

ANGLIA RUSKIN UNIVERSITY

BIODIVERSITY MANAGEMENT: APPLICATION OF BIODIVERSITY  
DATA TO INFORM CONSERVATION AND INDUSTRY PRACTICE

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ANGLIA RUSKIN UNIVERSITY

ABSTRACT

FACULTY OF SCIENCE AND TECHNOLOGY

DOCTOR OF PHILOSOPHY BY PUBLISHED WORK

BIODIVERSITY MANAGEMENT: APPLICATION OF BIODIVERSITY DATA  
TO INFORM CONSERVATION AND INDUSTRY PRACTICE

JOHN D. PILGRIM

May 2016

This submission presents a small selection of my publications on a theme – the application of biodiversity data to inform both conservation and industry practice. The published work presented here demonstrates my ability to generate new biodiversity data, to interpret how to apply those data to improve conservation outcomes, and to apply the same biodiversity data in different ways to reduce industry impacts. The core biodiversity data I use are related to species' distributions and conservation status, as direct indicators of their irreplaceability and vulnerability.

This thesis comprises five peer-reviewed journal papers and a double-blind peer-reviewed published report. Several of these are well-cited: the submitted publications have cumulatively received in excess of 500 citations.

My submitted publications have extended understanding in my area of specialisation, and had clear impact on scientific and professional practice. This is demonstrated not only by incorporation of these publications' findings into conservation action and policy, but also by the professional advice that I am regularly sought to give as a recognised authority in my field to leading global companies, financial institutions, conservation donors and non-governmental organisations.

My submitted work is the result of collaborations with leaders in my field. It includes the generation of new knowledge that has directly informed applied conservation of highly

threatened species in Asia. It contains substantial scientific advances, such as an innovative approach I developed to resolve the long-standing and intractable problem of 'limits to biodiversity offsets'. In some cases, it has had a clear practical impact on conservation – by guiding substantial donor funding towards, and even greater development investment away from, species and sites of highest global significance to conservation. In other cases, it has demonstrated influence on policy at a global level – such as shaping the International Union for Conservation of Nature's policy on biodiversity offsets.

Key words: biodiversity management; conservation; industry; threatened species.

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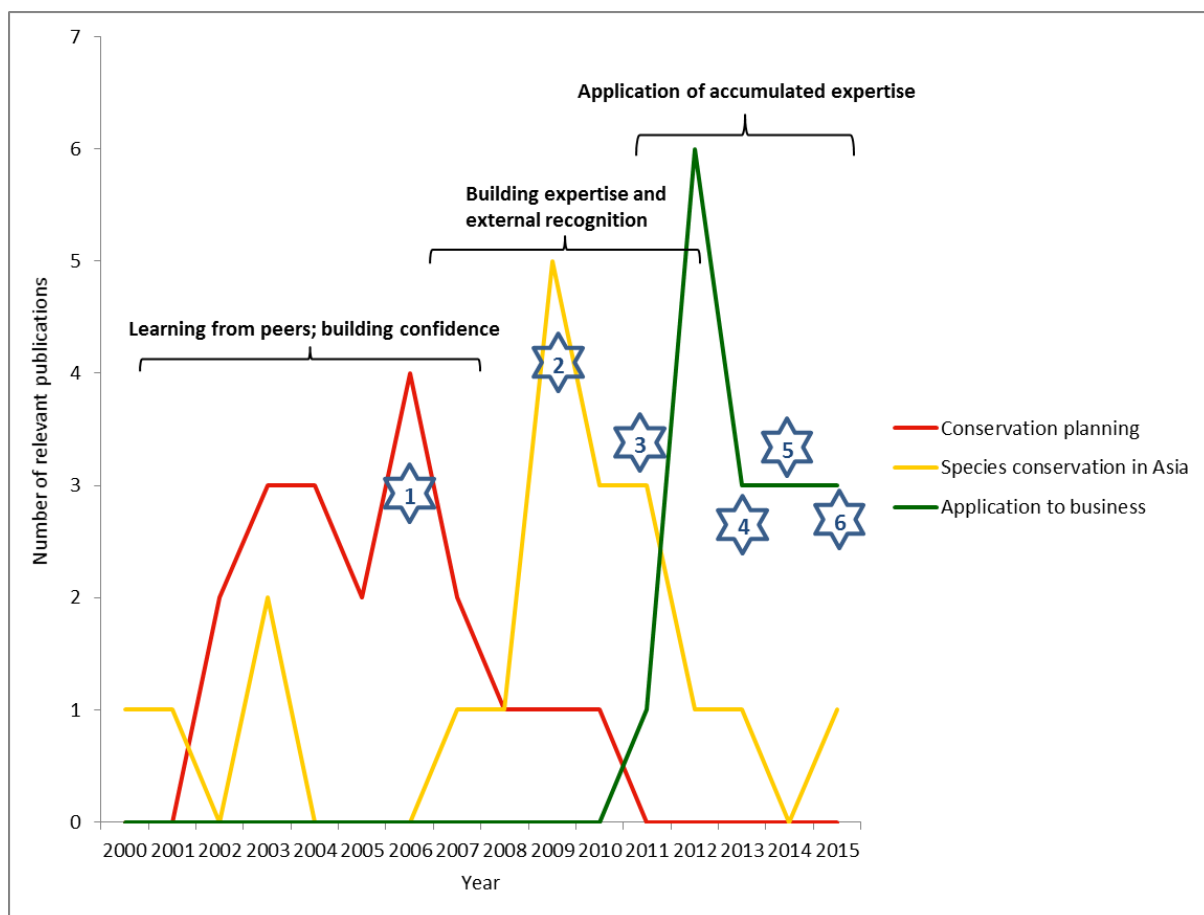
## 1 Published work submitted for this PhD

This submission is based upon a small selection of my publications in which I have shown substantial leadership or contribution. These publications were chosen to illustrate three key abilities: generation and analysis of new biodiversity data (2, 3); interpretation of how to apply those data to improve conservation impacts (1, 2, 3); and application of the same biodiversity data in different ways to reduce industry impacts (4, 5, 6). These are listed in order of date of publication and with web links as follows:

- (1) Rodrigues, A.S.L., **Pilgrim, J.D.**, Lamoreux, J.F., Hoffmann, M. and Brooks, T.M., 2006. The value of the IUCN Red List for conservation. *Trends in Ecology and Evolution*, 21, pp.71-76. Published [here](#).
- (2) **Pilgrim, J.D.**, Walsh, D.F., Tran Thanh Tu, Nguyen Duc Tu, Eames, J.C. and Le Manh Hung, 2009. The Endangered White-eared Night Heron *Gorsachius magnificus* in Vietnam: status, distribution, ecology and threats. *Forktail – Journal of Asian Ornithology*, 25, pp.142-146. Published [here](#).
- (3) Htin Hla, Nay Myo Shwe, Thura Win Htun, Sao Myo Zaw, Mahood, S., Eames, J.C. and **Pilgrim, J.D.**, 2011. Historical and current status of vultures in Myanmar. *Bird Conservation International*, 21, pp.376-387. Published [here](#).
- (4) **Pilgrim, J.D.**, Brownlie, S., Ekstrom, J.M.M., Gardner, T.A., von Hase, A., ten Kate, K., Savy, C.E., Stephens, R.T.T., Temple, H.J., Treweek, J., Ussher, G.T. and Ward, G., 2013. A process for assessing the offsetability of biodiversity impacts. *Conservation Letters*, 6, pp.376-384. Published [here](#).
- (5) **Pilgrim, J.D.** and Ekstrom, J.M.M., 2014. *Technical conditions for positive outcomes from biodiversity offsets*. Gland, Switzerland: IUCN. Published [here](#).
- (6) Rainey, H.J., Pollard, E.H.B., Dutson, G., Ekstrom, J.M.M., Livingstone, S.R., Temple, H.J. and **Pilgrim, J.D.**, 2015. Corporate goals of No Net Loss and Net Positive Impact on biodiversity. *Oryx*, 49, 232-238. Published [here](#).

## 2 Professional journey and genesis of the published work

In this section, I have briefly summarised where, when and over what period the research contributing to the published work was undertaken. For context, I have noted some landmark papers and themes that framed my work. The entire period of research and publication covered in this submission spans ten years, from 2006-2016, and might best be visualised in the context of the three main phases of my career development and overall publication record to date (Figure 1).



**Figure 1. Chronology of my publications in the three main phases of my career, showing personal development over time and timing of submitted publications** (numbers in blue stars correspond to submitted publications in [Section 1](#))

### 2.1 Learning from peers and building confidence

I was introduced to the importance of biodiversity data when I started conducting Red List assessments for the landmark Threatened Birds of the World (BirdLife International, 2000).



Soon after, I was fortunate to be hired by the Center for Applied Biodiversity Science at Conservation International (CI), a highly influential conservation non-governmental organisation (NGO) based in Washington DC. I was tasked with researching the world's most biodiverse and intact regions ("wilderness areas") and most biodiverse and threatened regions ("hotspots"). The hotspot concept was developed by Myers (1988) as a way to efficiently allocate scarce conservation resources to disproportionately high proportions of the world's most threatened biodiversity in relatively small land areas. At CI, we developed this concept further by systematically identifying 34 regions as biodiversity hotspots if they had at least 1,500 vascular plants as endemics and at most 30% of their original vegetation remaining (Mittermeier, *et al.*, 2004). Many of these hotspots overlap the biodiverse tropics (e.g., Madagascar, the Tropical Andes and Wallacea), but other regions rich in plants also qualify (e.g., the Mediterranean Basin and Cape Floristic Province). These urgent priority regions for conservation were complemented by identification of five high-biodiversity wilderness areas (Amazonia, Congo Forest, New Guinea, North American Deserts and Miombo-Mopane) that were also disproportionately important for conservation, but where conservation could afford to be more proactive. These areas also hold at least 1,500 vascular plants as endemics, but have at least 70% of their original vegetation remaining, are large, and have low human population densities (Mittermeier, *et al.*, 2002).

This extensive work on hotspots and wilderness areas gave me a sound grounding in the core principles within the field of conservation planning. This was a rapidly developing field at this time, particularly owing to the efforts of researchers in South Africa (notably Richard Cowling and colleagues) and Australia (notably Bob Pressey and colleagues). My work at CI took a slightly different approach to conservation planning, focusing on *a priori* prioritisation of areas rather than prioritising dynamically for complementarity. Nonetheless, it was still based on vulnerability and irreplaceability, highlighted in a seminal paper as focal elements of a systematic approach to conservation planning (Margules and Pressey, 2000). Hotspots are both highly vulnerable and irreplaceable (holding many threatened and restricted-range species) and wilderness areas are highly irreplaceable but have greater opportunity for proactive conservation before they are highly threatened. The concepts of vulnerability and

irreplaceability entered my work in these early years and have remained a central thread to the present time.

My research and data collation for hotspots and wilderness areas underpinned my involvement in a series of high-impact peer-reviewed papers, which I co-authored at CI alongside some of the most noted experts in this field (e.g., Rodrigues, *et al.*, 2004a; 2004b). Many of these related to global frameworks for conservation planning (i.e. Mittermeier, *et al.*, 2002; 2003a; 2003b; 2004; Brooks, *et al.*, 2006; 2010; Hoffmann, *et al.*, 2006; 2007). My relative inexperience among such experts meant that I did not take the lead role in authorship, and so these early publications are not submitted here.

Towards the end of my time at CI, I had gained sufficient confidence and knowledge to play a more significant role in authorship – particularly of conservation planning publications to which my growing ornithological conservation expertise was relevant. For example, I played major roles in authorship of a key book chapter on the conservation of avian evolutionary history (Brooks, *et al.*, 2005) and in development of a ground-breaking approach to identifying priority sites for species conservation (Ricketts, *et al.*, 2005). For the former publication, I led collation of data and played a major role in writing the chapter. For the latter publication, I was part of a core group of around five people that developed the concept, I led collation of data from the Pacific, and I helped the two lead authors to structure and write the paper. Neither publication, however, forms part of this submission.

By this time, I had gained sufficient self-assurance and experience in publication of journal papers to play a principal co-authorship role alongside the world-leading experts I learned from and worked with at CI. I thus co-led development and authorship of the first publication on which this submission is based (Rodrigues, *et al.*, 2006: contribution stated in [Section 5](#)). This has become the definitive and much-cited paper on conservation applications of the IUCN Red List of Threatened Species. It synthesised my viewpoint on biodiversity data up to that date, and shaped much of my subsequent work.

## 2.2 Building expertise and external recognition

By 2006, feeling I needed more on-the-ground experience, I was ready to move from Washington. My work on threatened species for BirdLife International (2000) had initially launched my passion for conservation. BirdLife International (2001) subsequently raised my awareness of the urgency of the extinction crisis among Asian birds. It was thus a natural move for me to go to Vietnam to work for BirdLife International *in Indochina* in Hanoi.

I had previously led fieldwork projects in Indonesia and Papua New Guinea, but shown less leadership on analysis and publication of results (Pilgrim, Leadley and Saifuddin, 2000; Marsden, Pilgrim and Wilkinson, 2001; Marsden *et al.* 2003a; 2003b – publications that are thus not part of this submission). My subsequent work at CI gave me the experience in data analysis and writing up of journal papers that was necessary for me to now lead or coordinate a number of significant – albeit specialised – publications on species conservation in Asia (e.g., Pilgrim, *et al.*, 2006; 2009a; 2009b; 2011; Pilgrim and Pierce, 2006). Foremost among these were two publications submitted here: Pilgrim, *et al.* (2009b) and Htin Hla, *et al.* (2011). Both journal papers built on my strong foundation in species-based conservation planning (e.g., the IUCN Red List), and represented major advances in knowledge for highly threatened and – at the time – poorly-known bird species. Through generation of new data, this research directly changed the course of conservation for these species (as evidenced in [Section 3.2](#)).

## 2.3 Application of accumulated expertise

I have continued to work on the conservation of Asian birds through new collaborations since my return to the UK in 2010. I continue to be passionate about – and publish on – conservation in the region ([Figure 1](#)). For example, my research in Papua New Guinea provided data that were essential to production of Buchanan, *et al.* (2008 – not part of this submission), which tested a novel method to use remote sensing to assess changes in species' conservation status. Further, my expertise on Asian bird taxonomy has developed to the point that I played a key role in conceptualisation and authorship of the pioneering Tobias, *et al.* (2010 – not part of this submission), which presented the first quantitative

global framework for identifying species limits in birds from phenotypic characters (as highlighted in *Nature*: Brooks and Helgen, 2010).

I moved back from Asia, however, in order to explore emerging opportunities to apply familiar biodiversity data and concepts to fresh challenges. At this time, “no net loss” approaches were rising in popularity for managing industry impacts on biodiversity. No net loss is a goal in which gains from mitigation and offset measures equal or exceed residual impacts on biodiversity (Pilgrim and Ekstrom, 2014): essentially, industry fully compensates for any impacts on biodiversity. As a concept, no net loss first rose to prominence through its adoption as a project-level policy goal in the 1977 United States Clean Water Act (Rainey, *et al.*, 2014). There was a hiatus in the spread of the concept, but interest rapidly accelerated and broadened from 2006, with the publication of International Finance Corporation (IFC) Performance Standard 6 (on biodiversity conservation and sustainable management of living natural resources: IFC 2006). As a global investment safeguard for one of the world’s largest finance institutions, this standard’s focus on no net loss has been extremely influential. The spread in awareness of no net loss and offsets as concepts has not, however, been matched by development of methodological guidance and resolution of technical issues.

Employment at The Biodiversity Consultancy (TBC), in Cambridge, from 2010 has allowed me to explore solutions to technical issues associated with no net loss approaches, through work with companies to develop good practice for managing their impacts on biodiversity. Revision of PS6 (IFC 2012) has increased its influence on other bank, company, and government policies – and no net loss approaches have proliferated commensurately. Nonetheless, the field of “biodiversity management by industry” is currently quite novel and specialised, and involves identification and demonstration of real value to industry from careful management of biodiversity impacts and risks. Frameworks such as “no net loss” of biodiversity inherently require substantial biodiversity data in order to measure losses of (i.e., impacts on) biodiversity by industry and gains of biodiversity from mitigation and offsets. I thus seized the opportunity to reduce industry impacts on biodiversity, by using existing data that were developed to assist conservation planning and practice.

I have led, or made significant contributions to, a number of innovative publications in the field of biodiversity management by industry, which demonstrate methodological solutions (e.g., Pilgrim, Ekstrom and Ebeling 2011; Ekstrom, Temple and Pilgrim, 2012; Temple, *et al.*, 2012; The Biodiversity Consultancy and Fauna & Flora International, 2012a; 2012b; 2012c; 2012d; Martin, *et al.*, 2015) or novel conceptual approaches (e.g., Gardner, *et al.*, 2013; Pilgrim and Bennun, 2014). These publications are mostly multi-author efforts, and do not comprise part of this submission. Nonetheless, they demonstrate that I have co-authored publications with many of the other leaders in this new field. Most of these collaborations have stemmed from the Business and Biodiversity Offsets Programme (BBOP), which developed much of the early thinking on offsets and no net loss (e.g., BBOP 2009a; 2009b), ultimately leading to best practice standards and guidelines (BBOP 2012a; 2012b).

The three most recent papers submitted here form part of this current phase of my career. The first, Pilgrim, *et al.* (2013a), shows my leadership in developing and proposing the first substantive solution to the complex problem of limits to biodiversity offsets. The second, Pilgrim and Ekstrom (2014), demonstrates my overview of the entire body of work on offsets and fed into the influential ten Kate and Pilgrim (2014). The most recent – on which I was senior, coordinating author – reviewed the rapid proliferation of corporate no net loss frameworks for the first time, and identified potential for improvements (Rainey, *et al.*, 2015).

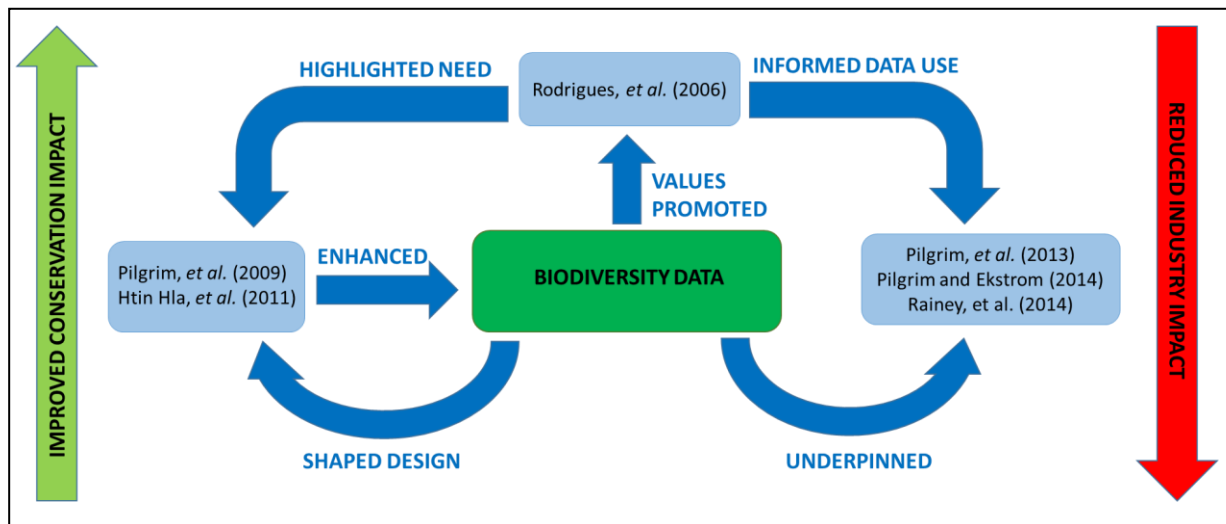
### 3 Aims and impacts of the submitted published work

#### 3.1 Synthesis of aims and impacts

The core conservation planning axes of irreplaceability and vulnerability (Margules and Pressey, 2000) are central to my submitted published work, with species' distributions and threat status as their most frequent respective indicators. Irreplaceability and vulnerability are core to conservation planning because they indicate the units of biodiversity with, respectively, the least spatial options for conservation (owing to their restricted spatial distributions) and the least temporal options for conservation (owing to their high levels of threat, and potential for extinction or similar). Opinions vary on the best ways to allocate scarce conservation resources, but most conservation strategies prioritise high irreplaceability in order to achieve the greatest 'bang for the buck' or reduction in biodiversity loss for unit of conservation investment (Brooks, *et al.*, 2006). Strategies are generally then either reactive in targeting high vulnerability biodiversity before it is lost, or proactive in targeting low vulnerability biodiversity before it becomes threatened.

The submitted published work demonstrates how my strong foundation in conservation planning has helped me collect new data of value to threatened biodiversity ([Section 3.2](#)). It also demonstrates my understanding of the application of existing biodiversity data to improve conservation, through well directed investment ([Section 3.3](#)). Last, it demonstrates my ability to re-interpret core conservation planning concepts and to understand and demonstrate how the same existing data can be applied to reduce industry impacts on biodiversity ([Section 3.4](#)). My submitted published work, and my other recent publications, have stood alongside that of a relatively small number of other authors in shaping and extending the scientific and professional boundaries of the field of biodiversity management. Leaders in this field have particularly comprised the core collaborators within BBOP, such as Kerry ten Kate, Toby Gardner and Susie Brownlie, but also include others – particularly in Australia, such as Phil Gibbons and Martine Maron.

The relationships among the six submitted published works can be viewed in various ways. Figure 2 shows one way of conceptualising how the work promotes, enhances and uses biodiversity data, ultimately improving conservation impact and reducing industry impact.



**Figure 2. Relationships among submitted published work, illustrating how the work uses biodiversity data to ultimately improve conservation impact and reduce industry impact**

[Table 1](#) outlines the scientific impact of my submitted publications. The impact is measured via the impact factor of the journal in which they were published, their total number of citations, and their number of citations per year since publication. By these measures, some of these publications are unquestionably of high scientific impact. For others, however, these are crude measures of overall impact, as they do not correspond well with the impact that they have had on conservation practice (Sutherland, *et al.*, 2004).

The value of specialised publications and “grey literature” is particularly poorly represented by crude citation measures. In the former category fall my submitted publications on bird conservation in Asia (Pilgrim, *et al.*, 2009b; Htin Hla, *et al.*, 2011). In the latter category falls Pilgrim and Ekstrom (2014), a key input to development of the International Union for the Conservation of Nature’s (IUCN’s) biodiversity offset policy. IUCN has more than 1,200 member organisations, including over 200 governments and 900 NGOs, so its influence in conservation policy globally is unmatched. These broader impacts are discussed below, and highlights drawn out in [Section 4](#).

**Table 1. Scientific and broader impacts of the published work submitted in this application<sup>1</sup>**

Publication	Journal impact factor <sup>2</sup>	Citations to date		Citations/year <sup>3</sup>		Broader impacts
		Google Scholar	Web of Knowledge	Google Scholar	Web of Knowledge	
Rodrigues, <i>et al.</i> (2006)	14.125	460	295	46	30	The seminal reference on applications of the Red List
Pilgrim, <i>et al.</i> (2009b)	0.842	4	2	0.57	0.29	Major advance in knowledge for Endangered bird species
Htin Hla, <i>et al.</i> (2011)	1.250	6	5	1.2	1	First assessment of Critically Endangered vulture populations in Myanmar
Pilgrim, <i>et al.</i> (2013)	5.032	50	25	17	8.3	First solution to complex issue of limits to offsets
Pilgrim and Ekstrom (2014)	-	-	-	-	-	Influencing NGO and government policy worldwide
Rainey, <i>et al.</i> (2015)	1.849	19	2	19	2	Appraising global corporate biodiversity commitments

### 3.2 Generation of new biodiversity data for conservation

Two of my submitted publications focus directly on field collection of biodiversity data for highly threatened (i.e., vulnerable) bird species. These were both designed to fill important information gaps, in order to better understand the species' distribution and threat status. In both cases, these not only enhanced knowledge but also led to genuine advances in conservation on the ground. This role of Red List data in informing the conservation of species was precisely one of the values highlighted by my earlier publication, Rodrigues, *et al.* (2006) ([Section 3.3](#)).

<sup>1</sup> Citation statistics accessed on 29<sup>th</sup> April 2016.

<sup>2</sup> In year of publication, or nearest year available.

<sup>3</sup> To two significant figures.



In 2007, I raised funds for, and led design of, surveys to clarify the status of the globally Endangered White-eared Night Heron *Gorsachius magnificus* in Vietnam. At the time, the species was known from only two poorly-documented records in the country, and it was unclear if it was anything more than a migrant or vagrant to Vietnam. With my guidance, surveys across four provinces in 2008-2009 found the species at two sites, including nesting records. These represented a major range extension for the species (c.240 km from the nearest known sites in China). Such surveys, in a bureaucratically- and logistically-complex country like Vietnam, do not proceed without significant unexpected hurdles, which I dealt with by helping adaptation of plans throughout.

The results of the night heron survey were written up in Pilgrim, *et al.* (2009b). Based in large part on this, BirdLife International undertook [a review of the species' global Red List status](#). On a precautionary basis, this review concluded that there remained too few data to consider downlisting the species. Conservation actions, including further data gathering, were proposed by Pilgrim, *et al.* (2009b) and incorporated into official recommendations for the species (BirdLife International, 2013). Moreover, these have increasingly been implemented on the ground, for example through a management plan for the species at Ba Be National Park (Dine, 2012).

In 2010, I coordinated Burmese co-authors to write a paper which both summarised their extensive ground surveys and comprehensively reviewed both historic and recent data on vultures in Myanmar (Htin Hla, *et al.*, 2011). This was a critical conservation issue, as rapid, extensive, and catastrophic population declines had been witnessed in South Asian vulture populations (e.g., Green, *et al.*, 2004), owing to poisoning by diclofenac and related veterinary drugs. These declines resulted in uplisting of four species to globally Critically Endangered. At the time, it was unclear whether similar declines had occurred in the species' populations in South East Asia, or whether this region offered them a refuge. Our paper for the first time documented declines in vulture populations in Myanmar, but also revealed huge potential for conservation owing to presence of significant populations of vultures in the absence of diclofenac. This raised profile led to increased conservation efforts for vultures in South East Asia (e.g., through [donor-funded projects](#)). Moreover, the

increased understanding we generated on dynamics of vulture declines in the absence of poisoning by veterinary drugs is providing lessons for conservation in similar regions of the world, such as Africa (e.g., Ogada, *et al.*, 2011).

### **3.3 Application of biodiversity data to improve conservation impacts**

The previous section outlines some of my contributions to collection and use of data on threatened species. Another submitted publication, Rodrigues, *et al.* (2006), highlighted the specific value of the IUCN Red List of Threatened Species to conservation. It described the evolution of the Red List from a list of subjective expert opinions of species' extinction risk to a much more objective, transparent system for assessing extinction risk (i.e., species' vulnerability), backed up by comprehensive data compiled to support assessments. It also drew attention to the diversity of ways in which the Red List was increasingly being applied – including identifying sites for conservation action, and informing broader policy and management. This early focus on application of biodiversity data became the most consistent thread in my work, and forms the basis of this submission.

Rodrigues, *et al.* (2006) was based on the authors' collective experience using the Red List within conservation, since such a review had little precedent. It has become seen as the definitive reference on the subject – with 460 citations to date ([Table 1](#)). In general, these citations have been in the conservation literature and particularly focus on ways to improve the value of the Red List to conservation, or use Rodrigues, *et al.* (2006) to justify their uses of the Red List (notably in conservation planning and highlighting priorities for conservation). According to In Cites Essential Science Indicators, it is well within the top 1% most highly-cited papers in its field (environment/ecology) for its publication year.

This publication laid the foundation for much of my subsequent research by highlighting the importance of threatened species data to assessing an area's vulnerability, one of the core axes for conservation planning – alongside irreplaceability (Margules and Pressey, 2000). Within my career timeline, my next set of publications focused directly on collation of data on threatened species ([Section 3.2](#)).

### **3.4 Application of biodiversity data to reduce industry impacts**

Rodrigues, *et al.* (2006), discussed in [Section 3.3](#), mentioned the value of the Red List in informing national development policies and legislation. I was able to explore this area further from 2010, when I shifted into the field of biodiversity management by industry. I started focusing on concepts such as “no net loss” and “net positive impact”, seeing this as an innovative and highly effective route for influencing conservation outcomes. These concepts act as quantitative drivers of good mitigation practice, helping to identify how and when mitigation can most effectively reduce risks to biodiversity. Businesses are often keen to understand how much mitigation is sufficient in order to plan for profitable projects that are not overburdened by costs (or costly delays) imposed by regulators or other stakeholders as a result of poorly-managed biodiversity risks. For example, I am working with one of the largest copper mines in the world (Oyu Tolgoi, in Mongolia) to help resolve multi-year delays in obtaining financing from lending institutions. These delays have stemmed from the company’s challenge, as a large-scale mining project with substantial biodiversity impacts, in demonstrating an ability to meet the high expectations of IFC PS6. I have helped the company understand its key risks, measure its impacts, put in place plans for mitigation and compensation of these impacts, and forecast when and how it can meet PS6 requirements (The Biodiversity Consultancy and Fauna & Flora International (2012a; 2012b; 2012c; 2012d: not part of this submission). As a result, the mining project has put in place a goal of having a net positive impact on biodiversity of the southern Gobi region.

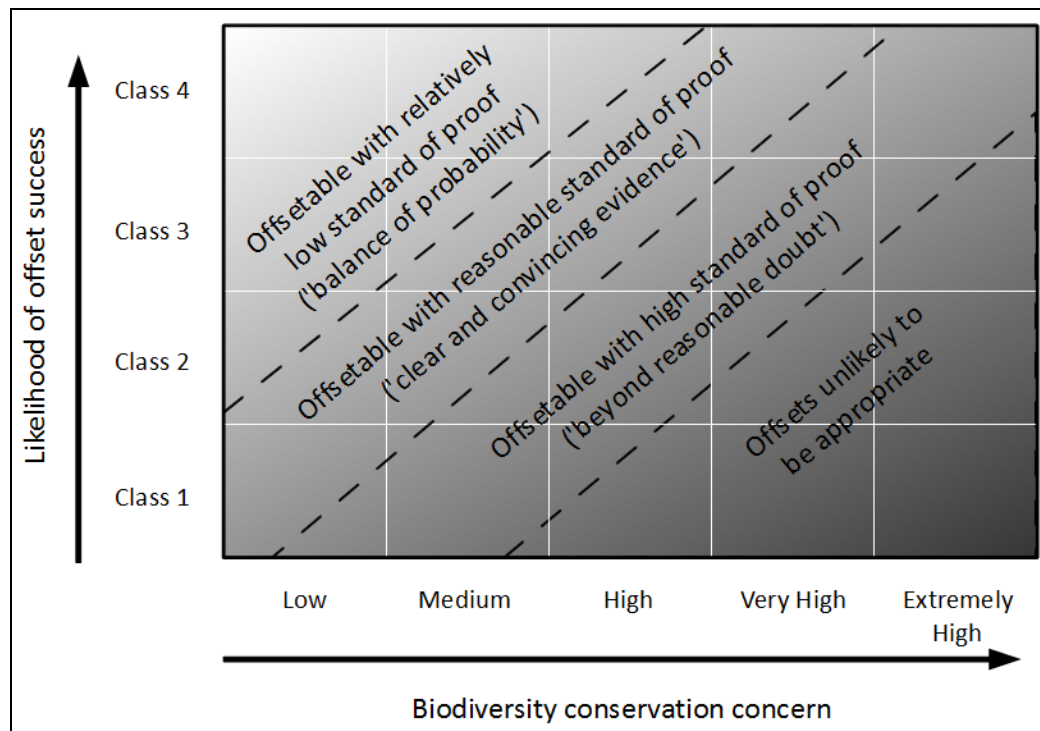
As senior author, I coordinated a paper documenting the growth of corporate policies on “no net loss” and “net positive impact” (Rainey, *et al.*, 2015). This paper was underpinned by a systematic search of an internet search engine for multiple terms. These terms were English-language variants on “no net loss” and “net positive impact”. It would have been useful, if time had allowed, also to search using appropriate terms in other common non-English languages. Cut-offs were drawn in both time (we only considered policies made before 2012) and effort (searches continued until five consecutive web pages, with 10 results per page, returned no positive results). The review could not claim to be

comprehensive, but should have provided sufficiently robust data to reveal our core interest: temporal trends in corporate policies on no net loss and net positive impact.

Rainey, *et al.* (2015) highlighted the rapid proliferation of no net loss frameworks, and ways that they could be improved through greater understanding of biodiversity and thus inclusion of relevant priorities, thresholds and limits. It demonstrated the fundamental importance of biodiversity data to sound management, from identification of conservation priorities (through the same concepts of irreplaceability and vulnerability used in conservation planning; [Section 3.3](#)) and ecologically appropriate timeframes, to measurement of biodiversity impacts and understanding of limits to offsets. This publication was intended to communicate the value of this new field of biodiversity management and was thus placed in *Oryx*, a journal well read by more traditional conservationists. Despite being placed in a relatively low impact journal for its field, its impact on the field is demonstrated by its frequent citation since publication ([Table 1](#)).

A key element of the no net loss concept is the idea of biodiversity offsets (similar in theory to carbon offsets) to compensate for any residual impacts after other mitigation. I was contracted by the New Zealand government to provide specific guidance on what impacts might not be offsetable. This had been an intractable problem for some time, because of the challenge in scientifically outlining any impacts which were not offsetable (i.e., which could not be fairly compensated for in some way, at least in theory), except complete extinction of specific units of biodiversity (such as species or subspecies). I resolved this by rejecting the prevailing binary view of offsetable and non-offsetable impacts, and developing a process to determine relative offsetability – i.e., the appropriateness of risks to biodiversity and achievability of offsets. First, I outlined a way to assess relative “biodiversity conservation concern”, using the same conservation principles of biodiversity irreplaceability and vulnerability that I employed when involved in conservation planning ([Section 3.3](#)). To these were added considerations of the “likelihood of offset success” (comprising the magnitude of residual impacts on biodiversity, opportunity for offsets, and potential feasibility of offsets). Biodiversity conservation concern and likelihood of offset success were then combined in a burden of proof framework to illustrate the appropriate

evidence base for a given offset proposal. This framework covers situations ranging from those in which offsets are unlikely to be appropriate (where biodiversity conservation concern is highest and likelihood of offset success lowest), through to those in which only a low standard of proof (e.g., 'balance of probability') might be required by regulators when biodiversity conservation concern is lowest and likelihood of offset success highest (Figure 3).



**Figure 3. Burden of proof framework for assessing relative offsetability (i.e., the appropriateness of risks to biodiversity and achievability of offsets), combining biodiversity conservation concern and likelihood of offset success (adapted from Pilgrim, *et al.*, 2013)**

I provide an account of this process in one of my submitted publications, a high impact paper in the prominent journal *Conservation Letters* (Pilgrim, *et al.*, 2013a). This has been cited extensively within a short time period (Table 1) and, according to In Cites Essential Science Indicators, is well within the top 10% most highly-cited papers in its field (environment/ecology) for its publication year. Owing to its novel approach to describing a gradient between the extremes of offsetable and non-offsetable impacts, it has become the standard reference for the term “offsetability” (e.g., Bos, Pressey and Stoeckl, 2014), which was rarely used in previous literature.

More than citations, the impact of Pilgrim, *et al.* (2013) is demonstrated by its adoption into official policy guidance by the New Zealand Government (2014) and its use to influence government policy elsewhere. For example, it was cited by Ferreira, *et al.* (2014) in a high profile *Science Policy Forum* article as one of just a handful of references to illustrate their concerns about erosion of Brazil's protected area system by development. This article and others that cite it (e.g., Englund, *et al.*, 2015; Sugai, *et al.*, 2015) aimed to influence the newly-elected national government to improve due diligence and policy approaches to large-scale development. As other examples, Pilgrim, *et al.* (2013) was cited by: Quétier, Regnery and Levrel (2014) to suggest changes to French no net loss policy; by Kormos, *et al.* (2014) to highlight key principles for national offset strategies; and by Villaroya, Barros and Kiesecker (2014) to stress the need for inclusion of limits to offsetability in environmental policy in Latin America.

My remaining publication in this submission is Pilgrim and Ekstrom (2014). This was commissioned by the International Union for the Conservation of Nature (IUCN), as part of my role in co-leading a Technical Working Group to develop recommendations for the organisation's policy on biodiversity offsets. Pilgrim and Ekstrom (2014) systematically reviewed 150 publications, based on searches for publications related to biodiversity offsets, biodiversity compensation, no net loss, and related terms in the peer-reviewed and grey literature. Based on this review, we assessed and summarised the technical conditions necessary for, first, positive outcomes from biodiversity offsets and, second, achievement of no net loss. Specific recommendations were made on how to deal with remaining uncertainty and how to improve outcomes from offsets. The review of approaches to uncertainty and, linked, the use of multipliers is the most comprehensive yet published. Multipliers (or "ratios") are modifiers to calculations of the scale of offset required for a given impact. For example, multipliers are sometimes used to seek over-compensation of industry impacts in order to achieve conservation goals (e.g., a "2x" offset multiplier may be used for a certain rare ecosystem to stimulate a national increase in its overall extent whenever it is impacted and offsets are used as compensation). Pilgrim & Ekstrom (2014) highlights the common misuse of multipliers in addressing uncertainty (e.g., to address

uncertainty of offset success, to compensate for inadequate currencies, or to address raised extinction risks of temporal loss).

Throughout this publication, in the same vein as Rainey, *et al.* (2015), we highlighted the necessity of biodiversity data for achieving no net loss through offsetting. For example, one extensive discussion focused on the mechanics of methods necessary for offsets. First, metrics are used for measuring biodiversity – often including extent or area (e.g., hectares of a forest type) and condition or quality (e.g., canopy cover within that forest area). Second, these are combined into extent × condition currencies (e.g., ‘habitat hectares’: Parkes, *et al.*, 2003) used for exchanging losses of (impacts on) biodiversity for gains (offsets) of biodiversity during offset transactions. Third, there are a number of limits that are often put on such exchanges (e.g., avoiding degradation: 2 ha of 50% quality forest are often not seen as appropriate compensation for loss of 1 ha of pristine forest). Last, there is even potential for trading one type of biodiversity for another (e.g., a loss in a certain number of elephants for a gain in a certain number of lions), although this has rarely happened in practice because of ethical concerns. All of these methodological considerations need underpinning with an understanding of the relative irreplaceability and vulnerability of biodiversity ([Section 3.3](#)). For example, stakeholders may be willing to ‘trade up’ losses of more common, widespread biodiversity for gains of more threatened, range-restricted biodiversity. Conversely, they are rarely likely to welcome ‘trading down’ in the opposite direction.

Pilgrim and Ekstrom (2014) underwent peer review as rigorous as many journal papers, receiving two double-blind peer reviews. It was one of two input papers developed to guide the IUCN Technical Working Group in making recommendations to a Policy Working Group, in which I also now participate. While the publication has received no formal citations, it underpins a process that is likely to be hugely influential. The offset policy is now in its final stages of development and will aim to guide more than 1,200 IUCN member organisations, including over 200 governments and 900 NGOs, in development of offset policies globally.

## 4 Conclusions and highlights

This submission focuses on six publications selected from >35 peer-reviewed publications, and a similar number of other publications, that I have authored or co-authored ([Figure 1](#), [Appendix 1](#)). [Section 3](#) discusses in detail how these six publications alone represent a significant contribution to generation and application of biodiversity data to conservation and industry best-practice, dwelling on their scientific impact. Below, I summarise some key areas in which my submitted publications have contributed to significant achievements and recognition in my field, at least equivalent to that expected of a doctoral degree.

### Generation of new knowledge and innovative approaches

Fundamentally, I see the essence of research as the generation of new data, or collation of existing data, and its interpretation to provide new knowledge or methods. Pilgrim, *et al.* (2009b) provides an example of my ability to conceptualise, design, implement, and adaptively manage a project to generate and interpret biodiversity data. This publication directly encouraged and shaped further conservation action on the ground for Endangered and Critically Endangered species, as did Htin Hla, *et al.* (2011). Pilgrim, *et al.* (2013) demonstrated my ability to re-interpret fundamental biodiversity concepts in order to develop a data-driven approach to resolve a complex and long-standing problem. This extended the forefront of my discipline and so has been adopted by scientific peers. Perhaps more importantly, it has also been directly adopted into policy guidance by a national government.

### Recognised authority in my field

I am now recognised as being at the forefront of the field of biodiversity management, particularly on the subjects of no net loss and biodiversity offsets. I am regularly called upon to review manuscripts for leading journals (e.g., *Animal Conservation*, *Biological Conservation*, *Conservation Biology*, *Conservation Letters*, *PLoS ONE*), and have been an Assistant Editor for *Forktail – Journal of Asian Ornithology*. Pilgrim, *et al.* (2013), on biodiversity offsets, was a breakthrough in my obtaining broad recognition, as it was



published in a high impact journal and had tangible influence on conservation policy. My recognised standing in the field of biodiversity offsets is demonstrated by my invitation by IUCN to co-lead a Technical Working Group, of just 13 other members, to develop recommendations for the organisation's policy on biodiversity offsets. This included synthesis of a substantial body of knowledge at the forefront of my professional practice (Pilgrim and Ekstrom, 2014).

More broadly, in my role as a Technical Director at TBC, I am regularly called upon by leading global companies such as Shell, TOTAL and Rio Tinto to use biodiversity data to make informed judgements on – and find solutions to – complex practical conservation issues. I continually develop and refine methods and approaches to ensure the best use of the very limited data that often exist, because my conclusions can have significant impact on industry decision-making (frequently in the tens of millions of dollars). I have had to develop a strong ability to communicate complex biodiversity concepts, conclusions and caveats to these non-specialist audiences.

### **Guiding investment**

The publications on global conservation planning framework that I was involved in at CI have been extremely influential, mobilising around a billion dollars for conservation in priority regions (Brooks, *et al.* 2006). Guided by my publication, Rodrigues, *et al.* (2006), I directly contributed to this allocation of flexible resources to priority species and sites, while working as one of two Grant Directors for the \$100 million Global Conservation Fund. My accumulated expertise in effectively prioritising limited funds for conservation is now regularly sought by global conservation donors, to evaluate and improve their strategies (e.g., Arcadia Fund, Critical Ecosystem Partnership Fund, John D. and Catherine T. MacArthur Foundation).

In a similar manner, my expertise is regularly sought out by multilateral and commercial banks to use biodiversity data to guide billions of dollars of investments away from environmentally-damaging projects, or to ensure those projects can meet best-practice biodiversity management. At a higher level, I have also helped some of these financial

institutions (e.g., the European Bank for Reconstruction and Development) to develop environmental safeguard policies that guide how their future investments are made.

### **Broad dissemination of best practice**

My expertise in the field of biodiversity management is considered extensive enough to not only be called on to provide advice, but also to conduct training for a diverse range of organisations. Upon request, I have repeatedly run a seminar on 'business and biodiversity' for the [University of East Anglia's Issues in Conservation module](#), aimed at Masters level students. In a personal capacity, I was sought out by the Asian Development Bank (ADB) to train their environmental staff on ADB environmental safeguard policy. In my position at TBC, I am regularly sought to provide biodiversity training for, or write best practice guidance for, leading companies and industry bodies (e.g., the International Council on Mining & Metals).

At a higher level, my submitted publication Rainey, *et al.* (2015) demonstrates my solid grasp of the requirements for sound biodiversity policy design. This has been sought after by companies (e.g., Shell, Rio Tinto), financial institutions (e.g., the European Bank for Reconstruction and Development), governments (e.g., New Zealand) and non-governmental organisations (e.g., IUCN; with inputs from Pilgrim and Ekstrom 2014). As a result, these entities all now have organisational-level policies or guidance in place (or, for IUCN, in draft) that require careful incorporation of biodiversity data into decision-making. It has been extremely rewarding to develop biodiversity policies and guidance with such wide-reaching influence.

## 5 Contribution to the published work

The published work on which this application is based is all the result of collaboration. For each publication, the relative contribution of each author to design, analysis, conduct and writing up of the research is outlined in this section. I certify these descriptions to comprise true and accurate reflections of my contributions.



John D. Pilgrim

### (1) Rodrigues, **Pilgrim**, Lamoreux, Hoffmann and Brooks, 2006

This peer-reviewed journal article on the value of species data to conservation was not based on primary research in the strict sense, but on our knowledge and experience of the subject. I helped with conception, design, and analysis for this publication. I played a major role in structuring and writing up the paper. The significance of my overall role was acknowledged by Ana Rodrigues in listing me as second author.

Ana Rodrigues led conception, design, analysis and writing up. John Lamoreux, Mike Hoffmann and Tom Brooks roughly equally contributed to design, analysis and writing-up.

### (2) **Pilgrim**, Walsh, Tran Thanh Tu, Nguyen Duc Tu, Eames and Le Manh Hung, 2009

Surveys for the globally Endangered White-eared Night Heron in Vietnam were identified as a high global research priority. I led design of a survey plan, raised funds for surveys, identified and engaged a primary surveyor, and led analysis and writing up of results in a peer-reviewed journal article.

David Walsh was the primary surveyor and contributed to survey design and – particularly – analysis and writing up. Tran Thanh Tu was the secondary surveyor. Nguyen Duc Tu made

significant contributions to survey design, engaged the secondary surveyor, and supported the survey team in the field. Jonathan Eames led conception of the project and contributed to survey design, analysis and writing up. Le Manh Hung assisted with engagement of the secondary surveyor and made some contributions to survey design and writing up.

(3) Htin Hla, Nay Myo Shwe, Thura Win Htun, Sao Myo Zaw, Mahood, Eames and **Pilgrim**, 2011

As senior author, I coordinated Burmese co-authors to write a peer-reviewed journal article which both summarised their extensive ground surveys and comprehensively reviewed additional data on vultures in Myanmar. I contributed to analysis of fieldwork data and collation of historical data, and led structuring and writing up of the paper. I was not involved in survey design or field data collection.

Htin Hla, Nay Myo Shwe, Thura Win Htun and Sao Myo Zaw contributed to survey design, led surveys, collated data on historical occurrence, and initiated data analysis and writing up. Htin Hla sadly passed away in 2013. Simon Mahood contributed to writing up of the work. Jonathan Eames conceived of the project, led survey design, and contributed to field data collection and writing up.

(4) **Pilgrim**, Brownlie, Ekstrom, Gardner, von Hase, ten Kate, Savy, Stephens, Temple, Treweek, Ussher and Ward, 2013

This publication was based on work commissioned by the Government of New Zealand. For that work, I led design, research, analysis and writing up, with support in conception, design and content from Gerri Ward, Jonathan Ekstrom and Helen Temple. Graham Ussher contributed greatly to ensuring appropriate national context.

I continued to lead writing up of the work as a peer-reviewed journal article. During this transformation, additional authors were invited to participate owing to their subject matter expertise. Susie Brownlie, Toby Gardner, Amrei von Hase, Kerry ten Kate, Conrad Savy, Theo

Stephens and Jo Treweek all contributed significantly to this, in terms of ideas, review, constructive discussion, and revision of the manuscript, including specific edits to the text.

**(5) Pilgrim and Ekstrom, 2014**

This double blind peer-reviewed paper was developed from an earlier unpublished document commissioned by IUCN. In both cases, I led design, analysis and writing up. Jonathan Ekstrom helped conceive and structure the paper, and made contributions to its content.

**(6) Rainey, Pollard, Dutson, Ekstrom, Livingstone, Temple and Pilgrim, 2015**

As senior author, I coordinated development of this peer-reviewed journal article documenting the growth of corporate policies on biodiversity management. I played a major role in conception, design and writing up of the research, and assisted with analysis.

Hugo Rainey led writing up and, along with Edward Pollard, led the research and analysis underlying the final publication. Other authors contributed ideas, data and text edits to the final publication. Jonathan Ekstrom also helped conceive of the idea.

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## Appendix 2 Statement regarding the research

The research on which the submitted papers were based was carried out over the period 2005-2014. In 2005, while employed by Conservation International, research (for Rodrigues *et al.* 2006) took place in Washington DC, USA. My next period of research was carried out in Hanoi, Vietnam, from 2006 to 2009, while working for BirdLife International *in Indochina* (resulting in Pilgrim *et al.* 2009 and Htin Hla *et al.* 2009). The most recent three publications submitted here (Pilgrim *et al.* 2013; Pilgrim & Ekstrom 2014; Rainey *et al.* 2015) were written as part of my employment at The Biodiversity Consultancy, Cambridge, United Kingdom. Research contributing to these publications took place during the period 2010-2014.



John D. Pilgrim

### **Appendix 3 Declaration regarding the work submitted**

I confirm that the work presented here has not been submitted in whole or in part for a research degree at any other university.

A handwritten signature in blue ink, reading "John Pilgrim". The signature is written in a cursive style with a large initial 'J' and 'P'.

John D. Pilgrim