

DEER ABUNDANCE AND IMPACT MONITORING SYSTEMS



BRIEF SUMMARY

 Innovative monitoring systems have been developed to measure the impact of the *Rusa Deer* on the undergrowth of New Caledonian rainforests and to assess the abundance of this invasive species in three priority areas of the territory.

The development of these systems follows objectives that complement the professional control actions implemented within the PROTEGE framework. The monitoring aims to carry out an initial assessment and evaluate the benefits of the control operations, using tools tailored to action areas that are difficult to access and boast exceptional biodiversity. More than 80% of the plant species in high altitude rainforests are endemic to New Caledonia.

An initial divisional study made it possible to identify the issues and environmental pressures as well as the socio-economic context, in order to define the priority action areas. For the first time in New Caledonia, a standardised protocol to measure the impact of deer has been developed. It is based on several indicators and takes into account the specific plant species concerned and the limitations associated with its implementation.

In addition, PROTEGE has helped develop an innovative method to assess deer abundance, using a drone equipped with a thermal sensor to record videos at night. A specially developed algorithm is also designed to automatically carry out detections from these videos, making it significantly easier to process the data. The implementation of this protocol for surveying 4,700 hectares revealed very high local population densities and herd concentrations, in places reaching some of the highest levels recorded anywhere in the world. These results provide valuable information for targeting future actions and monitoring their benefits.

However, the continued implementation of these systems, together with actions to control invasive ungulates, relies on obtaining external financial support. The outlook for local funding is in fact compromised by the ongoing crisis in the region since May 2024.

BACKGROUND

 In New Caledonia, the *Rusa Deer* is a priority in the strategy to control invasive alien species due to its significant negative impacts on forests, their unique biodiversity and the critical ecosystem services they provide. Although its presence has been documented throughout Grande Terre, more thorough monitoring of populations and their impacts is needed to effectively guide control measures.

Dense high altitude rainforests are among the most vulnerable and impacted natural areas. In these hard to access environments, where hunting for food is virtually non-existent, the invasive populations are out of control. **The negative impacts are significant for the plant species in the undergrowth, of which 80% are endemic to New Caledonia, as well as for the animal species that depend on this ecosystem.** In total, 335 plant species, 55 reptile species, 9 bird species and 3 gastropods are considered endangered or semi-endangered, and would be impacted by the *Rusa Deer*.

"deer prevent the regeneration of undergrowth and damage ecosystem services critical to the water cycle."

By eating native, supporting plants, the deer prevent the regeneration of undergrowth and damage ecosystem services critical to the water cycle. **The damage to the undergrowth increases soil erosion**, which contributes to the silting up of watercourses and raises the risk of flooding during rainy periods. By limiting the replenishment of groundwater, this damage also causes watercourses to dry up and raises the risk of shortages during droughts.

Within PROTEGE, the first professional deer control operations have been carried out in three priority areas of high altitude rainforest by specially trained agents: the Massif du Panié, the Massif de Néaoua Mé-Adéo and the Massif de Thio. However, when the project started, there was no system in place to assess the impact of these actions, either in terms of reducing deer populations or in terms of their impact on the regeneration of undergrowth.

ISSUES & OBJECTIVES

 This operation aims to put in place **monitoring protocols and indicators that will eventually make it possible to assess the benefits of invasive ungulate management actions** biodiversity and water resources. These measures focused on three priority areas of rainforest selected by managers.

The proposal and implementation of **methodological frameworks tailored to the specific context of high altitude rainforests** in the Central Mountain Range is a major challenge for the project. Access limitations in priority areas make it critical to use standardised protocols that are simple, inexpensive and sufficiently robust. This challenge has been taken into account by PROTEGE to ensure an implementation that is realistic and sustainable.



THE MONITORING SYSTEMS HAVE 3 GOALS:

- Measuring the impacts of invasive ungulates on forest undergrowth
- Measuring the abundance and identifying concentration areas of invasive ungulates
- Informing and guiding control strategies and their benefits



OUTCOMES

 The project has helped to define priority areas suitable for control, and to develop several indicators for monitoring the evolution of the impacts of deer on rainforest undergrowth and of deer abundance. The implementation of the drone abundance monitoring system has made it possible to obtain figures on nearly 4,700 hectares of nocturnal feeding areas within the project's three priority areas.

Firstly, it was necessary to **classify and characterise the environmental and socio-economic challenges**, ecosystem services, pressures and limitations of action within the three priority areas. This work made it possible to map out the project's priority action areas, as well as those to be excluded from control actions because of their spiritual importance, the presence of rare and endangered animal species, or human activity.

"An innovative monitoring protocol for assessing the impacts of deer on rainforests"

A **protocol for assessing the impact of deer on rainforest undergrowth**, specifically tailored to the context of New Caledonia, has been created, based on five criteria and indicators. The first indicator is based on monitoring the browsing rate on a group of indicator plant species, observed on linear sections of the landscape, called transects. Monitoring of forest regeneration and photographic monitoring of fixed points are two other complementary criteria, plotted out along the transects. These observations are accompanied by a simplified assessment of the state of the forest undergrowth, carried out qualitatively at transect level. Finally, a small fencing system is used to monitor the restoration capacity of the most severely impacted areas, serving as a control experiment to demonstrate impacts.

Following a literature review on assessing the impact of deer in rainforests, covering the former experiences in New Caledonia, the methodology was adjusted and its implementation was tested. This field work has also helped to pinpoint rare or endangered species, and to identify the plant species most eaten by deer. The tests were carried out in the project's three priority areas in Boréaré (Néaoua Mé-Adéo), Diahoué (Pouébo) and Pic Ningua (Thio) and in areas representative of the territory's three natural habitats at stake, notably the heart of the forest, middle areas and forest edges. This work has therefore resulted in a methodological report detailing the procedures and practices for rolling out the protocol.

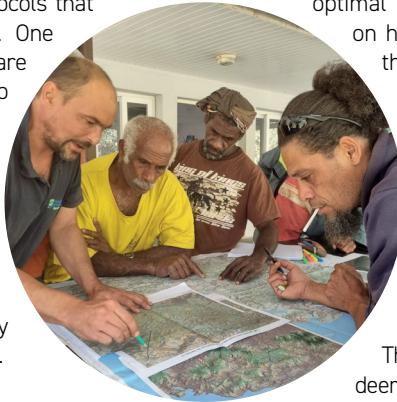
"Drone abundance index with thermal sensor reveals record densities in high altitude rainforests"

At the same time, an **innovative protocol monitoring night time deer abundance using a drone with a thermal sensor was developed and implemented to assess the abundance of deer populations in the project's priority areas**. Observations from this first implementation confirmed a high concentration of herds in the areas that are difficult to access and where there is virtually no hunting for food. In some areas, the densities recorded probably represent world records for all deer species.



This protocol has been developed following tests carried out in several habitats such as savannahs, dry and humid forests and at different altitudes and gradients. These tests have made it possible to write a feasibility study, enabling the development of two distinctive protocols that are designed not to frighten animals. One of them is tailored to the areas that are very difficult to access and have steep gradients. In addition, an automatic detection and counting algorithm has been developed to accurately distinguish the thermal signature of deer from those of other mammals in optimal environmental conditions. Cartographic analysis and field reconnaissance of the priority areas finally enabled us to identify the best pilot sites.

The implementation of the Aerial Abundance Index by Drone (IAAD), carried out between December 2023 and March 2024, enabled the detection of 2,043 deer



over a surveyed area of 4,694 hectares. This result is the fruit of 97 flight plans lasting a total of 118 hours. These enabled the survey of sectors spread across the three priority areas and were defined to allow optimal detection. Efforts were concentrated on herbaceous and shrubby savannahs on the periphery of or within the forested massifs, while dense woodland areas unfavourable to the aerial detection of deer feeding at night were mostly avoided.

The results show a very high abundance, with an average density of 43.5 deer per square kilometre, although there are significant disparities.

The Boréaré sector has by far the highest deer density (92 deer/km²), ahead of Konoyes Shaoué (78 deer/km²) and Bas Nindhia (63 deer/km²).

PROSPECTS AND SUSTAINABILITY

 **The protocol for monitoring the impact on undergrowth is now finalised and ready for use.** This methodology, designed to be simple and adaptable, can be used effectively to monitor future actions.

The Aerial Abundance Index by Drone with thermal sensor has, for its part, demonstrated its operational effectiveness. This technology is now completely functional and can be reused to assess changes in deer densities and concentrations over the long term. To support reusing this method, practical recommendations and indications of implementation costs have been included in the project's final summary and reporting documents.

However, the continued use of these systems will be a challenge, due to the repercussions of the crisis in **May 2024**. While control actions have been subject to the restrictions necessary to de-escalate tensions, the availability of funding is compromised for the future by the economic crisis and reconstruction needs.

“Sustainability of actions compromised by the crisis in New Caledonia”

In these circumstances, the continuation of control measures and the monitoring of their effectiveness will depend on the ability to generate additional sources of funding.

KEY FIGURES

4694 ha

surveyed by drone with thermal sensor



118

flying hours
spread over 97 flight plans

1 protocol

for monitoring the impact of deer on rainforest undergrowth

Average density of
43.5 deer/km²



207
deer/km²

across 53 ha:
a world record



5 indicators and criteria

specific to New Caledonia



FIRST-HAND ACCOUNTS

CAROLE WEMA

*PROTEGE Leader in the
New Caledonian Biodiversity Agency*



PROTEGE has developed and deployed innovative diagnostic and monitoring tools tailored to the limitations and specifics of the terrain. Until now, it was impossible to pinpoint deer concentrations in such remote and difficult to access areas, or even assess their density.

Creating standardised, simple and sufficiently robust protocols and indicators is another key innovation for the territory, and a challenge given the limitations associated with high altitude rainforests.

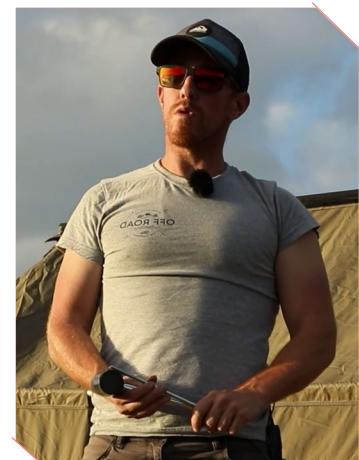


ROMAIN ALLIOD

Manager and Drone Operator of Ecotone in New Caledonia



From a technological point of view, the major innovation of the IAAD is the video processing that enables the detection of very slight movements (for example, of the head), which is much more sensitive and efficient than the processing of still photos. The development efforts undertaken in the PROTEGE project should be continued, promoted and shared among scientists and managers, especially as the rapid development of drone and thermal sensor technology should improve detection capabilities and reduce implementation costs.



PATRICK BARRIÈRE

*Coordinator of the Threats Unit at the
New Caledonian Biodiversity Agency*



The PROTEGE project has undoubtedly made it possible to develop and roll out operational measures in priority areas which, apart from their geographical remoteness, had not previously benefitted from the incentive and participatory control plan in place since 2008, mainly in easily accessible areas. On the other hand, while solid foundations have been built, continuing the actions undertaken with all stakeholders and increasing the benefits will be a considerable challenge.





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AERIEL ABUNDANCE INDEX BY DRONE (IAAD)

- New Caledonian Biodiversity Agency. 2023. Proposed flight plan scenarios for the implementation of IAAD-NC, following field verification carried out by Ecotone, in Néaoua-Mé Adéo, Nord du Panié and Pic Ningua Action Areas New Caledonia; 14pp.
- New Caledonian Biodiversity Agency. 2023. Cartographic summary following field verification, control and feasibility assessment of drone flights for the implementation of IAAD-NC in the Néaoua-Mé Adéo, Nord du Panié and Pic Ningua Action Areas. New Caledonia; 25pp. + Appendices.
- Alliod R. and Cherif N. 2022. Data sheet: Feasibility study of an aerial abundance index of deer by drone with thermal sensor. ECOTONE deliverable for ANCB within the PROTEGE project framework. New Caledonia; 4pp.
- Alliod R. and Cherif N. 2022. Report: Feasibility study of an aerial abundance index of deer by drone with thermal sensor. ECOTONE deliverable for ANCB within the PROTEGE project framework. New Caledonia; 133pp. + appendices.
- Alliod R. and Cherif N. 2024. Report: The implementation of the Aerial Abundance Index by Drone with thermal sensor (IAAD-NC) to assess the abundance of deer populations in the priority areas of the Massif du Panié, Néaoua-Mé Adéo and the Massif de Thio (Pic Ningua). ECOTONE deliverable for ANCB within the PROTEGE project framework. New Caledonia; 81pp. + appendices.
- Alliod R. and Cherif N. 2024. Summary: Implementation of the Aerial Abundance Index by Drone with thermal sensor (IAAD-NC) to assess the abundance of deer populations in the priority areas of the Massif du Panié, Néaoua-Mé Adéo and the Massif de Thio (Pic Ningua). ECOTONE deliverable for ANCB within the PROTEGE project framework. New Caledonia; 18pp.

SECTORISATION

- Dominique Y. and Verdier L.. 2024. Contribution to the identification and division by sectors of the action areas within priority areas. BIOEKO deliverable for ANCB within the PROTEGE project framework. Complete report (excluding appendices). New Caledonia; 48pp.
- Dominique Y. and Verdier L.. 2024. Contribution to the identification and division by sectors of the action areas within the priority areas. BIOEKO deliverable for ANCB within the PROTEGE project framework. Cartographic appendices. New Caledonia; 31pp.
- Monitoring the impact of deer on rainforest undergrowth:
 - Dominique Y. and Verdier L.. 2024. Adapting a methodology to monitor the impact of the Rusa Deer on rainforest undergrowth, New Caledonia. BIOEKO deliverable for ANCB within the PROTEGE project framework. Complete report (excluding appendices). New Caledonia; 51pp.
 - Barrière R., Dominique Y. and Verdier L. 2024. Adapting a methodology to monitor the impact of the Rusa Deer on rainforest undergrowth, New Caledonia. BIOEKO

deliverable for ANCB within the PROTEGE project framework. Appendices. New Caledonia; 31pp.

- Borelli M., Bourey M., Boulanger V. and Delvienne Q.. 2022. Literature review for adapting a methodology for monitoring the relative abundance and impact of deer in rainforests. BIOEKO deliverable for ANCB within the PROTEGE project framework. New Caledonia; 34pp. + appendix.

Monitoring of wild goat hunting in Maré et Lifou:

- New Caledonian Biodiversity Agency. 2024. Report: Survey of wild goat hunters in Maré. New Caledonia; 9pp. + appendices.
- New Caledonian Biodiversity Agency. 2024. Report: Survey of wild goat hunters in Lifou. New Caledonia; 10pp. + appendices.

NEWSLETTER

- PROTEGE (2023). Zoom in on actions to manage invasive alien species (IAS). PROTEGE newsletter #17, 3p



DOCUMENTARY RESOURCES



PROTEGE



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Taking thermal images by drone to measure deer abundance: a field report to understand the method



VIDEOS



Summary of the implementation of the Aerial Abundance Index of Deer by Drone with thermal sensor: methodology and key results for the 3 priority areas



REPORTS



How to monitor the impact of Rusa Deer on rainforest undergrowth: full report on the adaptation of a methodology tailored to New Caledonia





Find all the lessons-learned factsheets on invasive alien species **freely available on our website.**



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