The red vented-bulbul (*Pycnonotus cafer*): invasion dynamics and ecological impacts of an introduced pest bird in New Caledonia and implications for management.

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Preface

This thesis is structured as a series of connected manuscripts. With the exception of the Introduction and final Discussion, these manuscripts have all been published, or accepted or submitted for publication, at the time of thesis submission. These manuscripts are listed below and are presented in the thesis in separate chapters.

1. Thibault, M., Vidal, E., Potter, M. A., Dyer, E., and Brescia, F. (2018). The red-vented bulbul (*Pycnonotus cafer*): serious pest or understudied invader? *Biological Invasions*, *20*(1), 121-136.
2. M. Thibault, E. Vidal, M.A. Potter, F. Masse, A. Pujapujane, B. Fogliani, G. Lannuzel, H. Jourdan, N. Robert, L. Demaret, N. Barré, and F. Brescia (*Accepted*). Invasion by the red-vented bulbul: an overview of recent studies in New Caledonia. In: C.R. Veitch, M.N. Clout, A. Martin, J. Russell and C. West (eds.) *Island Invasives: Scaling up to meet the challenge*, pp. xx-xx. Gland: IUCN.
3. Thibault, M., Vidal, E., Potter, M. A., Sanchez, T., and Brescia, F. (2018). The invasive Red-vented bulbul (*Pycnonotus cafer*) outcompetes native birds in a tropical biodiversity hotspot. *PloS one*, *13*(2), e0192249.
4. Thibault M., Masse F., Pujapujane A., Lannuzel G., Bordez L, Potter M.A., Fogliani B., Vidal E. and Brescia F. (*Accepted*). "Liaisons dangereuses": The invasive red-vented bulbul (*Pycnonotus cafer*), a disperser of exotic plant species in New Caledonia. *Ecology and Evolution*.
5. Thibault M, Brescia F. Potter M. and Barbet-Massin M. (*In prep*). Global distribution of three highly invasive bird species under climate change. Biodiversity and Distribution

All papers were intentionally prepared as stand-alone pieces of work. For this reason, there is some unavoidable repetition between chapters. For example, in the description of study species and areas. I performed the majority of the work for the papers that form this thesis. This included developing the research questions, experimental designs, data collection, statistical analysis, and writing. My supervisors Prof. Murray Potter, Dr. Fabrice Brescia and Dr. Eric Vidal contributed to the conceptualisation of research and revision of the manuscripts. The coauthors of each paper provided comments during the revision of the manuscripts. Statements of contribution are provided for each manuscript presented in this thesis (Chapter 7, **Appendix 5**).

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Abstract

Invasive alien species are a major cause of biodiversity loss globally, especially on islands where high species richness and levels of endemism accentuate their impacts. Various international institutions have constructed lists of the most harmful invasive species to help environment managers at both global and local scales to prioritize their efforts. The red-vented bulbul (*Pycnonotus cafer*) is a passerine bird species considered among the three worst invasive birds on the planet. This species is currently spreading over the tropical archipelago of New Caledonia, one of the 36 world biodiversity hotspots. This dissertation presents the findings of a PhD study conducted in New Caledonia with two objectives: 1) to describe this introduced population, and 2) to evaluate the threats from its dispersal using both existing knowledge and new *in-situ* and *ex-situ* data and a variety of analysis techniques. From the literature, I identified three key impacts explaining the species' status: i) damage to agricultural crops, ii) noxious seed dispersal, and iii) competition with other avifauna. I estimated the local population size (approx. 140,000 individuals), its habitat use (inhabited areas), its density along an urbanization gradient (30-120 ind/km^2), and I produced lists of consumed plant and animal species and identified a color preference in the foraging strategy of the red-vented bulbul. Exploration of each impact category revealed i) substantial losses on fruit production (18% of tomato production), ii) impact on the abundance of nine native bird species that may be driving a spatial reassembly of the community, and iii) a short distance dispersal (77-92 m) that could promote the dispersal of introduced plant species at the expense of endemic species. Finally, through modelling, I estimated the climatic niche of the species at a global scale and identified that most island territories as suitable for the establishment of this invasive bird species. Regardless of whether the red-vented bulbul diserves its status as "world worst" species, quantitative impact assessments in its alien range such as the studies presented here are needed to prevent the dispersal and harmful impacts of this species on human activities and sensitive ecosystems. Implications for management are discussed.

Résumé

Les espèces exotiques envahissantes sont une cause majeure de perte de biodiversité à l'échelle mondiale, en particulier sur les territoires insulaires où la richesse en espèces et les niveaux d'endémisme accentuent leurs impacts. Des listes d'espèces envahissantes parmi les plus nocives ont été conçues par des organismes internationaux pour aider les gestionnaires de l'environnement à hiérarchiser leurs efforts à l'échelle mondiale et locale. Le bulbul à ventre rouge (*Pycnonotus cafer*) est une espèce d'oiseau considérée parmi les trois pires oiseaux envahissants de la planète. Cette espèce colonise actuellement l'archipel de la Nouvelle-Calédonie, l'un des 36 hotspots mondiaux de biodiversité. Ce mémoire présente les résultats d'une thèse menée avec deux objectifs: 1) décrire la population introduite en Nouvelle-Calédonie et 2) évaluer les menaces liées à sa dispersion en utilisant les connaissances disponibles, la collecte de données *in-situ* et *ex-situ* et diverses techniques d'analyses statistiques. À partir de la littérature, j'ai identifié trois impacts clés expliquant le statut de l'espèce: i) les dégâts sur les productions agricoles, ii) la dispersion des graines de plantes envahissantes et iii) la compétition avec l'avifaune. J'ai estimé la taille de la population locale (environ 140 000 ind), son utilisation de l'habitat (zones habitées), sa densité le long d'un gradient d'urbanisation (30-120 ind / km2). J'ai dressé des listes d'espèces végétales et animales consommées et identifié une couleur préférée dans la stratégie de recherche de nourriture du bulbul à ventre rouge. L'exploration de chaque catégorie d'impact a révélé i) des pertes substantielles sur la production fruitière (18% de la production de tomate), ii) un impact sur l'abondance de 9 espèces d'oiseaux natifs, pouvant conduire à un réassemblage spatial de la communauté, et iii) une dispersion à courte distance (77-92 m) qui pourrait favoriser les espèces végétales introduites par rapport aux espèces endémiques après la digestion. J'ai finalement estimé la niche climatique de l'espèce à l'échelle mondiale et j'ai mis en évidence que la plupart des territoires insulaires sont climatiquement favorables à l'établissement de cette espèce d'oiseau envahissante. Si les efforts actuels de recherche et de gestion consacrés au bulbul à ventre rouge à l'échelle mondiale ne justifient pas son statut d'espèce parmi les «pires au monde», des évaluations quantitatives d'impact dans son aire introduite comme les études présentées ici sont nécessaires pour prévenir les impacts nocifs de l'espèce. De telles évaluations offrent également des éléments concrets aux gestionnaires de l'environnement, utilisables directement dans la conception de stratégies de gestion adaptées.

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