Can Brahminy Kites survive the urbanisation challenge? A review of the factors affecting Brahminy Kites in the Hunter Region and beyond

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The return of the Brahminy Kite *Haliastur indus* to the Hunter Region coastline after an absence of almost two centuries offers an opportunity to expand our knowledge of this wide-ranging but understudied raptor. The species favours coastal habitat, a region rapidly succumbing to dramatic changes in native biodiversity as a result of the unprecedented growth of urbanisation. Raptors, due to their position at the top of the food chain, are particularly susceptible to habitat change, and for many raptor species, urbanisation has meant significant population decline and possible extinction. The global Brahminy Kite population is also trending downward, but range-wide observations indicate that the species shows a tolerance for human proximity, and adaptability in the face of habitat change. These qualities, in conjunction with appropriate conservation measures, may help the species to maintain a viable population throughout its extensive geographic range, and ensure continued recolonisation success along the Hunter Region coast, and beyond.

INTRODUCTION

Urbanisation, the expansion of commercial, industrial and residential land use associated with concentrated human presence, dramatically alters natural ecosystem patterns and processes (Chace & Walsh 2004; Kettel *et al.* 2018). It is predicted that by 2050, 68% of the world's human population will live in urban areas (mostly coastal), a reality that no amount of habitat protection or habitat restoration will change; therefore, native species must either avoid, adapt or exploit the conditions of life in extremely modified, human-dominated environments (Marzluff & Rodewald 2008; Kettel *et al.* 2018; United Nations 2018; Patankar *et al.* 2021). Urban development typically occurs near large waterbodies (rivers, estuaries, coastlines and lakes); therefore, all coastal avian species face some degree of habitat change, but raptors are particularly challenged (Melles *et al.* 2003; Chace & Walsh 2004).

Raptors are emblematic of the global biodiversity crisis. One out of five raptor species is threatened with extinction, over half have declining populations, and coastal raptors like Brahminy Kites *Haliastur indus* are especially challenged by the rapid and relentless urbanisation of their natural environment (Melles *et al.* 2003; Chace & Walsh 2004; O'Bryan *et al.* 2022). The global distribution of Brahminy Kites (~ 43,300,000 km²) extends from peninsular India and Sri Lanka, east through tropical continental Asia, and southern China, then south through south-east Asia, New Guinea and the Solomon Islands to its current southern range limit, approximately the mid-coastal regions of south-eastern and south-western Australia (Marchant & Higgins 1993; BirdLife DataZone 2024). Throughout this vast geographic range, the species is constantly faced with on-going anthropogenically-generated habitat modification at multiple scales and levels, and while the species is not yet flagged as "Threatened" a decreasing population trend has been detected (BirdLife Data Zone 2024).

The following discussion is based upon findings garnered from an extensive search of literature pertaining to current and historic Brahminy Kite range data, literature associated with the effects of urbanisation on avian species in general, and observations by the author.

The paper's objective is to heighten awareness of the challenges faced by Brahminy Kites, as a result of rapid urban growth, and endeavour to identify at least some of the drivers of raptor population decline which must be addressed if species population stability is to be achieved.

DISCUSSION

Coastal topography and regional economic factors can dictate the size and shape of shoreline urbanisation, but urban development usually follows a common format: a high-density, metropolitan core (administration and commerce) surrounded by irregular rings of diminishing commercial and industrial activity interspersed with suburban housing (Melles *et al.* 2003; Chace & Walsh 2004). This type of urban matrix tends to generate a graduated (native to urban) filter that favours some species, and selects against others, thereby creating a systemic catalyst that triggers species drop-out when the type and amount of land-use reconfiguration becomes intolerable, a situation that leads to food-web imbalance, reduced biological richness and inevitable raptor population decline (Chace & Walsh 2004; MacGregor-Fors & Schondube 2012; Sumasgutner *et al.* 2014).

Predicting the negative effects of habitat change for avian populations is not a new phenomenon. One of Australia's earliest ornithologists, Alfred J. North, expressed fears for the future of coastal avifauna as far back as 1901, citing urban growth and human activity as major concerns (North 1901). In more recent decades, calls to address the problem of decreasing avian diversity in urban areas have become more frequent and increasingly urgent.

Birds have attracted public and professional attention for centuries. Raptors are generally long-lived and difficult to monitor, but today's combination of electronically accessible data sourced from community science projects and professional research provide a measurable taxon upon which to model avian trait-shifts in an urban context. The emerging evidence of worldwide raptor population decline is worrying (3% status unknown; 27% of least concern; 52% in decline; 18% threatened with extinction) (McClure *et al.* 2018; Patankar *et al.* 2021; Hamdan & Misman 2020).

Raptors contribute critical ecosystem services. Declining populations could disrupt these services and eventually trigger a cascade of events that negatively affect human well-being (McClure et *al.* 2018; Patankar *et al.* 2021; O'Bryan *et al.* 2022; Schenk *et al.* 2022).

1. Pest and disease control: control of invasive faunal species and carriers of disease (Patankar *et al.* 2021; O'Bryan *et al.* 2022).
2. Recycling: scavenging of carrion and garbage (Patankar *et al.* 2021).
3. Provisioning: an indirect aid to plant regeneration via ingestion of seed-eating prey (Patankar *et al.* 2021).
4. Cultural services: a connecting link between nature and increasingly nature-deprived environments (Patankar *et al.* 2021).

As apex predators, raptors are positioned at the top of the ecological food web, making them highly susceptible, directly and indirectly, to the effects of land-use change; therefore, studies relating to urban raptors are thought to be essential if management and conservation measures are to succeed (McClure *et al.* 2018; Patankar *et al.* 2021; O'Bryan *et al.* 2022).

Brahminy Kites are thought to have undergone a northern range retraction in NSW very shortly after First European Settlement (1788) (Marchant & Higgins 1993; Cooper *et al.* 2014). Records for Sydney Cove appear to cease by the late 1700s, and Hunter records for the same time period are similarly rare (Hindwood 1970). Gould, during his time in NSW (1839-1842), only recorded one Brahminy Kite sighting, a bird flying in the lower reaches of the Hunter Estuary (Gould 1848). In the 1700s, 30ºS latitude may have been the southernmost edge of the Brahminy Kite's range in south-eastern Australia (Marchant & Higgins 1993). Populations at the edge of a range tend to be small and vulnerable; therefore, it's possible that late 18th century Brahminy Kites in southeast NSW succumbed to the challenges of Australia's first urbanisation experiment (Verberk 2011; Connallon & Sgrò 2018).

The 2016 Red List Index classifies the species as a raptor "of least concern" and the species has also been cited as "the most commonly observed bird of prey in the Indonesian Archipelago", and "Australia's most urban-tolerant raptor" (Iqbal *et al.* 2009; Headland *et al.* 2023; BirdLife DataZone 2024). While these facts would seem to assuage concerns for the future of the species, an earlier baseline study of NSW raptors clearly sounds the alarm and draws attention to Brahminy Kites as a species specifically threatened by coastal habitat destruction and pollution, a warning now constantly echoing throughout the literature (Debus 1992). The vast tropical and subtropical range of the Brahminy Kite spans many countries and cultures, all of which have the potential to drastically modify local native habitats in ways that may expose the species to significant hazards. Continued survival, throughout their range, will require a high degree of behavioural plasticity.

During the past 15 years (2010-2025) Brahminy Kites have slowly returned to the Hunter coast. Increased sightings, successful nests and territories have led to regional species reclassification from Category 3 (1993) "rare; vagrant" to Category 1 (2018) "common breeding resident" (Stuart 1994; Williams 2019). The convergence of three factors: habitat change (restricted hunting and nesting), stress (related to human activity), and climate change (increasing frequency and severity of weather events) present the current generation of Brahminy Kites with challenges of far greater magnitude than those faced by their ancestral counterparts (Kettel *et al.* 2018; Sergio *et al.* 2022) (**Figures 1 & 2**).

Habitat and range

Shoreline modification throughout the Brahminy Kite's range (mainland southeast Asia to Australia) has been extensive. Commerce, shipping, recreational boating, wild and farmed fishing, shrimp ponds, logging, charcoal burning, housing, and tourism are just some of the anthropogenic enterprises that have contributed to the removal of native coastal habitat (Khaleghizadeh & Anuar 2014a). Population decline of the species has now been noted in India, Thailand, Laos, Cambodia, Indonesia, Malaysia and the Philippines (Van Balen *et al.* 1993; Duckworth & Hedges 1998; Indrayanto *et al.* 2011).

In the Hunter, Brahminy Kites tend to establish territories in sheltered estuarine areas with easy access to calm water for fishing and large, mature trees for nesting (Wooding 2017, 2019). Unsurprisingly, such locations also constitute prime human habitat, a scenario with the potential to spawn contentious situations in which nature seldom prevails.

Breeding landscape and nests

Even though there has been intense development of the Hunter's shorelines, relatively un-urbanised terrain may still be found around coastal lakes and rivers (Lake Macquarie; the Myall Lakes and river system), two major estuaries (Port Stephens Estuary; the Hunter Estuary), low-profile coastline, a scattering of offshore islands, and in areas protected by national parks. Due to lack of access, the number of Brahminy Kite nests in these areas is unknown, with the possible exception of Broughton Island (Stuart 2020).

Tree removal regulation has helped retain native trees, including mature Blackbutts *Eucalyptus pilularis*, which appear to be the nest-tree species of choice for Hunter Brahminy Kites (Port Stephens Council 2016; Wooding 2017, 2019**).** In tropical and sub-tropical regions there are records of nests in a wide variety of tree species and, occasionally, on artificial structures (Marchant & Higgins 1993; Indrayanto *et al.* 2011; Riddell 2017) (**Table 1**). Regional nest-tree adaptation augers well for breeding success.

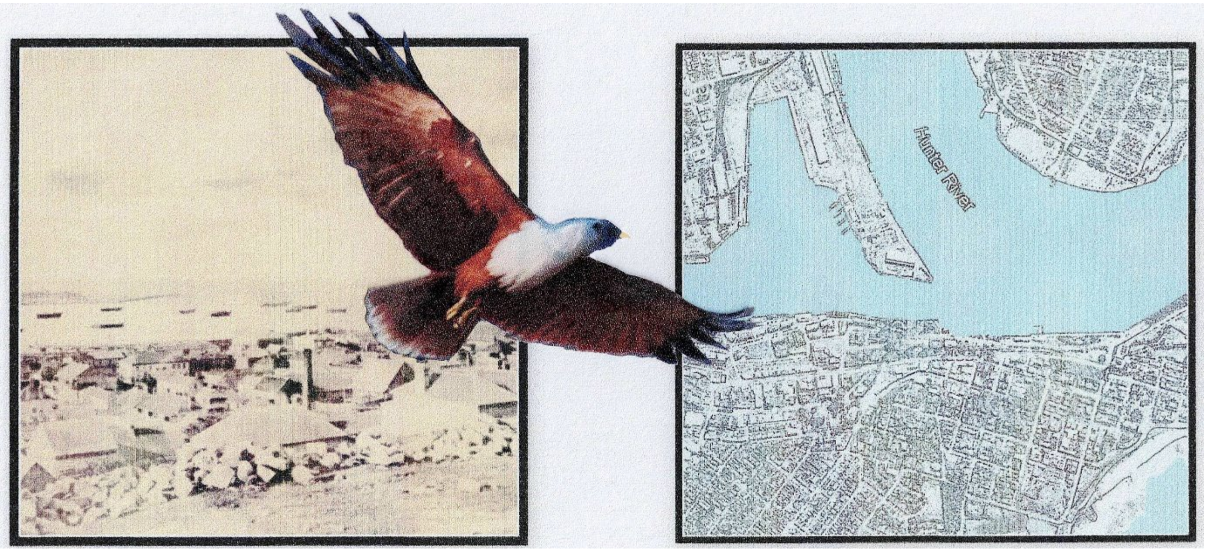

Figure 1. Newcastle Harbour (approx.1860).
Photo: Newcastle Public Library Archives (Photographer unknown).

Figure 2. Newcastle Harbour 2021.
Adapted from Google Earth 2021.

Table 1. Known Brahminy Kite nest trees

Common Name	**Scientific Name**	**Region**
African Mahogany	*Khya ivorensis*	Southern India
Blackbutt	*Eucalyptus pilularis*	Coastal Australia (NSW, Qld)
Chilean Mesquite	*Prosopis chilensis*	Southern India
Coconut Palm	*Cocos nucifera*	Southern India
Drumstick Tree	*Maringa alifera*	Southern India
Grey Mangrove	*Avicennia marina*	Southern India
Gum Arabic	*Acacia arabica*	Southern India
Indian Horsetail	*Casuarina indica*	Malaysia
Indian Lilac	*Azadirachta indica*	India; South-east Asia
Indian Mulberry	*Morinda tinctona*	South-east Asia; Australasia
Mango	*Mangifera indica*	India; South-east Asia
Milkwood	*Astonia actinophylla*	Malaysia
Norfolk Island Pine	*Araucaria heterophylla*	Southern India (introduced)
Palmyra Palm	*Borassus flabellifer*	Malaysia; Coastal NSW; Qld
Pornupan Mangrove	*Sonneratia alba*	Malaysia; Northern Territory
Portia Tree	*Thespesia populnea*	Southern India; Malaysia
Rhu Tree (Horsetail She-oak)	*Casuarina equisetifolia*	Coastal NSW
Sacred Fig	*Ficus religiosa*	Southern India
Scribbly Gum	*Eucalyptus racemosa*	Coastal NSW; Qld
Scrubby Seablite	*Suaeda fruticosa*	Southern India
Tamarind	*Tamarindus indicus*	India; South-east Asia
Teak	*Tectone grandis*	South-east Asia

All Hunter Region nests known to the author were found close to houses in older residential neighbourhoods, located approximately 100-400 m back from the shoreline (Wooding 2017, 2019). However, in Darwin the species has been observed nesting in the seaward side of Pornupan mangrove forests (Riddell 2017). Older neighbourhoods with single unit dwellings may have greater numbers of exotic flora and fauna (cats, dogs and non-native plants), but these districts are less disturbed than inner-city locations. They also tend to have taller, more mature trees, and greater biodiversity due to embedded green space (parks, gardens, golf courses, vacant lots). This variety creates a situation where tolerance for human presence becomes an acceptable trade-off for access to desirable nest sites and hunting areas (Chace & Walsh 2004; Dykstra 2018; Kumar *et al.* 2019).

Nests located slightly inland may also reduce nest-defence conflicts with other local Hunter raptors (Osprey *Pandion haliaetus,* White-bellied Sea Eagles *Icthyophaga leucogaster* and Whistling Kites *Haliastur sphenurus*) that generally prefer nest sites closer to the shoreline (pers. obs.). Although fierce in nest defence, Brahminy Kites appear to have a relatively stoic disposition (pers. obs.) (**Figure 3**). They were not seen by the author to initiate aggression towards other raptors or other avian species. They gave ground to frequent attacks by Whistling Kites and Ospreys, they ignored mobbing by smaller species (e.g. Little Corellas *Cacatua sanguinea*) and flew steady, unswerving, parallel hunting transects with White-bellied Sea Eagles (Wooding 2017, 2019).

Figure 3. Female Brahminy Kite defending nest from Pied Butcherbird (photo: L. Wooding.)

Hunter Region nests vary from new nests (presumed first-time breeders), refurbished nests (occupied over consecutive breeding seasons), and replacement nests (constructed in close proximity to earlier nests irreparably storm-damaged or abandoned as a result of human disturbance). Persistent nesting within the same area would seem to support the theory of territorial faithfulness (Marchant & Higgins 1993; Indrayanto *et al.*2011; Khaleghizadeh & Anuar 2014a; Wooding 2017, 2019). Range-wide evidence also supports the hypothesis that Brahminy Kite nest-tree selection is directly related to the close proximity of inter-tidal mangrove forests. When mangroves were removed from known nesting areas local Brahminy Kite populations quickly declined (Van Balen *et al.* 1993; Indrayanto *et al* 2011; Khaleghizadeh & Anuar 2014b).

Mangroves may be of threefold importance to Brahminy Kites: nest-tree sites; a source of construction material for nest building and nest repair; and an indirect dietary source (North 1889; Khaleghizadeh & Anuar 2014b; Wooding 2017, 2019). Mangrove systems have a significant ability to absorb CO_2, a beneficial asset in the attempt to mitigate global warming and slow down climate-related habitat change (NSW Dept. of Primary Industry 2008). They also protect shorelines from wave-action and storm-induced erosion, while providing vital nursery habitat for a wide variety of aquatic life forms, which in turn enrich the food-chain and, ultimately, the Brahminy Kite's diet (NSW Dept. of Primary Industry 2008; Hamdan & Misman 2020; Sabino & Macusi 2023). However, tidal barriers, uncontrolled stock access, off-road vehicles, dumping of rubbish, chemical spills, rising sea levels and shoreline development are just some of the threats jeopardizing mangrove forest health (NSW Dept. of Primary Industry 2008). In NSW, government regulation has helped protect mangrove forests, and as a result, the Hunter Region's Brahminy Kites, currently, have adequate mangrove access (NSW Dept. of Primary Industry 2008). However, this may not be the case range-wide. Over the past fifty years, approximately one-third of the world's mangrove forests has been lost, mostly in tropical and sub-tropical regions, to make way for shoreline development projects (Khaleghizadeh & Anuar 2014b; Sabino & Macusi 2023).

Diet

A Tolerance Index Score found that body mass was the only trait that significantly influenced a positive response to urbanisation among smaller raptors, particularly Brahminy Kites in Australia, making them more successful in urban landscapes than larger-bodied raptors (Headland *et al.* 2023). This trait may be driven by behavioural flexibility, particularly dietary flexibility (Headland *et al.* 2023). Smaller-bodied raptors often supplement their species-specific prey preference with smaller prey items (Headland *et al.* 2023). Although fish form the major component of the Brahminy Kite's diet, they are actually dietary generalists known to consume insects, small animals, small mammals, birds, reptiles, benthic species and carrion (Marchant & Higgins 1993; Debus 2012; Wooding 2019) (**Figure 4**).

Figure 4. Brahminy Kite fishing at Lemon Tree Passage NSW (photo: L. Wooding).

As dietary generalists, the species is more likely to profit from Australia's sprawl of suburban greenspace, which tends to attract a variety of small, but acceptable, supplementary prey options (Headland *et al.* 2023). Dietary flexibility, the ability to feed on whatever prey is locally present, makes smaller-bodied raptors, like Brahminy Kites, more likely to survive dietary change than dietary specialists (Chace & Walsh 2004; Sumasgutner *et al.* 2014; Patankar *et al.* 2021; Headland *et al.* 2023). Also, raptor home ranges are large; therefore, dietary restrictions can be alleviated to some extent by establishing territories that extend beyond the urban boundary, thereby eliminating the need to meet all ecological requirements within urban limits (Chace & Walsh 2004). However, the pressure of urban expansion constantly disrupts rural and native ecosystem patterns around the metropolitan fringe (Chace & Walsh 2004).

Although dietary generalists may appear to have broader dietary options, the advantage of a wider prey base could be offset by the possibility of increased exposure to harmful chemicals (McClure *et al.* 2018). Chemical residue from agricultural pesticides, herbicides and a variety of urban pollutants run off into creeks, rivers and estuaries, and eventually reaches inshore coastal waters (all of which are preferred Brahminy Kite hunting areas) and permeates the food-web, becoming more concentrated via primary, secondary and tertiary ingestion (Chace & Walsh 2004).

Olsen's research on organochlorines (e.g. Dichlorodiphenyltrichloroethane - DDT) revealed the cumulative effects of that particular chemical on Australian raptors (Olsen & Olsen 1985; Olsen *et al.* 1993; Olsen & Marples 1993). These studies showed that the reproduction rate for Brahminy Kites became significantly lower due to smaller clutch size, eggshell thinning, and increased embryo death (Olsen & Olsen 1985; Olsen *et. al.,* 1993; Olsen & Marples 1993).

The use of DDT in Australia was banned in 1987 but not necessarily banned, or monitored, throughout the entirety of the Brahminy Kite's range (Australian Government 2023). DDT residue is long-lasting and may still be present in some regions; also, excessive use of pesticides and insecticides on rice fields and fish farms may still occur in tropical areas (Van Balen *et al.* 1993).

Pre-market chemical testing in Australia is now more rigorous; however, accumulations of compounds, popularly referred to as "forever" chemicals (~4000 per- and polyfluoroalkyl substances - PFAS) widely used over the past 70 years, are now thought to pose a threat to wildlife, along with highly toxic levels of second-generation anti-coagulant rodenticides (Vendl *et al.* 2023; Australian Government PFAS Taskforce 2024; BirdLife Australia 2024; Stuart 2024).

While the diffusion of chemical residue and its cumulative effects on upper trophic species is now better understood, a review of recent studies focussing on the effects of chemical residue on lower trophic species since the end of WWII, suggests that 40% of global insect species are threatened with extinction over the next few decades (Raven & Wagner 2021). Knowledge of Australian insect population trends and their drivers is poor; however, in 2019 a symposium hosted by the Australian societies for entomology, systematic biology and arachnology reviewed the current Australian literature and identified 10 major taxonomic orders (approx. 37% of species) that are experiencing rapid decline, and 18% of species with population increases (Braby *et al.* 2019). The species in decline included many beneficial species (e.g. pollinators) whereas the species showing population increase had very little conservation value (Braby *et al.* 2019). The interaction of urbanisation and climate change (water stress; heat waves; mega fires and land-use practices) were considered the most likely drivers for the more recent insect extirpations (Braby *et al.* 2019). Given that insects are largely representative of the food-web's foundation, these alarming predictions of insect decline, should they eventuate, would have repercussions for all life forms.

Hunting techniques

Brahminy Kite territories, regardless of extent or location, are directly or indirectly managed by humans, but fortunately the species does not appear to be strictly limited to provisioning from a coastal larder (Kumar *et al.* 2019). The Brahminy Kite's lazy flight, supposed lack of speed and manoeuvrability, and weak feet, were thought to make the species unsuited for active hunting (Bell 1985). This theory would seem to be dispelled by reports throughout tropical areas (including Queensland, Aust.) of hunting forays well inland from coasts (2 km - 20 km) over grasslands, agricultural land and forests, up to altitudes of 2400 m, where Brahminy Kites were seen to hunt in the manner of buteos *Buteo* spp., folding their wings and diving through the forest canopy with remarkable manoeuvrability to take locusts, phasmids and small birds on the wing (Gilliard & LeCroy 1966; Morris 1980, 1981; Bell 1985; Marchant & Higgins 1993; Olsen 1997; Olsen & Trost 2007). One report of this behaviour in NSW was found: a Brahminy Kite swooping to take a Noisy Miner *Manorina melanocephala* from a shrub (Lutter *et al.* 2006). A demonstrated flexibility in hunting range and hunting techniques (perch and swoop, pursuit and swoop) in tropical regions would seem advantageous traits that might well transfer to southern range environments should the warming climate bring about a tropical transformation of temperate zone vegetation (Headland *et al.* 2023). Successful attempts at kleptoparasitism of cormorants, requiring considerable flight manoeuvrability, were also observed by the author.

Some major drivers of urban raptor decline

Establishing a territory does not necessarily guarantee success. For Brahminy Kites, and other raptors, life in an urban landscape holds many anthropogenically-generated drivers of population decline (Chace & Walsh 2004; MacGregor-Fors & Schondube 2012).

Collisions: car strikes, window strikes, collisions with towers and masts, and powerline entanglement (Chace & Walsh 2004; McClure *et al.* 2018; Patankar *et al*. 2021).

Noise: cars, trucks, heavy-duty equipment, trains, aeroplanes, industrial and recreational activities produce noise that can initiate temporary or permanent nest abandonment **(**Wooding 2017; Patankar *et al*. 2021). Low-frequency noise, such as traffic noise, carries over long distances, masking bird song, and disrupting avian communication (Patankar *et al*. 2021).

Pollution: (in addition to insecticides and pesticides) airborne ingestion of emissions from cars, trucks, planes, shipping and industry, plus exposure to plastics and pollutants while scavenging human refuse (Isaksson *et al.* 2018). Notably, for coastal and aquatic raptors, entanglement in lost or discarded fishing gear (Thomson *et al.* 2020).

Artificial light pollution: Night-time disturbance from vehicle lights, street lights and illuminated signage produces stress (Isaksson *et al.* 2018; Patankar *et al*. 2021).

High temperatures: cities develop their own microclimate (the heat-island effect). Radiant heat from artificial surfaces generates higher temperatures than the temperatures experienced in the surrounding countryside and can produce heat stress. Also, lower trophic-level species may not respond to heat-induced early bud-burst and insect emergence, which may result in food chain disruption and fragmentation (Isaksson *et al.*2018; Patankar *et al*. 2021).

Exotic species: the introduction of exotic flora and fauna (pets and non-native plants). Replacing native trees and shrubs with exotic varieties can result in the modification of lower-trophic food options which, in turn, may decrease biodiversity within the food chain (Patankar *et al*. 2021).

Disease: inter-species transmission of diseases and parasites at gathering points (bird feeders and bird baths) increases the risk of disease transmission within the food chain. Raptors may identify these sites as easy hunting areas and become infected (Chace & Walsh 2004; Isaksson *et al.* 2018).

Flight Initiation Distance (FID): raptors that have become used to traffic and human presence tend to be bolder and exhibit shorter FID, increasing the risk of accidents due to distance misjudgement (Patankar *et al*. 2021).

Human cultural practices: legislation notwithstanding, shooting, poisoning (direct and indirect), trapping, caging, plumage collection, and egg collection still occur. Also, because of their size and beauty, stuffed raptors like Brahminy Kites are popular souvenirs in some quarters (Van Balen *et al.* 1993; Marzluff & Rodenwald 2008; McClure *et al.* 2018; Wooding 2019; Villegas *et al.* 2021).

Climate change: the frequency and severity of extreme weather events related to climate change may have direct effects on raptor breeding success, due to the destruction of nests, eggs and chicks, and may also be capable of reconstructing entire ecosystems, with consequences that substantially influence human and wildlife communities (Marzluff & Rodewald 2008; Sergio *et al.* 2022).

The outlook for Brahminy Kites

Between 2000 and 2030, the footprint of global urbanisation is predicted to triple, particularly in coastal areas (United Nations 2018**.** Increasing coastal urbanisation will escalate land-use imbalance and exacerbate negative issues affecting human/raptor interaction, the framework within which the fate of the Brahminy Kite will be decided (Dykstra 2018; Isaksson *et al.* 2018).

Brahminy Kites are an emblematic species symbolizing the ecological reality of all native, avian fauna currently facing life in coastal urban settings. Although the species is not yet globally recognised as “of concern” or “threatened” a downward population trend has been detected (BirdLife Data Zone 2024). Given that the species occupies a position at the top of the food web across a huge tropical and sub-tropical range comprised of many different countries and cultures, speedy consensus on management and conservation measures may prove difficult; therefore, the possibility of range-wide population fragmentation cannot be ignored.

It’s thirty-five years since Debus (1992) warned about the negative effects of continued coastal habitat destruction for NSW raptors and the evidence for raptor population decline has become irrefutable. Awareness in the literature has become more vocal and more urgent, but scant public understanding of the challenges facing raptors is in danger of being totally submerged by public and political pressure focussed on the building of more houses in order to solve the current housing crisis, an exercise which will inevitably contribute to the extension of the urban footprint.

For their part, Brahminy Kites have demonstrated (so far) the behavioural plasticity needed to cope with anthropogenically-generated reconfiguration of native coastal habitat throughout their vast range, and, in Australia, all levels of government, to their credit, have introduced various conservation measures. However, for these apex predators burgeoning urbanisation may compromise or even overwhelm their prospects for future population success (McClure *et al.* 2018; Patankar *et al.* 2021; O'Bryan *et al*. 2022). Clearly, future urban design must take a multi-faceted, multi-disciplinary approach, involving input from both professionals and citizen scientists in many fields when addressing the complex mechanisms and ecological values of urban species that need to be understood in order to retain, protect and enhance their habitats. Issues involving the variety of the built environment, the manufacture, control, monitoring and eradication of dangerous chemicals, and the exploration of avenues that heighten public awareness must also be considered. Fostering connections between people and their natural heritage is key to the success of conservation and protection measures (Chace & Walsh 2004; Marzluff & Rodewald 2008).

CONCLUSION

Currently, Brahminy Kite recolonisation of the Hunter Region appears to be successful, but being a modern-day Brahminy Kite is not easy. Viewed through the prism of history, losing the Brahminy Kite the first time was sad, but understandable. From a 21st century viewpoint, losing this sentinel species, now recognised as Australia's most adaptable and human-tolerant raptor, for a second time could be the harbinger of much wider ecological adversity.

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