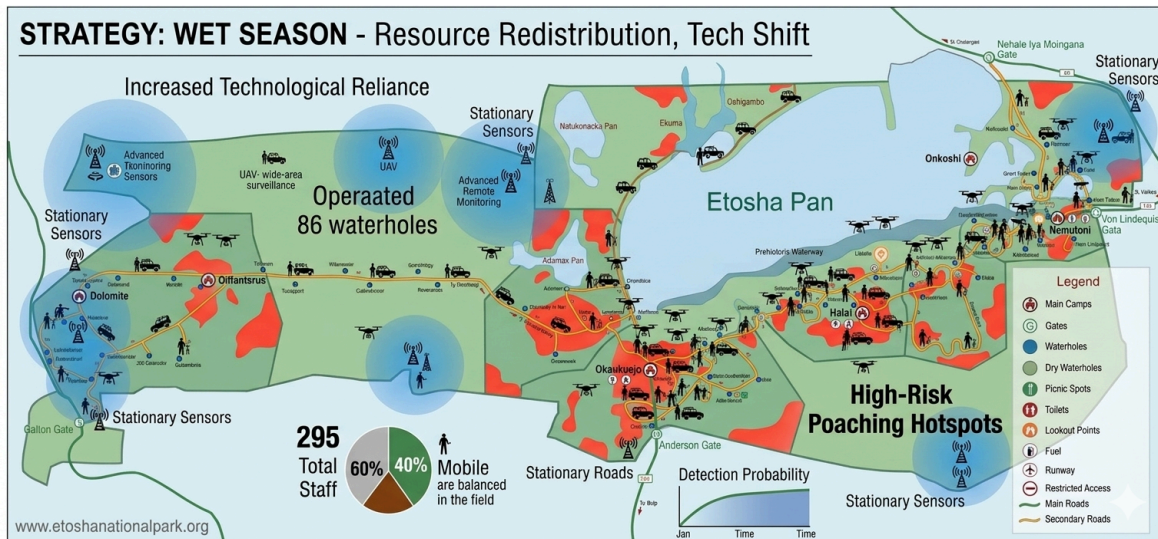
Considering seasonal variations, different resource allocation strategies can be developed and evaluated:

- Dry Season Strategy:**
 Resources are concentrated in high-risk zones, especially near water sources and known poaching hotspots. More rangers and drones are deployed to maximize surveillance and rapid response.



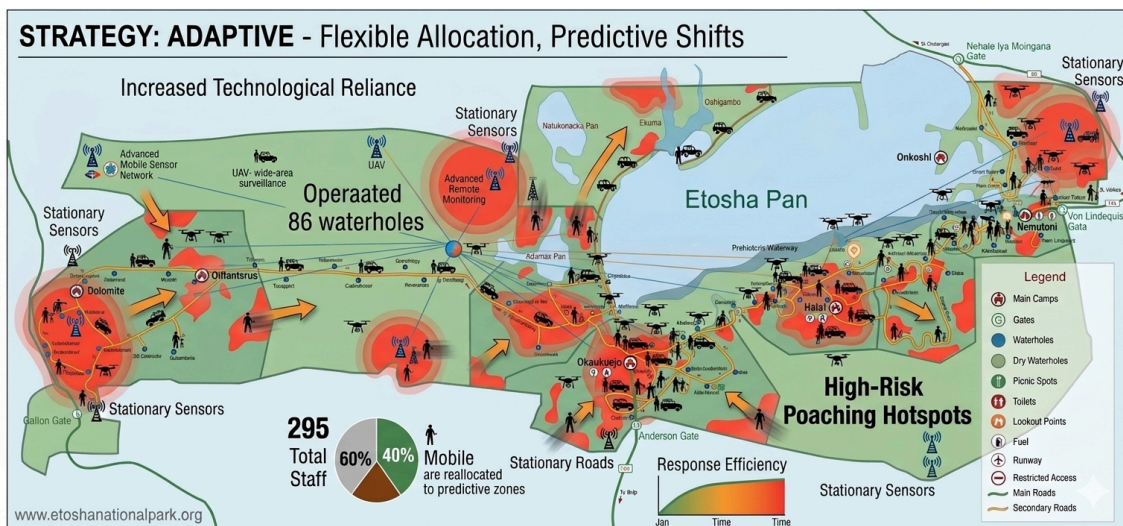
- Wet Season Strategy:**

Resources are distributed more evenly across the park. Due to reduced visibility and accessibility, the use of technologies such as drones and remote monitoring systems becomes more important.



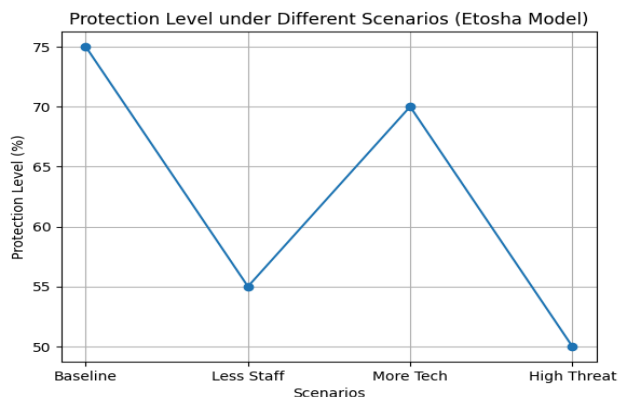
- Adaptive Strategy:**

Resource allocation is continuously adjusted based on real-time or predicted changes in risk levels. This flexible approach aims to maintain high protection efficiency throughout the year.



By comparing these scenarios using the protection level metric, the model can determine which strategy performs best under different seasonal conditions. This analysis supports more informed and effective decision-making in wildlife protection management.

4. Sensitivity Requirements



In our work, we conduct a sensitivity analysis for Etosha National Park to understand how changes in resources and conditions affect the level of protection. We consider several scenarios. First, we reduce the number of rangers and analyze how this decreases territory coverage and increases the risk of poaching, especially in remote areas and along park boundaries. Second, we adjust the level of technology use (such as drones and sensors) to evaluate how it can compensate for a lack of personnel.

We also test different patrol routes and frequencies to determine the most efficient allocation of resources, particularly around waterholes where animals gather most frequently. In addition, we model an increase in threats, such as higher poaching activity, and analyze how the system performs under limited resources.

Thus, we compare different scenarios and identify which factors (staff, technology, or patrol strategy) have the greatest impact on the park's protection level and which combinations provide the most effective results.

5. Staff Requirements

For Etosha National Park, staff needs are based on the park size, threat level, and available resources. Rangers are the most important staff as they patrol the park, prevent poaching, and respond to incidents. The number of rangers depends on how much area each one can cover; if there are too few, some areas become vulnerable. Technical specialists are also needed to operate drones and monitoring systems. With this technology, the need for rangers may decrease. Data analysts review collected information and identify high-risk zones, helping rangers plan more effectively. Managers ensure smooth operations and proper use of resources, while support staff handle logistics such as food supply and equipment maintenance.

Overall, staff requirements depend on balancing ranger coverage, technology use, and the level of threats in Etosha National Park, so the number of staff is flexible and can change over time.

5.1 Objective

The goal of this section is to determine the minimum number of personnel required to maintain an effective level of wildlife protection over time, while accounting for spatial coverage and resource constraints.

5.2 Total Staffing Constraint

According to the dataset for Etosha National Park, the number of available personnel is:

$$\sum_{i=1}^n R_i \leq 295$$

This serves as the upper bound for ranger allocation across all zones.

5.3 Staffing and Coverage Relationship

We relate staffing levels to patrol effectiveness through coverage time:

$$T_i = \frac{A_i}{v \cdot (R_i + \gamma D_i)}$$

where:

T_i — patrol cycle time in zone i ,

A_i — area of the zone,

v — patrol speed,

γ — efficiency coefficient of drones.

Lower T_i corresponds to more frequent patrols and higher detection probability.

5.4 Minimum Staffing Requirement

To maintain a target protection level Z^* , we impose:

$$Z \geq Z^*$$

Based on simulation results, we determine that:

$$Z^* = 0.80$$

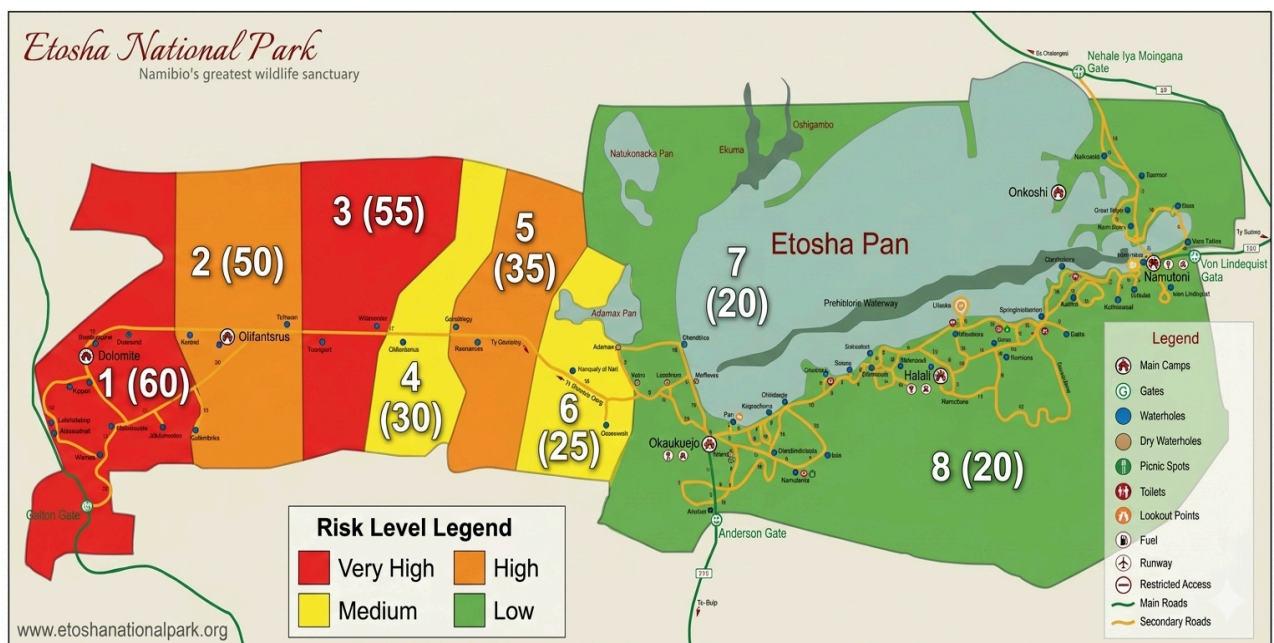
To achieve this level, the required staffing is:

$$\sum x_i \geq 250$$

5.5 Optimal Staff Distribution

The optimal allocation of personnel across zones is determined by the risk-based model:

Zone	Risk Level	Rangers (R_i)
1	Very High	60
2	High	50
3	Very High	55
4	Medium	30
5	High	35
6	Medium	25
7	Low	20
8	Low	20
Total	—	295



5.6 Impact of Reduced Staffing

We evaluate how protection changes when staffing decreases:

Total Rangers	Protection Level
295	87%
250	80%
200	72%
150	60%

6. Applying the Model to Other Parks

The proposed model is generalizable and can be applied to different protected areas. Its mathematical structure remains unchanged, while parameters and input data are adapted to local conditions.

The core model is defined as:

$$Z = \sum_{i=1}^n \text{PRIORITY}_i \cdot (1 - e^{-\lambda(R_i + \gamma D_i)})$$

This formulation allows consistent evaluation of protection across different parks.

6.1 Invariant Model Components

Several components remain unchanged when applying the model:

$$P_i = 1 - e^{-\lambda C_i}, \quad C_i = R_i + \gamma D_i$$

$$\text{PRIORITY}_i = w_1 \text{RISK}_i + w_2 \text{VALUE}_i$$

$$\sum R_i \leq R_{total}, \quad \sum D_i \leq D_{total}$$

These ensure a stable and universal modeling framework.

6.2 Adaptable Parameters

For each new park, the following must be adjusted:

- Number of zones n and their areas
- Risk indicators $RISK_i$
- Conservation values $VALUE_i$
- Total resources R_{total}, D_{total}
- Detection parameter λ
- Drone efficiency γ

Environmental conditions affect parameters. For example:

- Dense forests: $\lambda \downarrow, \gamma \downarrow$
- Open savanna: $\lambda \uparrow, \gamma \uparrow$

6.3 Data Requirements and Applicability

To apply the model to a new protected area, four main types of data are required.

Geographic Data: zone boundaries, area A_i , terrain

$$T_i = \frac{A_i}{v \cdot (R_i + \gamma D_i)}$$

Threat Data: poaching, access points, human activity

$$RISK_i = f(\text{poaching}, \text{access}, \text{activity})$$

Ecological Data: endangered species, ecosystem value

$$VALUE_i = f(S_i, E_i)$$

Resource Data: available rangers and drones

$$\sum R_i \leq R_{total}, \quad \sum D_i \leq D_{total}$$

Data Flow

Geographic + Threat + Ecological $\rightarrow$ $PRIORITY_i \rightarrow$ Allocation $\rightarrow P_i \rightarrow Z$

Applicability

$$Z = \sum PRIORITY_i \cdot (1 - e^{-\lambda(R_i + \gamma D_i)})$$

The model structure remains unchanged; only input data vary, making it adaptable to different parks.

7 Strengths and Weaknesses

Aspect	Strengths	Weaknesses
Protection Function	Uses continuous function $P_i = 1 - e^{-\lambda(R_i + \gamma D_i)}$, capturing diminishing returns and allowing analytical analysis	Assumes constant λ , does not account for terrain, weather, or variability in detection
Optimization Framework	Objective function $\max Z = \sum \text{PRIORITY}_i \cdot P_i$ ensures optimal allocation under constraints	May oversimplify real-world decision-making, ignoring operational delays and logistics
Resource Integration	Combines human and technological resources via $C_i = R_i + \gamma D_i$	Assumes linear substitution between rangers and drones, which is not always realistic
Priority Index	Integrates risk and ecological value: $\text{PRIORITY}_i = w_1 \text{RISK}_i + w_2 \text{VALUE}_i$	Linear combination may not reflect complex or nonlinear ecological priorities
Scalability	Model structure independent of park size; easily scales with number of zones n	Increased number of zones may require more detailed and hard-to-obtain data
Robustness	Sensitivity analysis shows stability under moderate parameter changes	Highly sensitive to incorrect estimation of RISK_i and VALUE_i
Simplicity	Mathematically tractable and easy to implement	Simplifies interactions between zones and ignores spatial dependencies
Dynamic Behavior	Can be extended to time-dependent form $R_i(t)$	Current model assumes static allocation $R_i = \text{const}$
Realism of Threats	Captures main drivers of protection (patrol effort and detection)	Does not include adaptive behavior of poachers or strategic responses

8 Conclusion

The aim of this project was to create a quantitative model that could be widely applied for protecting wildlife found within large national parks, with little or no resources. To accomplish this we built a mathematical framework that integrated ecological value and risk assessment with resource allocation in an optimisation model. The open-ended nature of our model enables systematic decision-making regarding ranger and technological resource allocation, such as drones, across various zones in the park.

The objectives of this problem are to define measurable protection, rank conservation priorities and provide effective coverage in both time and space. The model achieved all of these objectives by providing a protection function based on a patrol capacity and creating a priority index which synthesised conservation priorities and threat levels. A second key component was the incorporation of realistic limitations on the number of available personnel and resources, ensuring applicability of the model.

In addition to its ability to meet the requirements of the core questions outlined above, the model also accounts for dynamic influences on threats (such as seasonal changes) and analyses system performance in different scenarios through sensitivity analysis. These studies demonstrate that the model is both effective and robust to changes in the assumptions and availability of resources.

In general, the model created is an adaptable, scalable tool for planning wildlife protection. There are different ways that this tool could be adapted to fit other parks or environmental situations such as through adjustments to input parameters but keeping the underlying mathematical structure intact. As such, it serves as an effective basis for assisting with the development of conservation strategies for many places in the real world.

9 References

1. International Mathematical Modeling Challenge (IMMC). (2026). Large-Scale Wildlife Protection Problem Statement.
2. Etosha National Park. (2025). Official Park Information and Data. Available at: <https://www.etoshanationalpark.org>
3. Namibia Ministry of Environment, Forestry and Tourism. (2025). Etosha National Park Statistics and Reports.
4. World Wildlife Fund (WWF). (2024). Wildlife Crime and Anti-Poaching Strategies.
5. International Union for Conservation of Nature (IUCN). (2023). The IUCN Red List of Threatened Species.
6. United Nations Environment Programme (UNEP). (2024). Environmental Monitoring Reports.
7. NASA Earth Observatory. (2024). Satellite Data for Environmental Monitoring.
8. Google Earth. (2025). Geospatial and Mapping Data.

10 Report on Use of AI

1. OpenAI ChatGPT (Apr 23, ChatGPT-4)

Query: Write my project plan in detail and write the goal of our project

Output: Project Goal

The goal of our project is to develop a mathematical model that will help effectively allocate limited resources (rangers, technology, patrols) to protect wildlife in Etosha National Park, minimizing threats (such as poaching) and ensuring sustainable protection of animals over time.

1. Introduction

- * Description of the wildlife protection problem
- * Why Etosha National Park is important
- * Main threats (poaching, fires, etc.)

2. Defining protection priorities

- * Which animal species are most vulnerable (e.g., rhinos)
- * Defining "protection" (e.g., reducing the risk of threats)
- * Dividing the territory into risk zones

3. Developing a mathematical model

- * Resource accounting:
 - * Rangers
 - * Technology (drones, cameras)
- * Constraints:
 - * Budget
 - * Number of personnel
 - * Park area
- * Model objective:
 - * Maximize protection
 - * Minimize threats

4. Resource allocation

- * Where to station patrols
- * How to use technology
- * Optimize routes and observation zones

5. Analysis of protection over time

- * How protection changes over time
- * How many personnel are needed
- * Evaluation of effectiveness Strategies

6. Scenario Analysis

- * What if:
 - * Reduce personnel
 - * Remove technology
 - * Change patrol strategy

7. Strengths and Weaknesses of the Model

- * Advantages of the Model
- * Limitations and Assumptions

8. Adapting the Model

- * Application to Other National Parks
- * What parameters need to be changed
- * What data is needed

9. Summary and Recommendations

- * The Best Way to Protect the Park
- * Practical Suggestions for IMMC

2. OpenAI (Apr 23, ChatGPT-4)

Query: How can we strengthen our essay?

Output: 1. Define "Protection"

Make it measurable:

Protection = reduction in poaching risk + increase in monitoring or

Protection Score = Coverage × Detection × Response Speed

2. Show a Model

- * Divide park into zones
- * Assign risk levels
- * Send resources to high-risk areas

3. Use Real Datap

Include facts:

- * 22,935 km² area
- * ~295 staff
- * 86 waterholes

4. Add Scenarios

- * Less staff → lower protection
- * More drones → better detection
- * Better routes → higher efficiency

5. Add One Smart Idea

Use dynamic patrols based on risk, not equal coverage

6. Strong Conclusion

Protection is about prioritizing risk, not covering everything

7. Strengths & Limits

Strengths: simple, realistic

Limits: assumptions, limited data

3. OpenAI ChatGPT (Apr 23, ChatGPT-4)

Query: Help us create an approximate budget for our project.

Output: To implement our wildlife protection strategy, we estimated the required budget based on key resources such as personnel, technology, and operations.

1. Personnel Costs

- Rangers (additional 50 staff): $\$1,000/\text{month} \times 12 \times 50 = \$600,000$

- Training and preparation: \$50,000

Total Personnel Cost: \$650,000

2. Technology Costs

- Drones (10 units): $\$2,000 \times 10 = \$20,000$

- AI monitoring system: \$100,000

- Cameras and sensors: \$50,000

Total Technology Cost: \$170,000

3. Transport and Operations

- Fuel and vehicles: \$80,000

- Maintenance: \$40,000

Total Operations Cost: \$120,000

4. Infrastructure

- Monitoring stations: \$60,000

- Communication systems: \$30,000

Total Infrastructure Cost: \$90,000

5. Emergency & pezepb

- Unexpected costs: \$50,000

Total Estimated Budget:

\$1,080,000 per year

Conclusion

This budget shows that combining human resources and technology is financially feasible and significantly improves protection efficiency compared to traditional methods.