Communication for Conservation

Case Study Evaluating Sunshine Coast Council Regional Flying-Fox Management Plan (RFFMP)

December, 2022

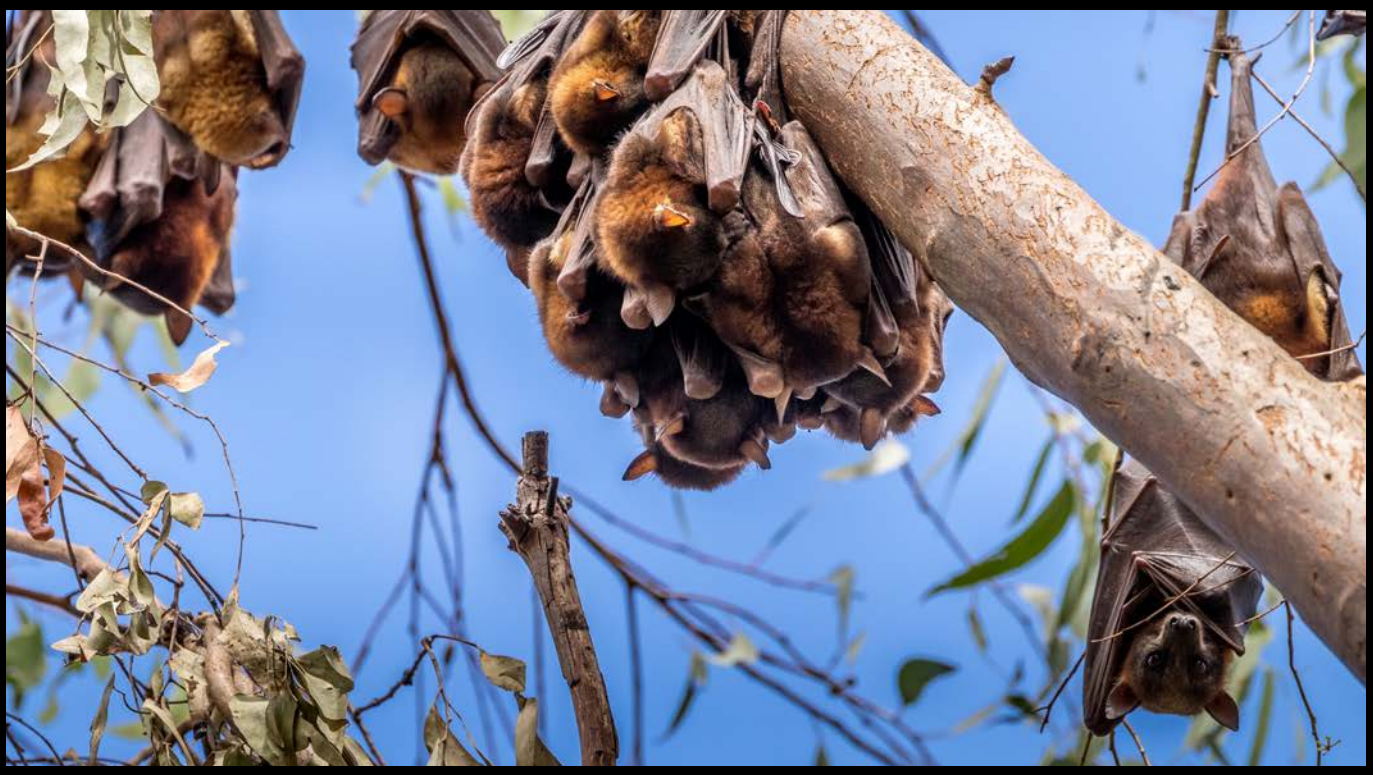

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Image credit
Front cover: Cluster of Little red flying-foxes (*Pteropus scapulatus*), Sunshine Coast, Queensland, Dr Julie O'Connor, 2019.

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Acronyms and abbreviations

ABL	Australian bat lyssavirus
BFF	Black flying-fox (*Pteropus alecto*)
Council	Sunshine Coast Council
EPBC	Environmental Protection and Biodiversity Conservation Act 1999
GFF	Grey-headed flying-fox (*P. poliocephalus*)
HeV	Hendra Virus
IUCN	The International Union for Conservation of Nature
LGA	Local government area
LRFF	Little Red flying-fox (*P. scapulatus*)
RFF	Regional flying-foxes
RFFMP	Sunshine Coast Council Regional Flying-fox Management Plan
SC	Sunshine Coast regional area
SCC	Sunshine Coast Council
SDGs	United Nations 17 Sustainable Development Goals
SEQ	Southeast Queensland
UFFMA	Urban flying-fox management area
UNESCO	United Nations Educational, Scientific and Cultural Organisation

Executive Summary

This report summarises the findings from online surveys and interviews undertaken by participating Sunshine Coast (SC) residents, councillors, and local non-profit organisations (NGOs). The overall aim of the study was to evaluate Sunshine Coast Council's (SCC or Council) conservation management communication and awareness program and examine the effectiveness of existing communication activities in achieving program aims in the SCC Regional Flying-Fox Management Plan (RFFMP), using a case study design. The study analyses residents' understandings and opinions of regional flying-foxes, human-wildlife interactions (flying-foxes), and SCC flying-fox campaigns, and identifies effective conservation communication outcome areas to assist with future flying-fox communications to the Sunshine Coast (SC) community.

The Sunshine Coast provides important roosting and foraging habitat for three Australian flying-fox species (Genus: Pteropus) that occur in Southeast Queensland (SEQ): the Black flying-fox (Pteropus alecto) (BFF), Grey-headed flying-fox (P. poliocephalus)(GHFF), and Little Red flying-fox (P. scapulatus) (LRFF). These species are all protected in Queensland under the *Nature Conservation Act 1992*. The GHFF is listed nationally as a threatened species and protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

As long-distance seed dispersers and pollinators, flying-foxes are of extraordinary ecological and economic importance, playing a crucial role in the maintenance and regeneration of forest ecosystems. However, Australian flying-foxes became subject to commercial harvest sold as a luxury food item in trade, hunted for sport, or killed by farmers to protect their orchids and crops (Fujita & Tuttle 1991). Although indiscriminate and widespread persecution ceased in the 1990s, it contributed to an observable decline in population numbers (Fujita & Tuttle 1991). Contemporary threats, including loss and degradation of roosting habitat, colony dispersal, and increased severity and frequency of weather events, such as drought, bushfires, and heat waves also contribute to the decline of flying-fox species in the recent decade (Baranowski et al. 2021; Roberts et al. 2021; Welbergen et al. 2008). Flying-foxes are frequently misunderstood and exceptionally vulnerable to extinction, with species management requiring balancing conservation outcomes with negative public perception and human–wildlife conflict (Kung et al. 2015).

The SC local government area (LGA) is an internationally recognised United Nations Educational, Scientific and Cultural Organisation (UNESCO) Biosphere Reserve and is managed by SCC. Yet, the region is rapidly developing, with population growth between 2011 and 2021 of over 79,000 people and is forecast to increase to over 217,230 dwellings by 2041 (SCC 2022). Despite occurrence of remnant vegetation in urban spaces providing multiple foraging opportunities for flying-foxes (SCC 2016), it still exposes them to additional anthropogenic threats, including electrocution on powerlines, vehicle collisions, and exacerbated human-wildlife conflict (Taylor- Brown et al. 2019).

Executive Summary

Small colonies in remnant urban and peri-urban bushland are generally tolerated, however, conflict can arise when the influx of large numbers of flying-foxes (most often associated with the large-scale nomadic movements of LRFF) are located close to residents, businesses, public spaces, and government buildings (Kung et al. 2015; Currey et al. 2018; SCC 2016). Large roosts can cause loss of social amenity due to substantial noise, odour, vegetation damage, property damage, and concerns about disease (McDonald et al. 2021). This is exacerbated by public concern of bat-mediated zoonotic diseases such as the Australian Bat Lyssavirus (ABLV) and Hendra Virus (HeV) (Paterson et al. 2014). To address human-flying-fox conflict and community concerns, the SCC endorsed an adaptive Regional Flying-fox Management Plan (RFFMP) in 2016, to manage the conservation of flying-fox roosts in urban areas, and the impacts on potential human-wildlife conflict (SCC 2016). Council drives an innovative flying-fox education program, events and diverse activities and campaigns for the community in the SC Region. Communication and education are one of five main management actions aimed at dealing with complaints regarding flying-fox colonies in urban areas and promoting flying-foxes ecological significance and conservation and influencing positive community sentiment and awareness (SCC 2016).

Online surveys and semi-structured interviews were administered online via email invitations and SCC webpage and social media posts between August and October 2022, to Sunshine Coast: residents aged 18 years or over, not-for-profit organisations who engage with flying-fox conservation, and Councillors. A total of 364 Sunshine Coast residents and four not-for-profit organisations completed online surveys. Survey questions included open (qualitative) and closed (quantitative) questions relating to participant characteristics (demographic data), knowledge, awareness, and attitudes in relation to regional Flying-foxes (RFF), proximity to RFF, recall of SCC RFFMP and communication campaigns, and opinions and recommendation for improving awareness of SCC RFF and the RFFMP. Semi-structured interviews were conducted via video conferencing with four Sunshine Coast Councillors focused on knowledge, awareness, and attitudes in relation to RFF, awareness of SCC RFFMP and communication campaigns, and recommendation for improving understanding of SCC RFF.

The results indicate that over half (n=186; 59%) of the participants had not seen any communication campaigns provided by Sunshine Coast Council about flying-foxes in the last five years. For those who have seen Sunshine Coast Council flying-fox campaigns, the information did increase knowledge, has been consumed via most of the sources employed but the preferred medium, email, was under-utilised. The target audiences are diverse with divergent opinions and responses to living in proximity to flying-foxes. A key rule in effective conservation and environmental communication is know the audience. Consideration of who the audiences are with respect to connectedness to nature, frames of reference, proximity to roosts and knowledge of flying-foxes will aid in framing content that is relevant, meaningful, and actionable.

Recommendations were drawn from the results of this study, participant comments and reviewing conservation communication research. Participants provided suggestions on where and how to communicate, topics of interest and audiences to whom information should be shared to increase awareness of flying-foxes. Opportunities to enhance conservation communication recommend consideration for inter-generational inclusion and innovative communication approaches such as interpretation, storytelling, achieving conservation through tourism and leisure, and citizen science.

Introduction

The rapid decline in global biodiversity from human activities and environmental change is predicted to have severe effects on ecosystem functioning and human well-being (Bennet et al. 2015). In response, international agreements including the United Nations' 17 Sustainable Development Goals (SDGs) of the 2030 Agenda call for commitment to reducing substantial loss and addressing sustainability concerns. The 17 SDGs (Figure 1) are interdependent, with targets that range from achieving economic prosperity to environmental preservation, conservation, and well-being of people (UN 2022). This study is related to SDG13 (Climate action), SDG15 (Life on land), SDG17 (Partnerships for the goals).

Figure 1 The UN 17 Sustainable Development Goals (SDGs).

Focal species: Flying-foxes

Bats (order Chiroptera) include more than 1300 species, forming the second largest mammalian order (Voight & Kingston 2015). Bats are unique among mammals in their evolution of powered flight and immense physiological and ecological diversity (Voight & Kingston 2015). Due to their key roles as pollinators, seed dispersers (Maas et al. 2016), insect predators (Böhm, Wells & Kalko 2011), and bioindicators in respective ecologies (Stahlschmidt & Brühl 2012), these species are of outstanding global ecological and economic importance. However, bat populations are under threat in many regions of the world (Frick, Kingston & Flanders 2020). The main threats identified that bats face include habitat loss (e.g., logging and agricultural land use), human persecution (e.g., hunting), intrusions and disturbances (e.g., recreational activities) (IUCN 2022). Bats are divided into two main groups: Megabats (fruit and nectar feeders) commonly referred to as fruit bats or flying-foxes, and microbats (insectivores) (QLD 2021).

Focal species: Flying-foxes

Flying-foxes (Pteropus spp.) have existed for over 35 million years (QLD 2021). As nocturnal foragers with well-developed vision, flying-foxes feed on blossom and fruit resources (Timmiss et al. 2021), and rest by day in arboreal roosts that can collectively number hundreds to hundreds of thousands of individuals (DCCEEW 2022). Flying-foxes are mobile species that travel nomadically among networks of roosts within their ranges (Welbergen et al. 2020). Roosts are used by flying-foxes foraging in nearby areas as daytime rest stops, as temporary stopovers for migrating animals, and as maternity colonies during breeding season (Lunn et al. 2021; Meade, Martin & Welbergen 2021). Roosts may comprise a mix of flying-fox species and are occupied continuously, seasonally, or irregularly depending on availability of foraging resources and/or encroaching development (QLD 2021). Typically, flying-foxes are found in coastal areas, inhabiting melaleuca and casuarina swamps, mangroves, heathlands, dry and wet eucalypt forests, woodlands, and rainforests (Lunn et al. 2021). The little red flying-fox is the only species found further inland in arid or semiarid areas (Figure 2) (Lunn et al. 2021).

The Australian mainland is home to four species of flying-fox (Pteropus species) (Figure 2). The persecution and killing of Australian flying-foxes was indiscriminate and widespread until the 1990s (Hall 2002; Fujita & Tuttle 1991). Species listed as threatened such as the Grey-headed Flying-fox (Pteropus poliocephalus) are now afforded national protection under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (DAWE 2022). Other species are protected from harm under state-level legislation such as protected in Queensland under the *Nature Conservation Act 1992* (DES 2022).

Despite improved levels of protection, conservation challenges such as loss and degradation of roosting habitat, colony dispersal, and increased severity and frequency of weather events—including drought, bushfires, and heat waves—continue to pose a substantial threat for flying-fox species (Baranowski et al. 2021; Roberts et al. 2021; Welbergen et al. 2008). With changes in climatic conditions, Australia is seeing native forests flowering at different times, flowering with no nectar production or not flowering at all (Welbergen et al. 2008). Increasingly, flying-foxes are exploiting urban resources for foraging and roosting, and many urban areas in eastern Australia now support permanent flying-fox colonies that were not historically present (Kung et al. 2015; Currey et al. 2018). Additionally, flying-fox management must balance conservation outcomes with ongoing human-wildlife conflict and negative public perception (BBC 2017; Scheelings & Frith 2015; Currey et al. 2018; Mo et al. 2020).

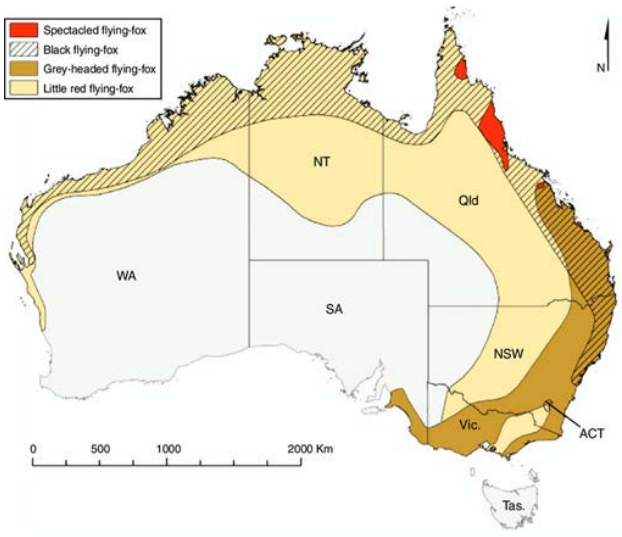


Figure 2 Distribution of Australia's four mainland flying-fox species.

Human-flying-fox conflict

Globally, people care about wildlife for a variety of reasons. Wild species are a source of attraction, fascination, curiosity, even fear, with utilitarian value and symbolic meaning. Human-created physical characteristics of wildlife species and their "personalities" have elicited a wide range of emotions (Kellert et al. 1996). Fear and anger, for example, can be induced by predators that are larger and heavier than humans, such as large carnivores (e.g., wolves) (Almarcha, Ferrández & López-Bao 2022), or by species that are unappealing to most people, including reptiles and bats, which are frequently perceived as harmful (Knight 2008). Furthermore, some species can represent a threat due the damage they can inflict on human health, property, or crops (e.g., flying-foxes) (Currey et al. 2018), which can promote negative attitudes motivated by emotions of anger, disgust, and fear. Thus, understanding human attitudes towards wildlife can be a determinant of the success or failure of a conservation initiative, policy, or practise, and demonstrates one of the primary conservation challenges for wildlife species (Connelly, Lauber & Stedman 2022; Boso et al. 2021).

Despite threats to flying-foxes and the critical ecosystem services they provide, they are usually a socially stigmatised group, misunderstood, and even hunted (Kung et al. 2015; Boso et al. 2021). The role of bats in disease emergence and transmission has resulted in increased negative public perceptions (Degeling & Kerridge 2013), while in urban areas, aspects of bat behaviour (e.g., vocalisations and territory marking, which cause noise and odour) interfere with human habitation (Currey et al. 2018). These negative aspects of living near a flying-fox roost can contribute to anxiety and sleep deprivation, and impact on people's mental health and wellbeing (SCC 2016). Human development has increased proximity of homes, businesses, and schools to roosts, creating community tension and amplifying the need for effective management strategies (Currey et al. 2018). Community concern and negative media coverage have resulted in local governments using various methods to disperse bats from ‘troublesome’ roosts in urban areas (Degeling & Kerridge 2013).

Conservation Management and Communication

Wildlife conservation goals and awareness programs that evaluate and incorporate social perception are crucial (Castillo-Huitrón et al. 2020; Boso et al. 2021). Wildlife management through public promotion of conservation is defined as "the planned effort to influence public opinion through good character and responsible performance, based upon mutually satisfactory two-way communication" (Fazio & Gilbert 1986, p. 8). Effective communication and education strategies, designed for diverse outreach, can provide meaningful contributions to the people, places, and species and broader attitudinal change to bridge the gap between conservation science and the public (Basak et al. 2022).

Conservation education is described as the process of influencing people's attitudes, emotions, knowledge, and behaviours about biodiversity conservation (Basak et al. 2022). Conservation education shares many objectives with the broader field of environmental education. In Australia, the approach to environmental communication draws on a range of medium "to reach defined audiences with specific messages.....using a combination of both extension and interpretive approaches" (Hockings, Carter & Leverington 1998, p. 644). Diverse, responsive, purposeful, and well-planned strategies can stimulate an environmentally aware public and meet specific management-related aims. Effective communication, that which achieves broader stakeholder aims (e.g., those of managing agencies, communities, and conservation groups), motivate behavioural change, inform policy action, and support conservation, (Hockings, Carter & Leverington 1998) is key.

Case Study Background

Regional context

The Sunshine Coast is located in Southeast Queensland, Australia, a region of high biodiversity, sub-tropical climate, and diverse ecosystems. The Sunshine Coast local government area (LGA) was internationally recognised as a UNESCO Biosphere Reserve in 2022 and managed by the SCC (Figure 3). Over half (55%) of the region is vegetated, with 12% of vegetation occurring in urban areas (SCC 2020). Council's 2020 Sunshine Coast Biodiversity Report documented that around 28% of the Sunshine Coast area is managed for conservation, and 24 regional ecosystems remain poorly conserved including five with none of their remaining extents represented in protected areas (SCC 2020). Further, according to the Queensland Government's conservation status classification, almost 50% of the Sunshine Coast Council area's regional ecosystems are threatened or in significant decline (SCC 2020).

The Sunshine Coast is a rapidly developing region, with population growth between 2011 and 2021 of over 79,000 people and is forecast to increase to over 217,230 dwellings by 2041 (SCC 2022). Urbanisation is a detrimental process for wildlife and the ecosystem services they provide (Taylor-Brown et al. 2019). The consequences of environmental changes to wildlife, include a reduced ability to forage, reduced prey or food availability, altered immune function, and diminished breeding success (Taylor-Brown et al. 2019). Despite occurrence of remnant vegetation in urban spaces providing multiple foraging opportunities for mobile native animals, such as bats (SCC 2016), it still exposes wildlife to additional anthropogenic threats, including electrocution on powerlines, vehicle collisions, and exacerbate human-wildlife conflict (Taylor- Brown et al. 2019).

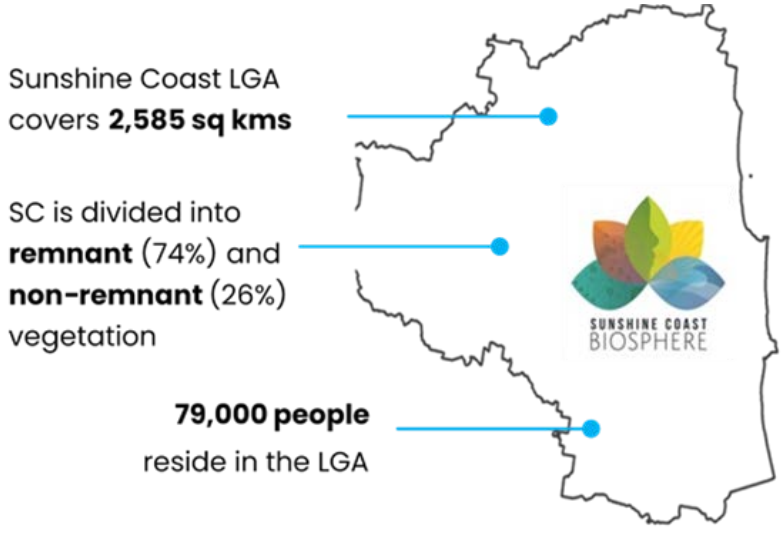


Figure 3 The Sunshine Coast Biosphere.

Flying-foxes on the Sunshine Coast

The Sunshine Coast provides important roosting and foraging habitat for all three species of flying-foxes that occur in Southeast Queensland (SEQ): the Black flying-fox (*Pteropus alecto*) (BFF), Grey-headed flying-fox (*P. poliocephalus*)(GHFF), and Little red flying-fox (*P. scapulatus*) (LRFF) (Figure 4). All flying-fox species are protected in Queensland under the Nature Conservation Act 1994. The GHFF is listed nationally listed as vulnerable to extinction, however, in the state of Queensland the GHFF is listed as Least Concerned.

BFF and GHFF can usually be found on the Sunshine Coast throughout the year. GHFF generally show a higher level of fidelity to roosting sites, returning year after year to the same site (SCC 2016). LRFF have a shorter duration at a roost, for example, 2,500 LRFFs joined a small colony of BFF at a Mooloolaba roost in 2010, however only stayed at the site a month (SCC 2016). The LRFF are specialist nectar feeders and the most nomadic, with movements closely correlated with the flowering of preferred Eucalypt food source.

Figure 4 Sunshine Coast Flying-fox species: Black Flying-fox (left), Grey Headed Flying-fox (middle), Little Red Flying-fox (right). Image credit Dr Julie O'Connor.

Flying-foxes on the Sunshine Coast

The breeding cycle for each species within a colony is seasonal and synchronous, with a single birth pulse annually- generally September–November for GHFF and BFF, and May-June for LRFF (See Figure 5) (Lunn et al. 2021). Consequently, flying-fox population growth is slow, and they are very susceptible to threats (Westcott et al. 2018). During the breeding season roost sizes can change significantly in response to resource availability and arrival of animals from interstate (Lunn et al. 2021). From late spring to summer, roosts provide refuge for lactating females and their young throughout the day. At night, roosts provide a refuge for flightless young while adults depart to feed. Most roost trees are occupied by mixed groups of adults including a single male, who scent-marks and defends a territory shared by females and their young (Lunn et al. 2021). The lifecycle calendars for GHFF and BFF are almost identical, however, may differ under certain environmental conditions. The LRFF lifestyle calendar is reverse to the former two (Figure 5).

January	Young left at roost
February	Males establish territory
March	Breeding season/Peak Conception
April	Breeding season/Peak Conception
May	Gestation
June	Gestation
July	Gestation
August	Gestation
September	Birth & Caring for young
October	Birth & Caring for young
November	Birth & Caring for young
December	Young left at roost

January	Gestation
February	Gestation
March	Gestation
April	Gestation
May	Birth & Caring for young
June	Birth & Caring for young
July	Young left at roost
August	Young left at roost
September	Males establish territory
October	Breeding season/Peak Conception
November	Breeding season/Peak Conception
December	Gestation

Figure 5 Lifecycle stages of Sunshine Coast flying-fox species.

Flying-fox movements and known urban roosts

Human-modified landscapes have become critical foraging and roosting habitat for flying-foxes (Timmiss et al. 2021; Yabsley et al. 2021). Traditionally, roosts were believed to be occupied on a seasonal basis, possibly due to climate variables and the asynchronous flowering of many native diet species in different regions (Fujita & Tuttle 1991). However, in the last few decades, multiple new colonies have become permanently occupied in urban areas (Timmiss et al. 2021). Around 70% of the GHFF, BFF, and LRFF roosts in Queensland now occur in urban areas (Timmiss et al. 2021). GHFF colonies, for example, have been found to favour urban environments, and these are becoming occupied more permanently (Timmiss et al. 2021; Boardman et al. 2021) with individuals exhibiting higher fidelity to urban roosts and foraging over shorter distances when roosting in major-urban areas (Meade et al. 2021). The Sunshine Coast Regional Council (2022) has identified more than 40 established and emerging, seasonal flying-fox roosts in the region (See Figure 6 and Table 1).

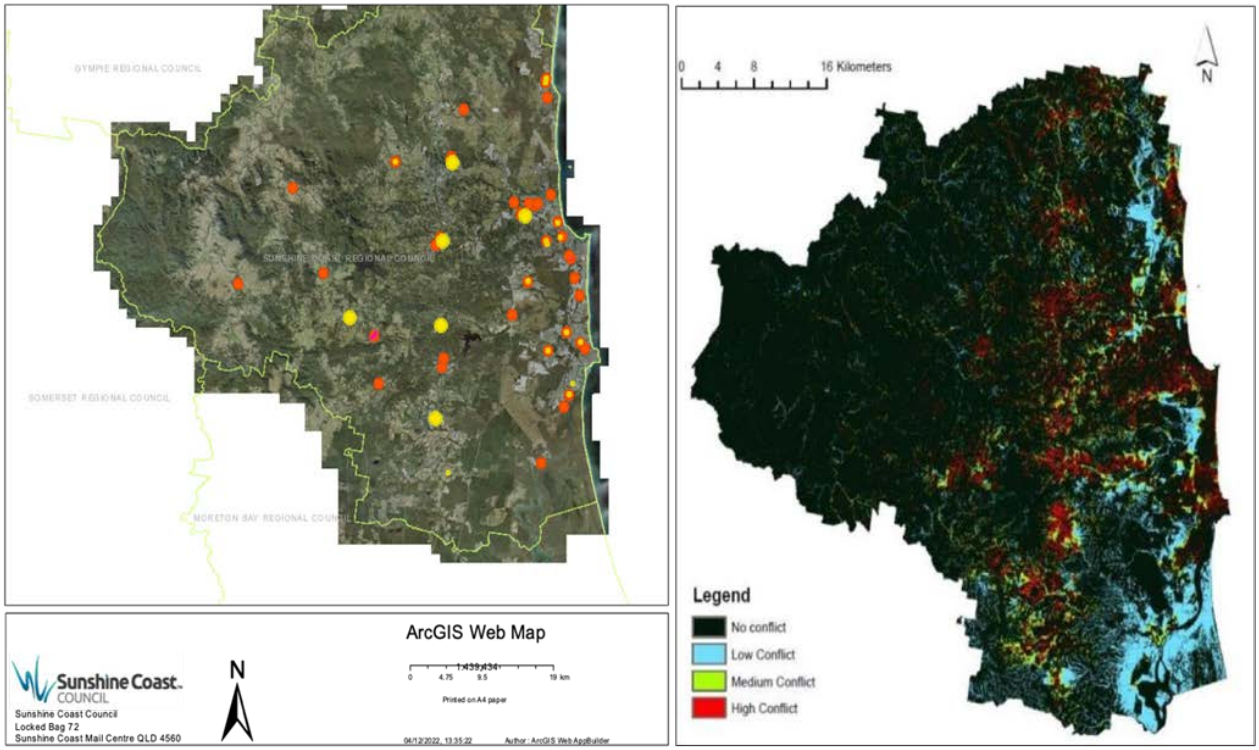


Figure 6 Sunshine Coast Regional Council Bat Map showing flying-fox roosts (left) and reported human-bat conflict areas (right) (Saint Ange et al. 2018).

Flying-fox movements and known urban roosts

Table 1 Known flying-fox roosts in the Sunshine Coast (SCC 2021).

Roost Name	Suburb
Albany St Park	Sippy Downs
Alex Forest	Alexandra Headland
Andrea Ahern Bushland Park	Battery Hill
Aragorn Bushland Reserve	Maroochydore
Barcrest Dr	Yandina
Bells Creek	Bells Creek
Buderim Pines Bushland Conservation Reserve	Buderim
Cassia Wildlife Corridor	Coolum Beach
Coochin Creek	Coochin Creek
Dunning St	Palmwoods
Elizabeth St Drain	Coolum Beach
Emerald Woods	Mooloolaba
Eudlo Creek	Eudlo Creek
Eumundi-Kenilworth Rd	Eerwah Vale
Frizzos	Glenview
Goat Island	Maroochy River
Hardie Buzacott Wildflower Reserve West	Moffat Beach
Herron Rd	Conondale
Jubilee Dr	Palmwoods
Kawana Island, Seriata Way	Mountain Creek
Kawana Island Environment Reserve	Parrearra
Kawana State College	Bokarina
Kolora Park	Palmwoods
Kuluin Neighbourhood Park	Kuluin
Livistonia Cres	Currimundi
McDonalds Rd	Peachester
Maroochy High School	Maroochydore
Mary Cairncross Scenic Reserve	Maleny
McArthur Park	Kuluin
Mellum Creek Esplanade	Landsborough
Meridan Downs Park	Little Mountain
Mooloolah Gardens Reveg Area	Mooloolah Valley
Obi Obi Creek	Obi Obi
Palmer Resort	Coolum Beach
Parkland Cres	Witta
Parkside Dr	Beerwah
Pecan Park	Maleny
Porter Park	Golden Beach
Tallangatta St	Nambour
Vidler Court	Landsborough
William Doig Park	Kureelpa

Sunshine Coast Council flying-fox management

An adaptive Regional Flying-fox Management Plan (RFFMP) was endorsed by the Sunshine Coast Regional Council in 2016 to address public concerns about flying-fox roosts in urban areas (SCC 2016). The purpose of this plan is to provide direction for the management of flying-foxes in urban areas within the Sunshine Coast regional council area (Figure 7). The plan is endorsed by the Queensland state government and federally approved as a conservation agreement (SCC 2016). The RFFMP seeks to increase community understanding, appreciation, and support for the conservation of flying-foxes. Moreover, the plan seeks to address and manage concerns of residents experiencing lifestyle impacts associated with living near flying-fox roosts, ensure community access to accurate and up-to-date information relating to perceived health risks, increase understanding of flying-fox behaviour through monitoring and research, and ensure management practices align with most recent knowledge to develop achievable flying-fox conservation strategies, and where possible, identify and prevent future residential/flying-fox land use conflicts.

Communication and education are one of the five main management actions aimed at dealing with complaints regarding flying-fox colonies in urban areas and promoting flying-foxes ecological significance and conservation and influencing positive community sentiment and awareness.

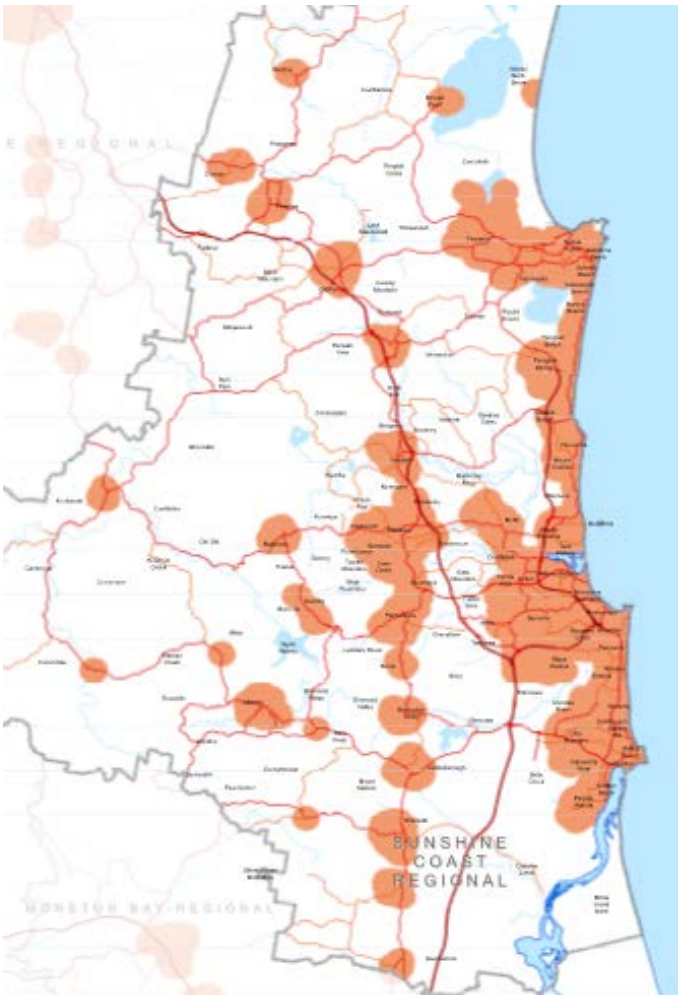


Figure 7 Sunshine Coast regional council urban flying-fox management area (UFFMA).

Communication and education

Sunshine Coast Council drives an innovative flying-fox education program and conservation management communication and awareness campaigns for the Sunshine Coast community. Council-supported environmental education programs are supported by a commitment to ongoing research partnerships, and explore a wide range of sustainability, conservation and flying-fox ecology themes throughout the local Sunshine Coast bushland and coastline. Although the communication planning documentation remains in draft form, the overall educational focus has been to:

- Inform and generate community awareness of flying-foxes
- Educate the community on the importance of flying-foxes to the survival of native forests and their conservation
- Increase positive community sentiment towards flying-foxes
- Reassure the community of councils' commitment to ongoing research for long-term flying-fox roost management.

Below is a condensed list of the approaches Sunshine Coast Council employs to increase awareness and assist the community on flying-fox management (See Figure 8):

- Community events
- Community news (bi-monthly)
- School programs
- Podcasts and radio
- BatMap monitoring
- Frankie the flying-fox mascot
- Council website and social media
- Annual presentations and stalls
- Posters
- Library talks

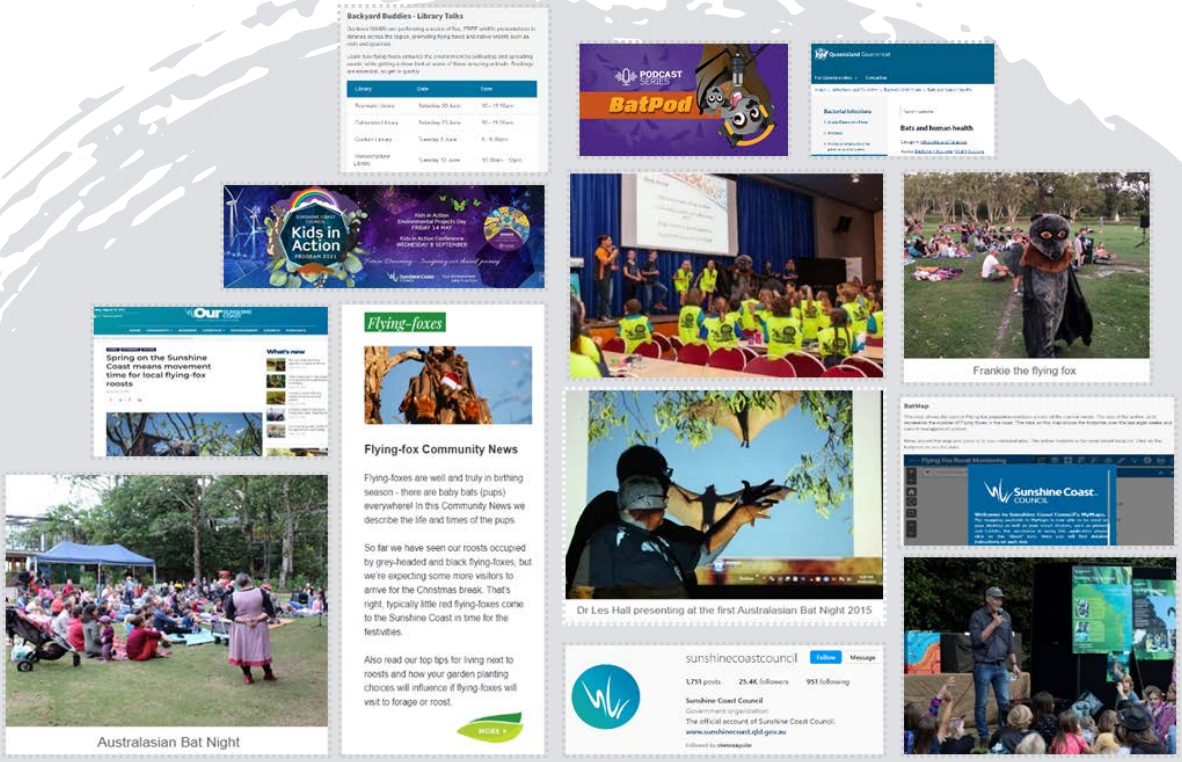


Figure 8 Examples of Sunshine Coast Council broad flying-fox education program activities.

Project aims and objectives

This report focuses on communication for conservation. A case study using the evaluation of the Sunshine Coast Regional Council Regional Flying-fox Management Plan (SCC RFFMP) and Communication program. The study examines program aims and outcomes based on existing communication activities, public perception of human/flying-fox interactions, resident awareness, knowledge, and opinions concerning flying-foxes, the SCC RFFMP, and suggestions for improving flying-fox awareness and communication efforts.

The overall evaluation question guiding the research was:

How have the existing communication approaches achieved program aims within the SCC Regional Flying Fox Management Plan and program (SCC RFFMP)?

The objectives of this study are to:

- Examine the existing conservation management communication strategies and activities, awareness campaigns.
- Inform continuous improvement of strategies that support future Sunshine Coast Coast conservation communication management and activities associated with flying-fox campaigns.
- Identify participant suggestions for increasing awareness.
- Provide recommendations for conservation communication focused on flying-foxes and the Sunshine Coast community.

Outcomes

As a research project, this study will assist to:

- Inform SCC RFFMP program and conservation communication outcomes
- Inform the ten-year review of the SCC RFFMP and associated communication plan
- Facilitate increased outreach and research in conservation communication
- Produce a final report and
- Academic publications and other presentations

Methodology

Case study design

A case study design was used to examine conservation communication effectiveness and outcomes as this allowed multi-faceted explorations of this issue within a real-world context (Yin 2003; Crowe et al. 2011), framed as a single case incorporating analysis of qualitative and quantitative data (Dul & Hak 2007). The research methodology was approved by the University of the Sunshine Coast (USC) Human Research Ethics Committee (HREC).

The methodology commenced with a document analysis. Document analysis is a methodical approach to systematically reviewing or evaluating documents, which can be used to provide context, generate questions, supplement other types of research data, track change over time, and corroborate other sources (Bowen 2009). According to Morgan (2022), document analysis is an underutilised approach in research. Document analysis was employed to gain insights into the SCC RFFMP purpose, objectives, communication approaches, action plan and activities, and intended outcomes. Also, to understand the extent to which the intended program aims of the SCC RFFMP were achieved through existing communication activities. The documents analysed included those provided by SCC, as well as other publicly available flying-fox communications.

Data collection

Primary data was collected via online surveys and interviews. Online surveys were developed for completion by Sunshine Coast residents, aged 18 years or over. A separate online survey was developed to collect responses from Sunshine Coast not-for-profit organisations who engage with flying-fox conservation. Invitations to undertake semi-structured interviews were shared with Sunshine Coast Councillors.

Online surveys: Survey data was captured using the online survey software tool, Qualtrics™. The survey included qualifying questions to include those aged 18 years and over who live on the Sunshine Coast. The survey included a brief project summary, Research Project Information Sheet, and request for consent to participate. Online surveys featured open (qualitative) and closed (quantitative) questions relating to:

- Participant characteristics (demographic data)
- Knowledge, awareness, and attitudes in relation to regional flying-foxes (RFF)
- Proximity to RFF
- Recall of SCC RFFMP and communication campaigns
- Opinions and recommendation for improving awareness of SCC RFF and the RFFMP.

Sunshine Coast Residents: Survey invitations were shared online via Sunshine Coast Council social media posts and website. The online survey was available between August and October 2022. In addition, invitations were offered to visitors to the Caloundra Music Festival (Sep 31- Oct 2, 2022) who attended the Sunshine Coast Council event stall. A total of 420 people attempted the survey. Of these, 364 (86.6%) valid surveys were included for analysis (Table 2).

Not-for-profits groups: Using a purposive sampling method, a total of seven Sunshine Coast NFP groups were invited by email to complete an online survey. All four completed responses were included.

Sunshine Coast Councillors: The Sunshine Coast region has 10 divisional Councillors. All were invited to take part in an interview with researchers with four (40%) choosing to do so. Semi-structured interviews were conducted with Sunshine Coast Councillors, identified through a purposive sampling method. Invitations were sent to all ten Councillors by email. Each interview took 30 minutes and was conducted via video conferencing using Microsoft Teams™. All interviews were carried out between August and October 2022 focused on gaining insights into participants:

- Knowledge, awareness, and attitudes in relation to regional flying-foxes
- Awareness of SCC RFFMP and communication campaigns
- Recommendation for improving understanding of flying-foxes

Table 2 Participant numbers by stakeholder group.

Sample group	Number (n=)
Sunshine Coast Residents	364
Not-for-profit	4
Sunshine Coast Councillors	4
Total	372

Data Analysis

Data collected was analysed using various software tools e.g., Excel, and SPSS (v22). Descriptive and statistical analysis was conducted on the survey data and thematic analysis was used to examine the interview data. Variability in response rates for each question is noted.

Findings

Document analysis summary

The wide range of media and techniques used by SCC to communicate flying-fox related messages are detailed in the draft Communication Plan 2021. Each is intended to reach one or more specific audiences at a particular stage in the different flying-fox lifecycles. The range of (largely online) media include:

Written material

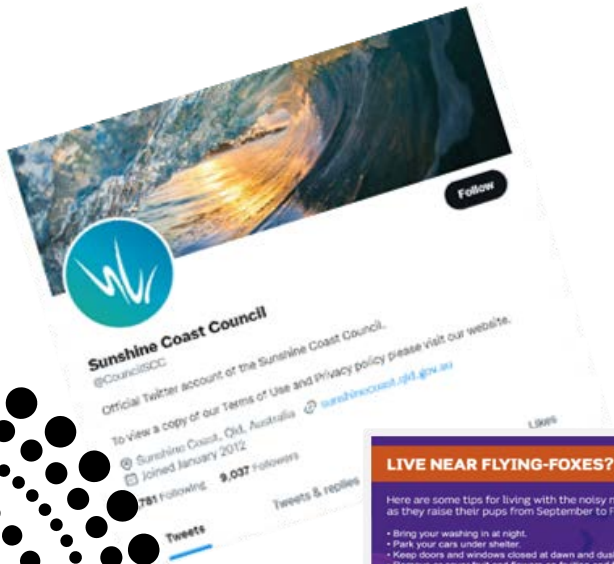
- Flying-fox flyers
- SCC Website with flying-fox content
- SCC Social media sites

Audio-visual

- Social media: Facebook and Instagram posts including videos
- YouTube videos relating to flying-fox ecology and conservation awareness

Signage

- On-site signage in visitor centres
- Posters/signage in libraries and information centres



Findings

Document analysis summary

The latest communication plan documentation identifies eleven 'key messages', each relating to the overarching importance of flying foxes to the ecosystem and human-flying-fox interface (Table 3).

Table 3 Key message themes from Draft Communication Plan 2021.

	Key message
1.	Council acknowledges psychological, social, and economic implications of living near a flying-fox roost.
2.	SCC has developed a Regional Flying-Fox Management Plan (RFFMP) providing management guidelines consistent with state and commonwealth legislation and attempts to mitigate impacts for residents living near problematic urban flying-fox roosts.
3.	To avoid escalating and compounding urban flying-fox conflict, non-lethal dispersal (if utilised) is being considered a last resort management action by SCC and will be informed by clear guidelines.
4.	Non-lethal dispersal may only have short-term benefits or displace problems elsewhere.
5.	Flying-fox numbers can vary according to season, roost condition and flowering periods however generally flying-fox numbers are not increasing on the Sunshine Coast
6.	It is not yet possible to control or easily predict where flying-foxes will roost.
7.	A Flying-Fox roost is a site where flying-foxes congregate during the day to rest. These roosts may be occupied seasonally or at some sites remain occupied for most of the year.
8.	Q Health advises that while Flying-foxes can carry Hendra Virus and Australian Bat Lyssavirus health issues are manageable and preventable, advice on precautions to avoid risk of infection found on web site http://www.health.qld.gov.au/communicablediseases/hendra.asp
9.	Flying-foxes are the only long-distance nocturnal pollinators for several Eucalypt species and therefore critical in ensuring the health and long-term survival of our Eucalypt forests.
10.	The GHFF is considered to exist as a single national population and there are three roosts on the Sunshine Coast which are identified as important to the national population.
11.	All flying-fox species move in response to food availability and changes in surrounding roost habitat.

Messages should be tailored to the audience and framed in a way that connects to their interests or concerns (Kusmanoff et al. 2020). Therefore, strategically framing a message requires determining the target audience and the best way to engage them, clarity of objectives, and audience outcomes, and once engaged, recognising the best messenger for continued engagement (Kusmanoff et al. 2020). The Sunshine Coast Council region has a distinct mix of audiences who, in the past, have responded to the flying-fox management in a variety of ways, reflecting the diversity of perceptions, attitudes, and behavioural norms (Econnect 2016). The reviewed document highlighted the importance of communication for achieving conservation aims and co-habitation between residents and flying-foxes. Designing, delivering and management communication to facilitate deep listening, responsiveness and timely information is a key aim outlined in the Sunshine Coast Council Communication Plan.

Participant characteristics

As knowing the audience is a key part of communication, demographic characteristics of participants were collected.

Sunshine Coast residents: Online survey participants

Demographic characteristics revealed participants in the survey mostly identified as female 71% (n=259) (Figure 9). Age distribution was across all groups from 18-85+ with 60% aged between 45 and 74 years (n=218) (Figure 9).

Of the 364 participants, most live in the Sunshine Coast region corresponding to the postcode 4551 (n=88; 23%). This was followed by 4560 (n=34; 9%), 4556 (n=33; 9%) and 4552 (n=29; 8%).

Most participants have lived on the Sunshine Coast for more than 10 years (n=222; 62%) with an average 17.39 years. Over a fifth of the 361 participants answering this question were long term residents of 26 years or more (n=79; 22%).

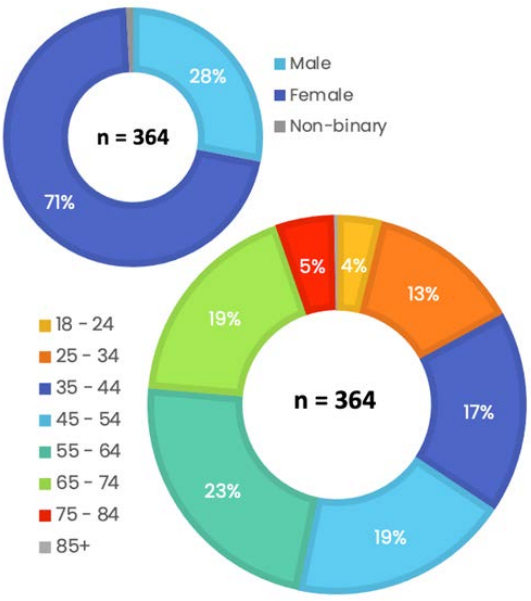


Figure 9 Age and gender breakdown of respondents in group.

Not-for-profits: Online survey participants

Seven local not-for-profit groups (NFP) were sent emails inviting staff and volunteers to complete an online survey. Four participants, who identified as female, aged between 45 to 74 years, provided responses. Participants had been working/volunteering in a group associated with flying-foxes for six years (n=1), eight years (n=2) and 10 years (n=1) in roles that included, flying-fox rescue services (*24 hr phone hotline*), operations such as rehabilitation and release (*raising orphans and orphan release site*), official positions (*President, Education Officer, Media Officer*), triage, transport (*to Zoo etc for medical attention*), *mentoring new carers, school talks, and community events such as World Environment Day, Bat Night, Library talks.*

Sunshine Coast Councillors

Six of the 10 Sunshine Coast Divisional Councillors responded to the invitation, with four completing an interview.

Participant characteristics

Nature connectedness

Previous studies have found a positive correlation between connection to nature and a higher motivation to show environmentally friendly behaviour. To gain an understanding of participants' connectedness to nature, the Inclusion of Nature in Self Scale (Figure 10) (Schultz 2002), a self-report survey question was incorporated. The scale contains a series of seven overlapping circles labelled self and nature. An individual who feels themselves as part of nature would likely have knowledge, beliefs, values; see themselves as the same as nature of self and nature that highly overlap (score of 7). Conversely, an individual who feels they are not part of, or are separate from nature, would have no points of intersection (score of 1) (Figure 10). Three hundred and five (84%) of the 364 participants indicated a moderate to high connection to nature scoring 4 to 7 with an average score of 5.20. Thirty-three (9%) participants see themselves as separate from nature with no points of intersection.

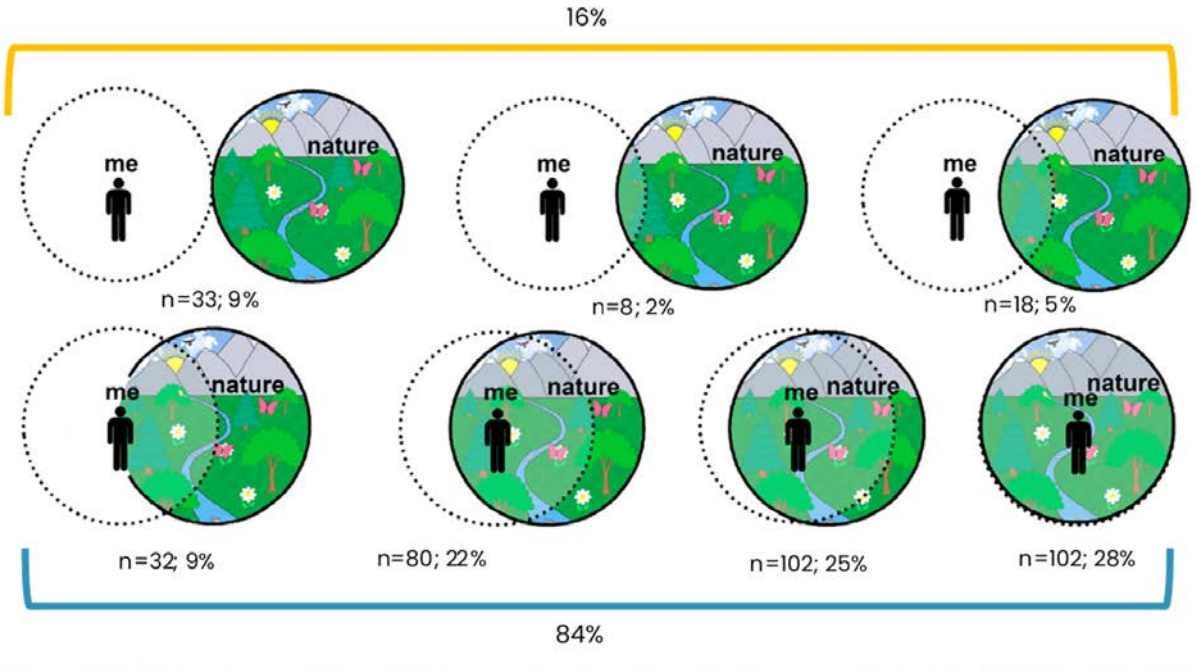


Figure 10 Participant perceptions of their connectedness to nature. Images adapted from the Illustrated INS (IINS).

Flying-fox sightings on the Sunshine Coast

All three species of flying-foxes (BFF, GHFF and LRFF) found on the Sunshine Coast throughout the year have been sighted by participants, with the GHFF seen most often (Figure 11). Forty-four percent (n=158) had seen flying-foxes but did not know what species they were. Only six (2%) participants had not seen flying-foxes on the Sunshine Coast.

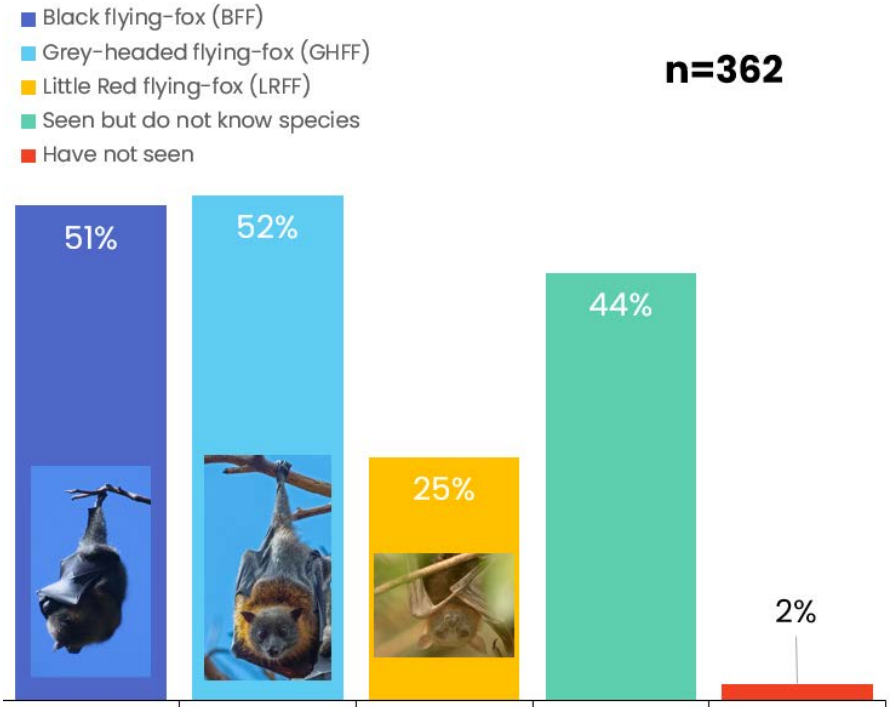


Figure 11 Flying-fox species seen on the Sunshine Coast.
Image credit BFF (S.Dixon, Unsplash), GHFF (R. Riegal, Unsplash) & LRFF (Dr Julie O'Connor)

Flying-fox sightings are frequent. Participants reported regular sightings (seasonally or monthly) (n=141; 42%) with a fifth seeing flying-foxes daily (very often) (Figure 12). Weekly (often) sightings were common as were occasional sightings (Figure 12). Frequent sightings are reiterated with comments such as *so many about*, and *the sky is lit up with flying-foxes.*

Also, *how few we see now*, and *I have not seen many of them at all, why is that*; participants *haven't seen then for a while wonder what happened to them and if they'll be back* and *wondering when they would return to the trees they hang out in.*

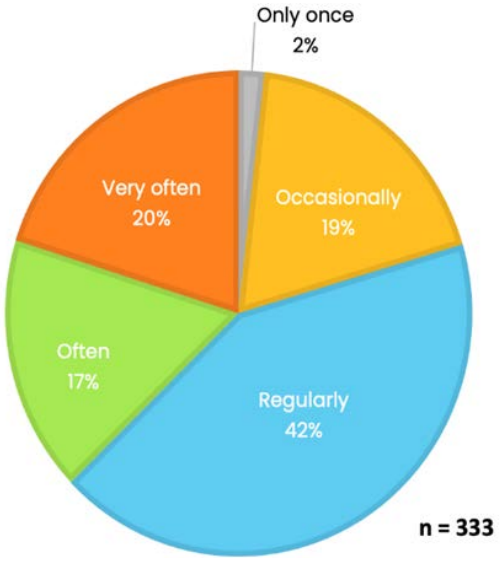


Figure 12 Frequency of flying-fox sightings on the Sunshine Coast.

Flying-fox sightings on the Sunshine Coast

Participants indicated that they had seen flying-foxes across 73 different locations indicating the sightings spanned across the Sunshine Coast regions (Figure 13).

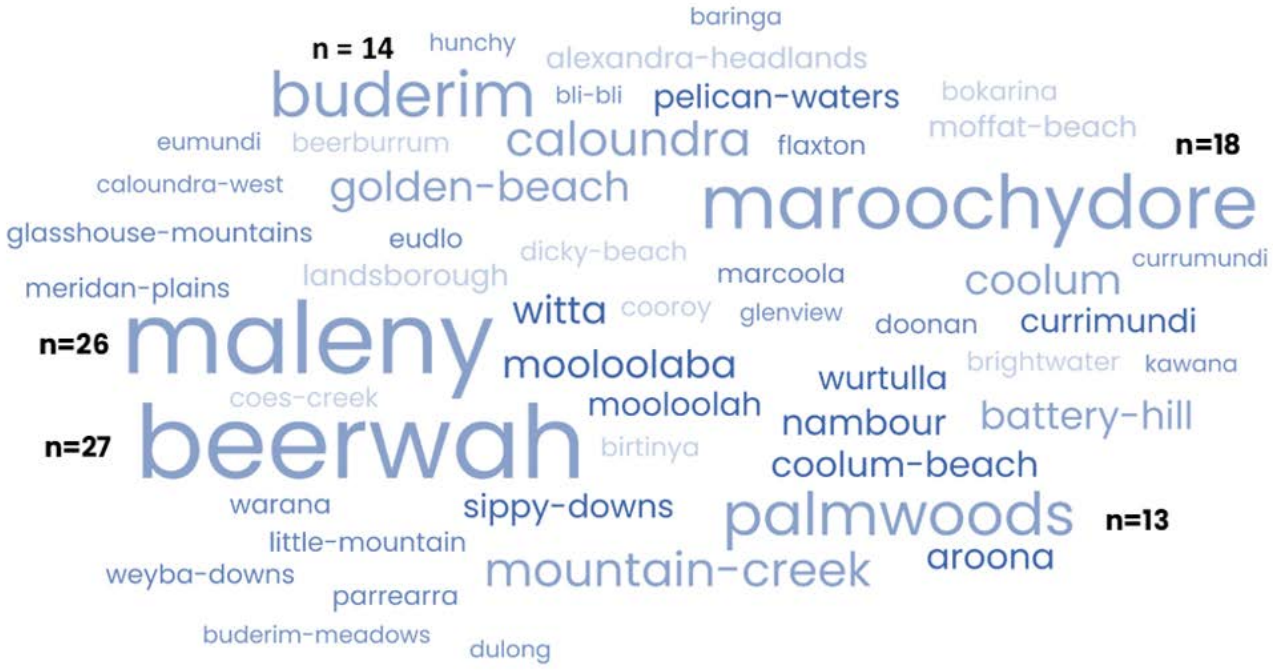


Figure 13 Location of flying-fox sightings on the Sunshine Coast. (NOTE: the larger the location name, the higher the frequency of sightings).

Proximity to flying-fox roosts

Expanding regional populations see humans living in proximity to wildlife including flying-foxes. A lack of understanding of flying-fox mobility exists. Australian flying-foxes are one of the most mobile animals with foraging trip ranges of up to 120 km in a single night and flying-foxes may travel thousands of kilometres each year. Roosts can be active for decades and host a changing roster of individual animals. Roost populations change in response to the availability of food sources.

Participants were asked if they live in proximity to a flying-fox roost. Of the 322 who responded to this question, 164 (51%) responded no and 158 (49%) responded yes.

Of those who said they did live close to a roost, most lived within 500 meters (n=95; 63%), while over a third (n=57; 38%) lived more than 500 meters from a roost (Figure 14). Almost three quarters of participants indicated they lived near a roost for less than 15 years (n=89; 70%) (Table 4). Of those who live near a roost, 106 (71%) knew the roost was there before they moved in. Almost one third (n=44; 29%) did not know the roost was located near their home until after they had moved.

Table 4 Number years living in proximity to flying-fox roost.

No. Yrs. Near Roost	No. Participants	% Responses
0-4	37	29%
5-9	33	26%
10- 14	19	15%
15-19	9	7%
20-24	14	11%
25-29	3	2%
30-34	5	4%
35-39	1	1%
40-44	1	1%
45-49	0	0%
50	5	4%

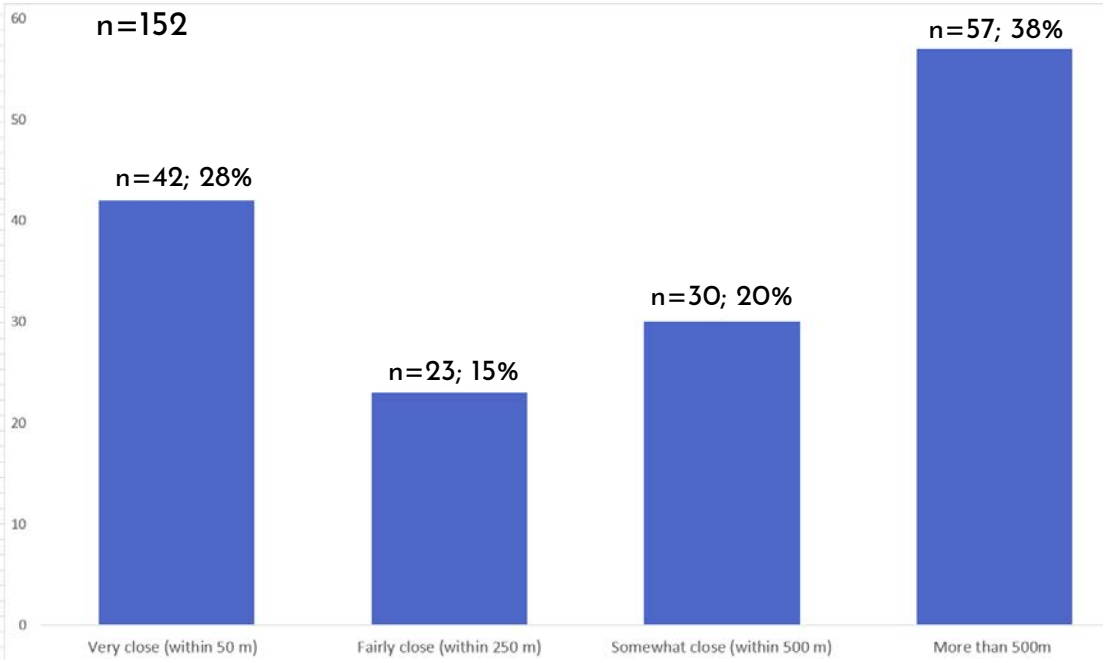


Figure 14 Number participants living in proximity to flying-fox roost.

Knowledge, awareness, attitudes of regional flying-foxes

As part of understanding the audience, participant knowledge, awareness, and preferences were explored in a variety of ways, commencing with thoughts and triggers of thoughts about flying-foxes.

Thoughts about flying-foxes and associated triggers

To gain insights into participants perceptions and opinions of flying-foxes, participants were asked if they had thought about flying-foxes in the past three months. Over three-quarters (n=268; 79%) said yes, they had thought about flying-foxes in that timeframe (Figure 15). In addition, thematic analysis was conducted on the 278 comments highlighting the triggers of thoughts about flying-foxes.

Triggers predominantly related to **seeing or hearing** flying-foxes (n=127):

- in backyards

I think about them regularly particularly after seeing or hearing them in the trees out the back

- flying overhead

seeing flying-foxes flying overhead at sunset
I saw one in flight during an early morning dog walk. I think they're special and misunderstood
"Fox" was flying above me at sunset

- eating fruit/pollen from trees

mulberries coming into bud, these have sustained flying foxes in the drought a few years ago
their ability to disperse the seed of native plants

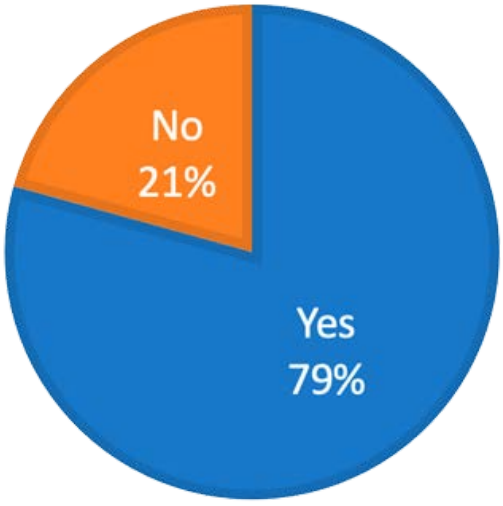


Figure 15 Number participants who had thought about flying-foxes in past 3 months.

Also

- with the approaching Little Red season (n=15)
- when flying-foxes come close to residents' homes (n=13)

Furthermore,

- Positive responses included expression of feelings (n=24)

I love flying-foxes, flying-foxes are very cute, seeing flying-foxes makes me happy
Flying-foxes are misunderstood little cuties who don't get enough credit

- Concerns were expressed for flying-foxes (n=22)

I feel their numbers are reducing
I am concerned at community misunderstanding
I think of their welfare

Thoughts about flying-foxes and associated triggers

Thoughts of flying-foxes were triggered when:

- seeing specific plants flowering which triggered thoughts about the environmental benefits flying-foxes have (n=16) for example pollination

they visit our mandarin tree

- thinking about or being reminded of other species which triggered thoughts about the connection flying-foxes have to the survival of other species (n=8) (flora and fauna) in particular, koalas

- participants heard or engaged in community discussions (n=10), education activities (n=2) and the media (n=2)

seeing them, and also talking to others about pollination of native plants

Figure 16 Flying-fox thought triggers.

Thoughts about flying-foxes and associated triggers

Most negative comments were about:

- flying-fox biology (e.g., morphology, physiology, anatomy, behaviour, origin, and distribution) (n=19)

drove past an area that had the flying fox odour and was just thinking that there were flying-foxes about
concern for self, other people (impacts on health, safety, wellbeing related to noise)
worry about increasing numbers and how roosting areas become uninhabitable
they're noisy and smelly
their unbearable screeching at night and hoping that they are not dropping their disease-ridden waste on my roof to contaminate my drinking water catchment area. concerned about their destruction of natural forestry and foliage

- concern for property (removing faeces) (n=22)

the number of them. There were a lot. The smell was unpleasant. They were noisy. I'm glad I don't own a property where they were congregating
when having my roof cleaned
I hear them most nights in a nearby Ficus tree, I worry that they could set up a colony near me and reduce the value of my property

Thoughts about flying-foxes and associated triggers

Mixed sentiment responses demonstrate the conflicted opinions of participants such as:

- *Flying Foxes/bats used to eat about 20%* [of bananas] *and I was happy to share. This winter however they are squealing away at night eating very unripe hard green bananas very early. They leave nothing. So, I commented to a friend they may be starving so I'll let them eat 100% for a while before I attempt to cover and protect some*
- *Thinking about habitat loss; seeing clawed and half-eaten paw paws*
- *Don't like to have all there vomit everywhere and the palms are just too close. Couple of years ago we had over 20 in each tree they came for some refuge cause of development going on somewhere (maybe you should be surveying development cause that's the problem) so I think of them all the time cause don't like all their activity too close to our veranda. But I am aware they are precious, and they are pollinators*
- *Don't mind them, they are wildlife in Sunshine Coast. It is interesting to watch them as they are so different to other animals. Also their breeding/sleeping sites smell sometimes a bit too strong. But I guess that is part of living around wildlife*
- *Lovely to see and hear them - but they don't roost close to my home*
- *Seeing their poo on my car and looking at the HUGE loss of habitat from urbanisation*
- *I was thinking about how wonderful they are as part of the interconnected ecosystem they play a key role in sustaining. But also, how smelly camps can be near built up areas*
- *Noise and smell but I still love them*
- *While an important part of the ecosystem, flying-foxes are destroying the trees in the roost beside Obi Obi creek in Maleny township*
- *Vectors for disease but important for pollination*
- *A friend said what pests they were. I told her how important they are to eucalyptus tree propagation.*

Comments highlighted the removal of trees to reduce proximity to flying-foxes:

- *Removing orange trees from my backyard due to flying foxes eating from them*
- *We have ripped out any fruiting trees in our garden to deter them (I don't go out when they are around. They have impact on me and my family)*
- *I am trying to decide if there is enough food for them if I cut the palm seeds off my palms*
- *Unit manager wants to cut down a tree that attracts them*

Also,

- *I noticed the local shop had installed a large bright light to stop the flying foxes nesting in their fig tree*

Knowledge

Sunshine Coast Councils' conservation management communication and awareness campaigns were designed to increase Sunshine Coast residents' understanding and appreciation of the essential ecological role of flying-foxes and the need for conservation efforts (RFFMP objective) (SCC 2016). Participant knowledge was explored to ascertain the effectiveness of communication efforts.

Self-identified level of knowledge

Increases in knowledge and awareness may enhance pro-environmental attitudes and behaviours. Understanding where the audience is at, can aid in directing resources to gaps in knowledge. Based on a scale of 0 (no knowledge) to 10 (extremely knowledgeable), most participants have moderate to high knowledge of flying-foxes (Figure 17). Less than one-third had lower levels of knowledge with only four participants having no knowledge of flying-foxes.

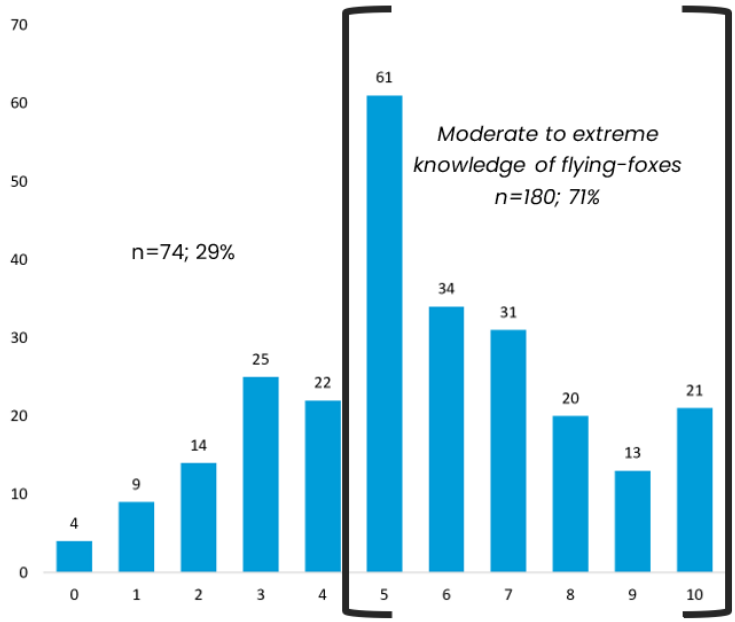


Figure 17 Levels of participant knowledge of flying-foxes.

The Queensland government department of Environment and Water (2022) states that "from a public health perspective, in almost all circumstances there is no reason to be alarmed if a colony of flying-foxes moves in nearby. Catching diseases directly from flying-foxes is extremely unlikely". Despite the availability of information, the previous comments (triggers to thoughts about flying-foxes) highlight the variability in understanding. Eight comments raised concerns about misinformation and flying-foxes being misunderstood.

Knowledge: True and False Statements

To further examine knowledge, true/false and agreement statements using a 5pt scale to offer insight to participant's level of knowledge. Nine statements (eight true and one false) were offered, to which participants could respond with True, False or Unsure (Figure 18).

1 True - FF play a critical role helping to keep our native forests healthy
2 True - Without FF, there would be no food and shelter for our koalas
3 True - FF are wild, seasonal animals
4 True - FF are nocturnal animals that fly out from their roost sites at sunset
5 False - FF numbers are increasing
6 True - Council routinely monitor FF roosts to identify FF movements
7 True - FF usually give birth to one 'pup' each year
8 True - FF pups drink milk from mum's teat, which is in her armpit
9 True - FF give birth to their young whilst hanging upside-down

High knowledge is evident in four of the statements:

- flying-foxes are nocturnal animals that fly out from their roost sites at sunset (Statement 4: n=312/320; 97%)
- flying-foxes play a critical role helping to keep our native forests healthy (Statement 1: n=271/319; 89%)
- flying-foxes are wild, seasonal animals (Statement 3: n=228/319; 71.5%)
- flying-fox pups drink milk from mum's teat, which is in her armpit (Statement 8: n=206/321; 64%)

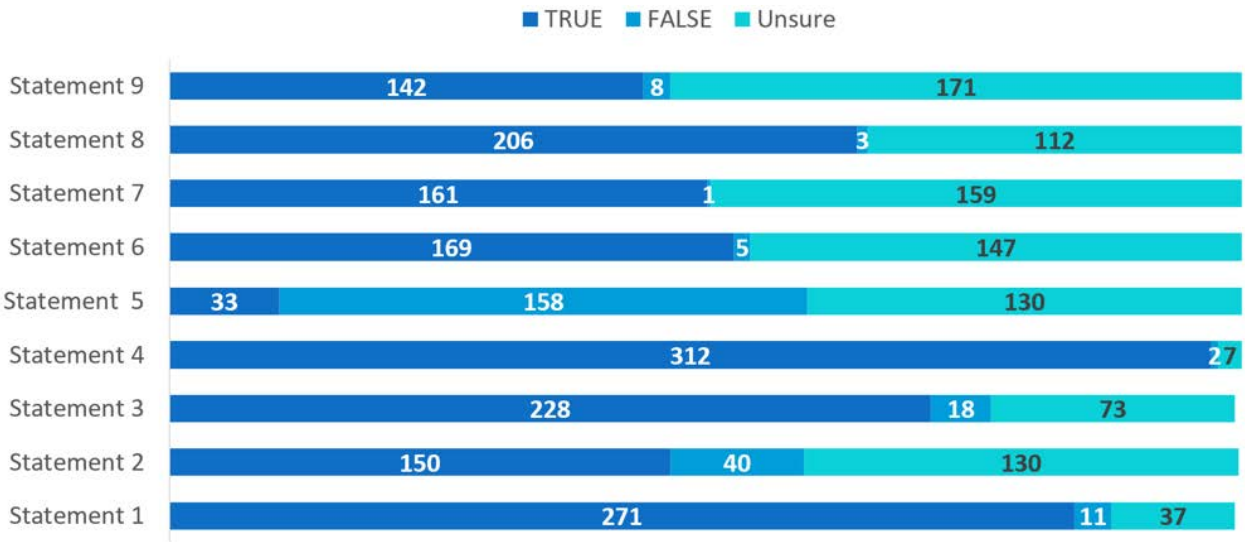


Figure 18 Participant responses to true/false statements.

Knowledge: True and False Statements

Three other statements received divided responses:

- Flying-foxes usually give birth to one 'pup' each year (Statement 7: true (n=161/321), false (n=1) and unsure (n=159)
- SCC routinely monitor flying-fox roosts to identify flying-fox movements (Statement 6: true (n=169), false (n=5) and unsure (n=147)
- Without flying-foxes there would be no food and shelter for our koalas (Statement 2: true (n=150), false (n=40) and unsure (n=130)
- Flying-foxes give birth to their young whilst hanging upside-down (Statement 9) received divided responses with more participants choosing false (n=171/321; 53%).

Responses were divided for the false statement (#5),
flying-fox numbers are increasing:
33 participants chose **true**
158 were **unsure**
130 chose **false**

Eleven statements were offered, to which participants indicated their level of agreement on a 7-point scale from strongly agree to strongly disagree (Table 5).
The statements were:

1 Flying-foxes play an important role in the environment
2 Flying-foxes are important for the functioning of our ecosystem
3 Conservation of flying-foxes is important
4 Humans should protect flying-foxes
5 Spaces should be set aside for flying-fox conservation
6 Humans must learn to coexist with flying-foxes
7 Flying-fox excrement is a source of good fertiliser
8 I do not like flying-foxes
9 Flying-foxes attract other species such as rats
10 Flying-foxes pose a threat to the animals where I live
11 We should not be concerned about the habitat of flying-foxes

Table 5 Participant responses to eleven statements about flying-foxes.

Statement	1	2	3	4	5	6	7	8	9	10	11
Strongly disagree	9	9	10	12	10	20	24	173	113	146	184
Somewhat disagree	3	6	12	15	5	9	15	21	35	35	27
Neither	18	18	12	13	15	12	104	26	90	47	13
Somewhat agree	27	22	22	21	33	26	32	19	9	13	16
Strongly agree	198	199	199	193	190	188	80	16	8	13	15
Total (Mean)	255 (4.58)	254 (4.56)	255 (4.52)	254 (4.45)	253 (4.53)	255 (4.38)	255 (3.51)	255 (1.76)	255 (2.07)	254 (1.87)	255 (1.63)

Knowledge: Agreement Statements

The statements to which participants strongly agreed were:

- Flying-foxes are important for the functioning of our ecosystem (n=199; av. 4.56)
- Conservation of flying-foxes is important (n=199; av. 4.56)
- Flying-foxes play an important role in the environment (n=198; av. 4.58)
- Humans should protect flying-foxes (n=193; av. 4.45)
- Spaces should be set aside for flying-fox conservation (n=190; av. 4.53)
- Humans must learn to coexist with flying-foxes (n=188; av. 4.38)

The statements to which participants strongly disagreed were:

- We should not be concerned about the habitat of flying-foxes (n=184; av. 1.63)
- I do not like flying-foxes (n=173; av. 1.76)
- Flying-foxes pose a threat to the animals where I live (n=146; av. 1.87)
- Flying-foxes attract other species such as rats (n=113; av. 2.07)

For Statement 7, most participants stated they neither agreed nor disagreed that flying-fox excrement is a source of good fertilizer.

Of the remaining participants, more participants agreed (n=112) than disagreed (n=39). It is noted that a few participants commented they did not know the answer so chose neither agree nor disagree.

Knowledge: Causes of flying-fox deaths

To further understanding participants knowledge of flying-foxes and communication effectiveness, using an open-ended question, participants provided their perceptions on the main causes of flying-fox deaths (Table 6 and Figure 19).

A total of 366 participants provided 929 responses which included 87 (9.4%) who responded with not applicable. One hundred and six Don't know responses were provided (11.4%).

Habitat loss and destruction (n=124; 13.3%) was the most frequently identified cause of death. *Heat, electrocution, barbwire fence entanglement, starvation, humans, domestic pets, being hit by a car* and *fruit tree netting entanglement*. *Disturbance of young, age, feeding on introduced species, constant disturbance, cyclones, infant mortality, being orphaned, fighting with each other, eradication and noise pollution* were all mentioned once (n=1; 0.1%).

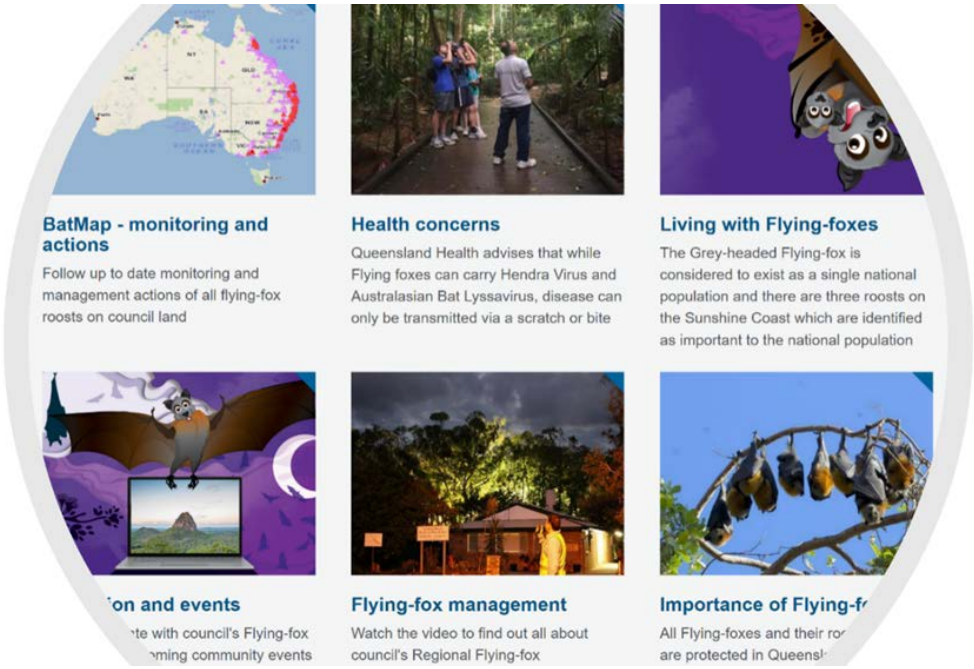
Table 6 Participant knowledge of main causes of flying-fox deaths.

Main causes of flying-fox deaths	n=	%
Habitat loss/destruction	124	13.3%
Heat	107	11.5%
Electrocution	61	6.6%
Barbwire entanglement	58	6.2%
Starvation	57	6.1%
Humans	41	4.4%
Dogs	41	4.4%
Cats	40	4.3%
Cars	39	4.2%
Net entanglement	33	3.6%
Disease	19	2.0%
Poison	17	1.8%
Weather	15	1.6%
Shooting	12	1.3%
Lyssavirus	9	1.0%
Pythons	9	1.0%
Climate change	8	0.9%
Dehydration	8	0.9%
Drought	5	0.5%
Shooting	3	0.3%
Cold	3	0.3%
Lack/poor roosting sites	3	0.3%
Predators	3	0.3%
Don't care	3	0.3%
Fires	3	0.3%
Glass pool fences	2	0.2%
Ticks	2	0.2%

Figure 19 Participant knowledge of main causes of flying-fox deaths.

Recall of SCC communication campaigns

When evaluating the effectiveness of communication programs, awareness and recall of community campaigns by participants offers insight to the memorability of information shared and the sources of recalled information. Presenting information and conservation messaging to the public with maximum fidelity is essential for science communication (Dornan 1990; Durant et al. 1989). What participants can recall (memory) is one way of assessing learning (Sternberg 2003). Furthermore, recall can help assess the potential success of conservation-based communication programs by offering insights into what information was understood (cognition) and stored in participants' long-term memory.



Source: SCC 2022. https://www.sunshinecoast.qld.gov.au/Environment/Native-Animals/Flying-Foxes

Participants were asked if they had seen any communication campaigns provided by Sunshine Coast Regional Council about flying-foxes in the last five years. Over half (n=186/316; 59%) responded no. For those who responded, yes, participants stated multiple examples of where they had seen/heard flying-fox content.

Recall of SCC communication campaigns

One hundred and thirty participants said they had seen Sunshine Coast Regional Council flying-fox-related communication campaign content.
As an open-ended question, multiple answers were permitted resulting in 315 responses. Thematic analysis of these responses revealed ten source types (Table 7). Analysis revealed most participants had seen information via social media posts and websites such as Sunshine Coast Regional Council pages (n=58; 18%). Increasing social connectivity via social media and mobile platforms. Conservation action can utilise these platforms to foster cost-effective campaigns, deliver rapid science communication, and engage a diversity of stakeholders, actors, and stewards (Theobald et al. 2015).

Community events (n=55; 17%), newsletters (n=46; 15%), and other sources such as conversations with Council officers, friends, and signage (n=31; 10%) were also sources of information identified by participants. Radio (n=19; 6%) and television (n=12; 4%) were least often identified as information sources.

Table 7 Sources of information participants had seen flying-fox information.

Source of SCC flying-fox communication	n =	%
Website and/or social media (e.g., Facebook, YouTube, SCC website)	58	18%
Community Event e.g., Talk at Maleny Community Centre by Les Hall, Environment festival at Cotton Tree, SC Council stall at Music Festival, Barung meeting, the Qld Garden Show, Bat Day/night, World Environment Day event, talk at Mary Cairncross Scenic Reserve, at the Nambour Garden Expo, local school event, saw Frankie at a talk by SC Council officer, Land for Wildlife display, Coolum Coast care family workshop	55	17%
Newsletters e.g., SCC Weekly Newsletter, from Land for Wildlife, Bush hands, SCC, letterbox drops, Barung Landcare	46	15%
Other e.g., Friends who are wildlife carers, a local real estate agent, sign near roost, word of mouth, conversations with friends, phone call with SC Council, UniSC, my workplace, tourist cabins, discussions at SC Airport,	31	10%
Posters e.g., at Barung Landcare, the Nambour Garden Expo, Maleny Wood Expo Council information day, local Library, Mary Cairncross Scenic Reserve, around town	28	9%
Newspaper e.g., Hinterland Times and Glasshouse Country, Maleny News, Local paper, Sunshine Coast Daily, Courier Mail, My weekly preview, Cairn's post	23	7%
Volunteer event e.g., helping to count flying-foxes April 2022 Kawana event for BushCare volunteer leaders, Nambour show	22	7%
Local library e.g., Education talk, workshop, leaflet	21	7%
Local radio e.g., ABC	19	6%
Television e.g., ABC, Channel 7 news, Local news	12	4%

Recall of SCC communication campaigns

In addition to recalling having heard/seen flying-fox information and the source of said information, participants were also asked to reflect and recall what they remembered seeing/hearing about flying-foxes. Participants recalled information about flying-foxes was dominated by three themes: flying-fox ecology and biology, management strategies and human actions.

Flying-fox ecology and biology

According to the comments provided by participants, flying-foxes are:

- beneficial to the ecosystem (n=14)
- good for nature as they disperse seeds and pollinate (n=10) and
- endangered (n=5)

Other recalled information included the importance of flying-foxes to human survival (n=3), and that flying-foxes are *intelligent, cute, social creatures that have personalities*; are *Australia's only nocturnal pollinators that move between roosts* (n=3), *travel vast distances* (n=2) and *without Flying foxes we may not have a number of our Hardwoods*.

Individual participants recalled hearing about the nesting behaviours of flying-foxes and information about how flying-foxes roost; that the Sunshine Coast is home to three different species (n=3) and faeces does not transmit disease.

Management strategies

Information that participants had seen or heard concerning flying-fox management included the need to:

- protect flying-fox habitats (n=3)
- monitor flying-fox populations, and
- the difficulty of controlling flying-fox movements

Specific Sunshine Coast Regional Council strategies recalled included:

- the management of unsuitable colony locations with smoke
- the role of council in keeping flying-foxes cool when roosting and

that the threatened status of some species mean Council management is complex

Recall of SCC communication campaigns

Human actions

Information that participants had seen or heard concerning human actions involved:

- not to handle them (n=5)
- to call *Wilvos* or similar if there is one that is injured (n=2)
- the need to co-exist with flying-foxes (n=4), greater understanding (n=2) and the need to be more tolerant
- to keep clear of roosting and nursery sites during the day when the Flying foxes are resting and
- to change perspective for example when trees are temporarily damage, treat it as a pruning and recover activity.

Participants recalled hearing people say *they are disease carriers* (Alyssa virus) and *should be moved on* and that *flying-foxes will become too many* and be *given priority over peace and quiet and residents will be forced to sacrifice land value to cater for them*.

Others recalled they had mostly heard people complaining about the noise and smell. One participant comment highlights the challenge of co-existence: *I know flying-foxes will move as they are looking for a new feeding habitat, but I want them to go asap*.

Based on content provided by Sunshine Coast Regional Council on the Living with Flying-foxes webpage, some recalled information may be inaccurate or misinterpreted, for example *flying-foxes return to their same roost always, so moving them somewhere else isn't an option* and *flying-foxes are detrimental they are to the ongoing rehabilitation of our native ecosystems*.

Effectiveness of flying-fox communication

Based on the communication seen or heard about flying-foxes on the Sunshine Coast, participants were asked to indicate how effective the information was for increasing their knowledge of flying-foxes (Figure 20).

Reviewing the 121 responses, 88% (n=107) indicated the information had some degree of effectiveness for increasing their knowledge of flying-foxes: information seen/heard was moderately (n=27; 22%) or very effective (n=40; 33%).

88% said information was effective in increasing their knowledge of flying-foxes

Figure 20 Effectiveness of the SCC flying-fox communications.

Interview responses highlighted that the information heard/seen was effective (n=4) and assisted to:

- *increased [my] understanding about the limitation for managing flying-foxes under the Act*
- suggest *that people have high expectations about what Sunshine Coast Regional Council can do* (without necessarily knowing or understanding of what the legislative requirements are) and
- *increase residents' knowledge about flying-foxes and needs to increase acceptance to be able to live together*

Also,

- *raising the need to have one on one and targeted group discussions and*
- *Yes, when information is presented in a fun way, it sticks (referring to examples such as the Maleny events and Nambour Garden Show)*

Awareness of SCC RFFMP

Participants were asked if they were aware of the SCC RFFMP. Sunshine Coast Regional Council outlines the response to community concerns about flying-foxes in the RFFMP which include actions such as conducting meetings on site with residents to assess specific situations, the implementation of education, and signage, and if required, early intervention, and site-specific actions. Awareness of these actions and the RFFMP is an integral part of community communication efforts for conservation.

Of the 317 participants who provided a response, two thirds were unaware of the plan (n=203; 64%) (Figure 21).

The 114 participants indicating they were aware of the SC RFFMP, were asked to briefly explain how they found out about it. Of these, 106 participants (93%) provided responses. Information provided by Sunshine Coast Regional Council created the most awareness of the Plan.

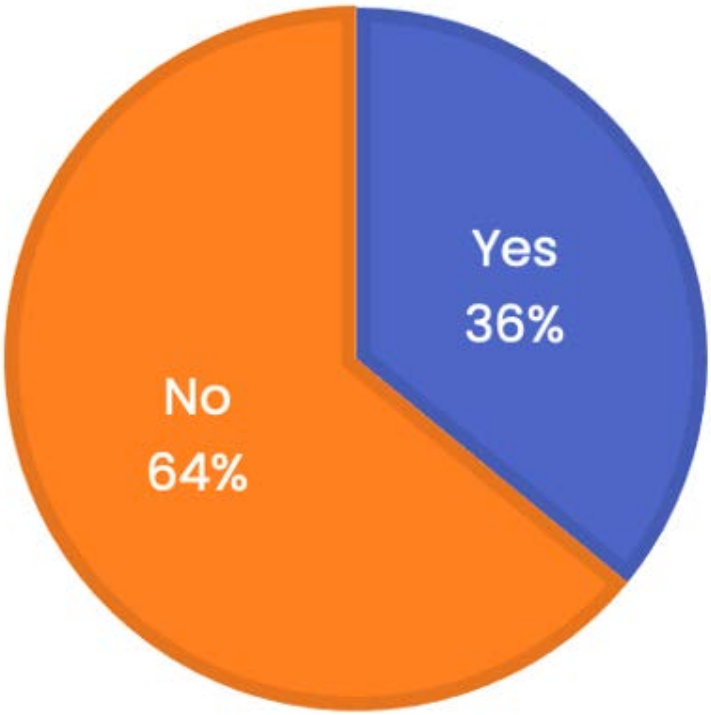
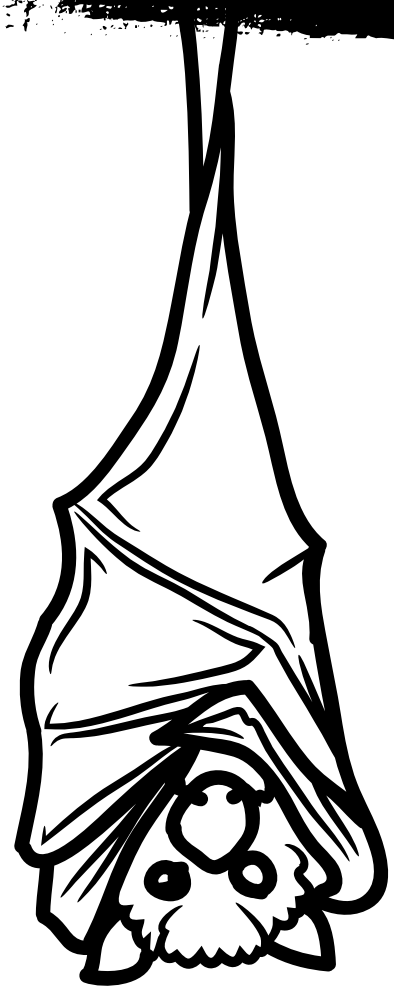


Figure 21 Number of participants who are aware of the SC RFFMP.

Recall of SCC RFFMP

A variety of Council originating sources were provided:

- Stalls and presentations hosted by SCC (n=16): workshop, information session at Maleny, Bat night, Land for wildlife program, Nambour Garden Expo, Maroochy Botanical Gardens, Landcare, Hardy Buzzacott reserve, Caloundra Music Festival (n=2)
- Talking to an environmental officer (n=10)
- Internal presentation
- Newsletter (n=3): Bush hands (Bush link)
- Corporate orientation
- Emails (n=2)
- SCC Website (n=18)
- Letter/Letterbox drop (n=2)
- Meeting about roosts (n=2)
- Speaking with a Councillor
- Social media (n=3)
- BushCare Coordinator's meeting



The SCC RFFMP is a 73-page report so needs to be broken down so people can read it.

People are so busy and overloaded with information it is difficult to get their attention if the issues is not theirs.

Awareness of SCC RFFMP

In addition, awareness of the RFFMP was gained through being a Sunshine Coast Regional Council employee (n=12), and from working or volunteering in relevant fields (n=5) such as ecologist, carers and wildlife hospital staff. Community engagement also served to raise awareness of the RFFMP with participants via bat rescue groups (n=3) and bat carers class, friends/family/neighbours/colleagues (n=6), a U3A presentation, and University presentation.

Participants did their own personal searching and used internet/online searches (n=8) that lead to raising awareness of RFFMP. Further, awareness was gained by reading the National Flying Fox management plan online and through a university assignment.

Finally, the media assisted to raise awareness of the RFFMP:

- Not specified (n=5)
- TV: Local news (n=2) stories of people's homes and town areas being swamped with FF colonies and councils in the areas concerned planning to move them. Not specifically SCRC
- Radio: Mentioned in connection to problematic roosts
- Local paper (n=4)

SCC Website (2022): page features the RFFMP
Source: https://www.sunshinecoast.qld.gov.au/Environment/Native-Animals/Flying-Foxes/Flying-Fox-Management

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Receiving more information about SCC RFFMP and flying-foxes

All participants were asked if they would like to receive more information about the SCC RFFMP and flying-foxes. In both cases, most participants said they would like to receive more information.

With regards to receiving more information about the RFFMP, over half (n=168; 54%) of the 314 participants said they would, and a quarter replied maybe (n=78; 25%)

Almost half (n=150; 48%) of the 310 participants said they would like to receive more information about flying-foxes and 22% replied maybe (n=69).

Receiving more information about SCC RFFMP and flying-foxes

Preferred delivery method of information: Regional flying-fox management plan

Two hundred and forty-one responses were received from 209 participants (multiple responses were possible). All three participant groups (n=121; 50%) prefer communication via email (Figure 22).

Other frequently suggested delivery methods included social media (n=24; 10%) such as Facebook, Instagram, LinkedIn and TikTok and community events and meetings (n=16; 7%), newsletters (n=13; 5%) from Sunshine Coast Regional Council and community groups such as Bush hands, TV (e.g., local news) (n=10; 4%) and the Sunshine Coast Regional Council website (n=10; 4%). Using the postal service to deliver flyers, brochures, handouts, and letters was also suggested (n=8; 3%).

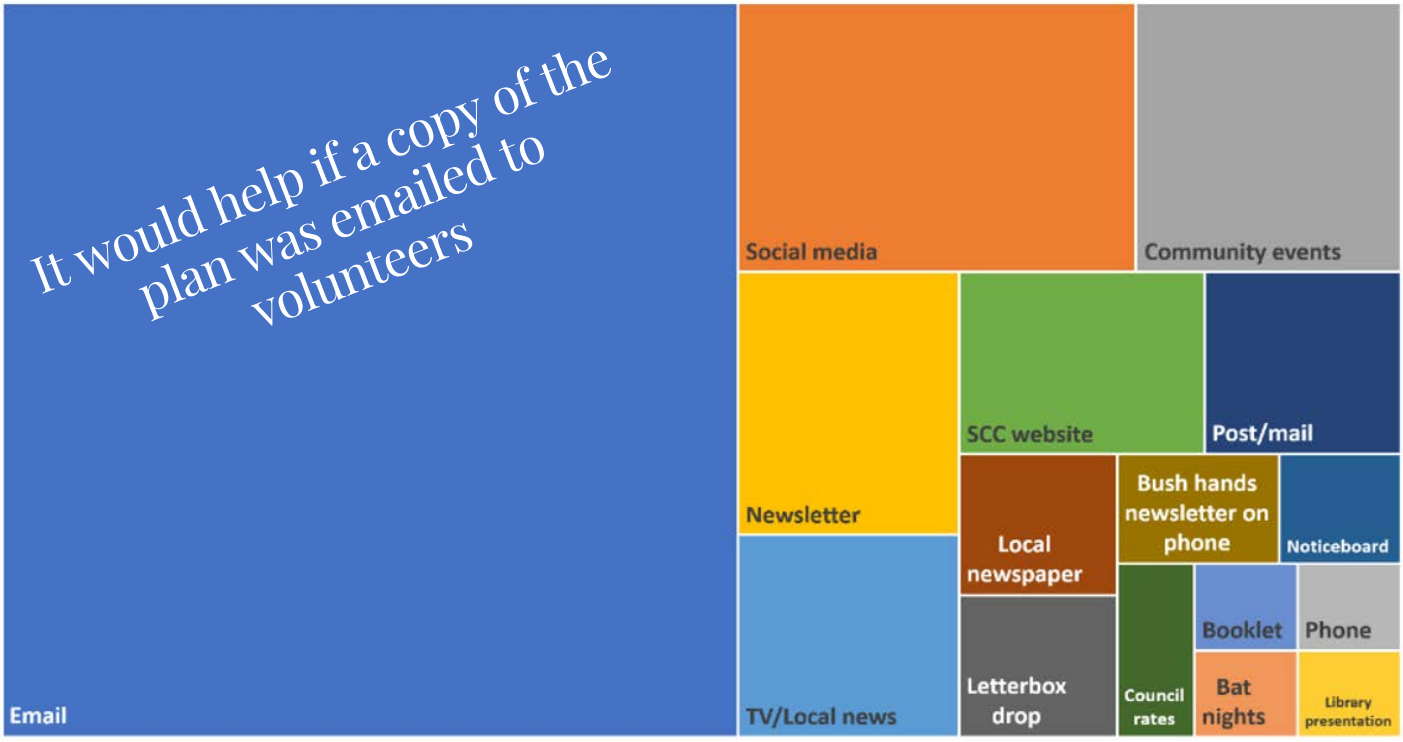


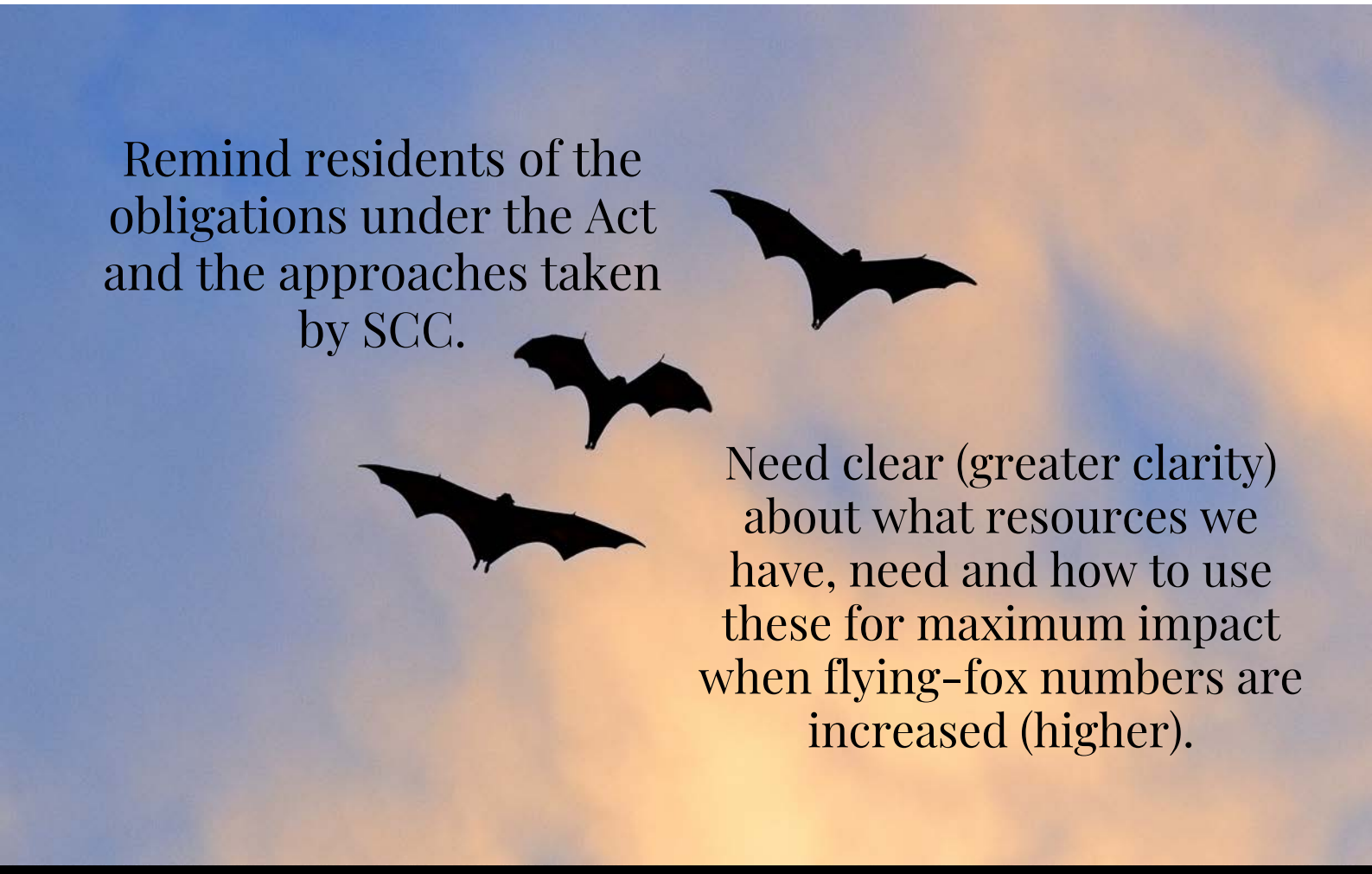
Figure 22 Preferred delivery method of communication about the RFFMP.

Receiving more information about SCC RFFMP and flying-foxes

Individual responses reveal some innovative suggestions such as *fridge magnets, radio stories, murals and artwork, infographics, and text messages*.

In addition, participants suggested:

- *an application (APP) for citizen scientists to record data such as roosts, illegal killing, fruit net issues, and all wildlife hospital numbers with injury and outcomes*
- *a register of anyone who is impacted that is updated regularly, monitored and states the impacts*
- *find out what residents need using phone, print, electronic to be able to reach the various demographic groups: cover all the options and send prior to the arrival of the little red flying-foxes*
- *15 mins videos (for Councillors) as we get too many emails; long emails are difficult to read and to take in all the information.*



Receiving more information about SCC RFFMP and flying-foxes

Preferred delivery method of information: Regional flying-foxes

Two hundred and four responses were received from 183 participants (multiple responses were possible) with regards to the preferred delivery method for more information about flying-foxes (Figure 23).

Similar to the previous responses for more information about the RFFMP, **email** was the most often suggested method (n= 111; 54%) followed by **social media** (n=24; 12%), **Sunshine Coast Regional Council website** (n=11; 5%), **postal service**(n=10; 5%), **Sunshine Coast Regional Council newsletter** (n=10; 5%) and **Sunshine Coast Regional Council hosted stalls and events** (n=6; 3%).

Small numbers and individual responses reveal some innovative suggestions such as *informative walks* and *one-on-one talks particularly with those who live near roosts*, *colourful information boards*, via *rates notice*, *interactive displays featuring fun facts*, *opportunities to meet flying-foxes* and *short fun videos*.

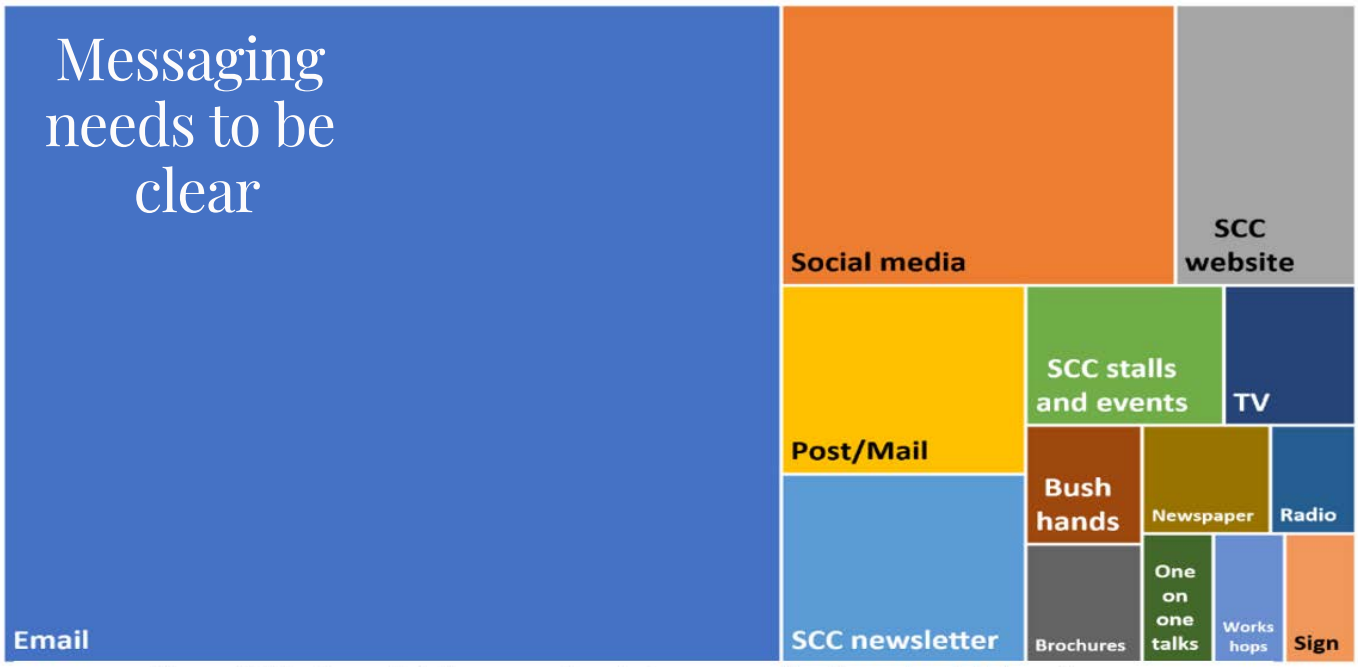


Figure 23 Preferred delivery method of communication about flying-foxes.

One participant indicated they would like any information to share and discuss with my neighbours and friends to increase knowledge, understanding and tolerance. While another suggested the need for innovative thinking.

Receiving more information about SCC RFFMP and flying-foxes

Preferred information (content)

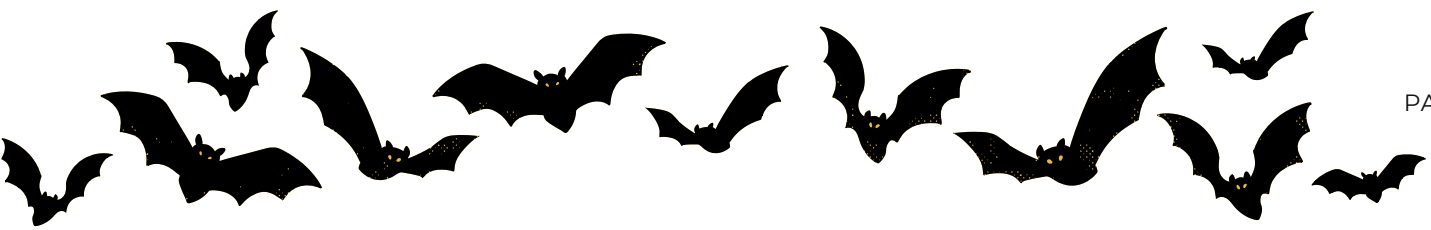
Participants were also asked to suggest the type of information they would prefer to receive about the RFFMP and flying-foxes. A broad range of topics were provided as listed below:

- Current protection status (n=5) and location of colonies (n=22)
- What community can do to help (n=13), information on how to protect flying-foxes. how to be advocates for flying-fox survival and habitat protection
- Any and all information (n=9)
- Conservation efforts (n=6) and all measures taken to protect flying-foxes (n=3)
- Flying-fox benefits and habits (n=7)
- Education about the lifecycle of flying foxes (n=7)
- Council actions to support conservation efforts (n=6)
- General information on species (n=5), how far they travel (n=3), where they travel to/from (n=3), awareness of flying-foxes and their role in the ecosystem (n=4)
- Measures to deter flying-foxes (n=3)
- Types of trees to plant, the type of netting for fruit trees and vegetable patches that are best for flying-foxes (n=3)
- How flying-foxes affect our environment
- Details of surveys, population status (n=2)
- RFFMP specific updates (n=2)
- Safe practice when observing an ill animal (n=2), numbers to call (what to do when one is dehydrated)
- Greater understanding of how important flying-foxes are (n=2)
- Updates on flying-fox population health and habitat regeneration
- Information on what the plan (RFFMP) aims to achieve and its progress on those goals
- The role flying-foxes play in the ecosystem
- Information regarding the type of studies being conducted and flying-fox management
- When little red flying-foxes arrive, their number, where their roosts are
- The risks of living with flying-foxes

Participant comments

Participants were offered an opportunity to offer their own final comments. Of those who chose to do so, the following additional comments:

- Develop resources that could be used by other Council regions. We could be **leaders in the space of flying-fox communication**; create collaboration, cost and resource effectiveness
- How to **turn negatives into positives** to increase ability to co-exist. How do we manage that?
- Roosts are noisy and smelly. How do we communicate this in a positive way?
- Use subsidies (e.g., double glazed glass, air-conditioning) as people want to open windows in summer. This may assist to offer **comfortable living** in the months the little reds are here
- Share tips with residents about how to maintain properties
- Handle **miscommunication** and advice on what to do if they see a flying-fox, not to handle them, about contacting the right authority
- **Mitigate fear** - education is key
- Support **advocates and champions** and utilising champions in the community
- Use opportunities of proximity to the species to bring awareness by offering workshops (open to not only residents but others) for education as a way to manage
- Make the sighting of these species something special. A celebration. Increase fascination. Create **"David Attenborough"** moments
- Create **eco-tourism/leisure** for night tours in appropriate areas and view mass flights at night - amazing - capture this phenomenon
- Maybe **first nation** opportunities to include the flying-fox in walk on country experiences
- Create or enhance **dark sky experiences**
- Increase the **incredible work of the SCC**, their commitment and passion - linking to resources. SC officers are passionate and proactive
- **Innovative** solutions
- More information - but how do we make the information relevant and a priority for non-impacted residents?
- Timing of information important. Be on the front foot. Ramp up engagement at key times. Use **technology** to record patterns of movements and heat maps to learn about the flying-fox and share with the public
- **Drone** technology
- **Listen** to the community. We are an evolving society so need to listen.
- Create a discussion piece about flying-foxes to elicit feedback and encourage **community input**
- Flying-foxes seem to be attracted to suburbia, to rivers, creeks and streams but the odour and noise are the **big issues**
- **Pro-activity** in providing support



Discussion

Achieving conservation goals requires consideration of the complexity and dynamism of the social–ecological systems they are intended to support. Human interactions with wildlife may be positive or negative, include economic and educational opportunities, benefit or detract from perceived quality of life and create concerns around human and wildlife safety and health.

Globally, human-wildlife conflict is a significant issue and has contributed to species extinction, structural and functional ecological changes, economic damage to crops and property, and diminished psychosocial well-being (Nyhus 2016; Woodroffe et al. 2005). Human-wildlife conflict arises whenever wildlife threatens, or is perceived to threaten, human interests (Redpath et al. 2013; Nyhus 2016). The management and mitigation of conflict are vital for environmental conservation and restoration.

Various methods are employed to mitigate the negative impacts of human-wildlife interactions. Monitoring the effectiveness of management actions in achieving the stated goals is a key component of any adaptive management process (Hockings et al. 2006). The use of strategic communication, linked to specific goals and outcomes is an integral part of this process. Strategic communication focuses on directing the desired message to the intended audience at the most suitable time, using appropriate channels.

From a neuroscience perspective, paying attention has two parts:
(1) the selection of important pieces from the continual flow of information bombarding our senses (e.g., sight, sound, touch) and
(2) protecting the selected information from being overwritten by less important information.
(Heim & Keil 2017)

Discussion

In our increasingly digitised world, information can be consumed anytime, anywhere (Costera Meijer & Groot Kormelink 2015), in more accessible ways, and is increasingly intertwined with daily activities. This is leading to information overload. To break through and be successfully received and understood, strategic communication must be thoughtful and deliberate.

Of the 316 participants who provided responses as to whether they had seen any communication campaigns provided by Sunshine Coast Council about flying-foxes in the last 5 years, over half (n=186; 59%) said they had not. This could equate to a large portion of the public who have not seen the communications shared by Sunshine Coast Council. Based on this, flying-fox communications could be deemed ineffective. This will need to be addressed. The recommendation section of this report offers approaches to increase exposure. In further understanding communication effectiveness, other aspects were explored to give a fuller picture and inform decision-making.

Based on the responses by participants who had seen or heard communication shared by Sunshine Coast Council, 88% (n=107/121) indicated the information was effective for increasing their knowledge of flying-foxes.

The Sunshine Coast Council Communication Plan aims to address public concerns about flying-fox roosts in urban areas by increasing community understanding and appreciation through access to accurate and up to date information relating to perceived health risks and flying-fox behaviour. The results highlight participants who were aware of flying-foxes in the region, had an understanding of the ecological and biological links and benefits of flying-foxes while also expressing concern for self, others, property, and for flying-foxes. Variable responses about the health risks to humans were shared, some of which were misinformation.

Over half of the participants indicated the information seen/heard about flying-foxes was moderate (n=27; 22%) to very effective (n=40; 33%).

Discussion

To achieve effective communications, knowing the audience is essential. When trying to target everyone, we fail to target anyone. The public is not a target audience as this is too broad and does not allow for nuanced messaging that will resonate with the receiver. Focused communication to specific target audiences can inspire action. Based on this study, the audience was predominately female across a diverse age range (age groups were represented from 18 year to 85+ years with 60% aged 45-74 years) and from across the region. When considering the audience, behavioural and psychographics characteristics are useful. For example, approximately half, lived near a roost with many having done so for a few years (0-4 years) with some unaware they would be living next to a roost until the flying-foxes appeared. This group will need specific messaging to ensure factual information to offer support and inform appropriate action as frustration, fear and concern for property, personal safety and quality of life were expressed by some participants.

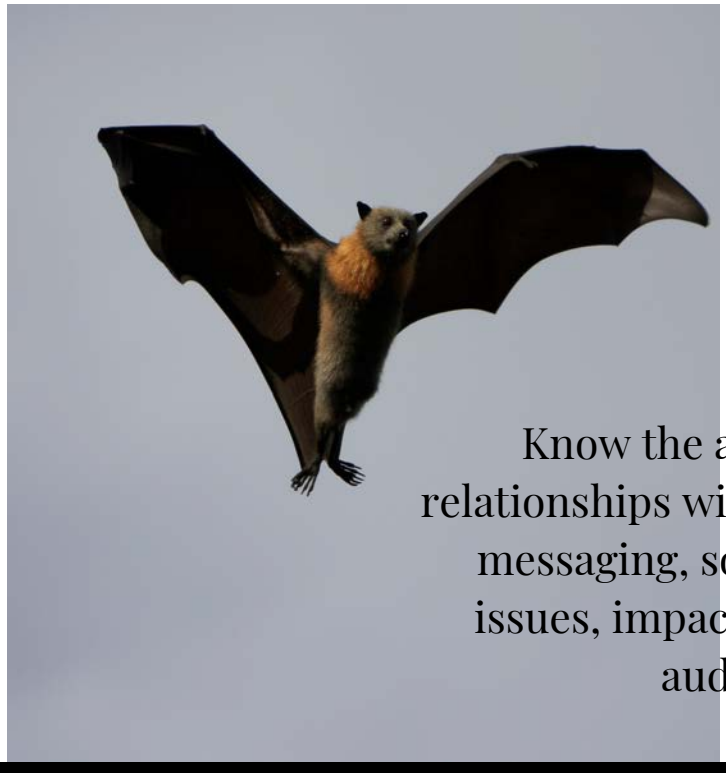
Sunshine Coast Council directs information to different formats to engage with community groups such as school aged children (e.g., school visits, BatPod), attendees at community events (e.g., Bat Nights, stalls at Garden Shows and Music Festivals) and general information publicly available on the Sunshine Coast Council website. For those negatively impacted by living in proximity to flying-foxes, there are targeted communications such as newsletters, dedicated sections on the websites and options to have direct contact with a Council Officer. While the availability and formats used to share flying-fox information are varied, some participants were unaware of where to source information.

Discussion

The connection of people to nature is decreasing (Kleespies et al. 2021). Nature connectedness creates humans and environmental benefits. Research has revealed that environmental education and awareness programs are one way of increasing the connection to nature (Kossack & Bogner 2021; Liefländer et al. 2013; Braun & Dierkes 2017; Mullenbach, Andrejewski & Mowen 2019). Connection to nature can lead to pro-environmental attitudes and behaviour (Zelenski & Murphy 2009; Hoberg et al. 2021). This study explored nature connectedness using the Inclusion of Nature in Self scale (Schultz 2002) to examine environmental self-identity or the extent individuals see themselves as acting in an environmentally friendly way (Van der Werff, Steg & Keizer 2013). Half of the participants identify as being highly or very highly connected to nature and as such, may have broader concern for environmental issues. This can be shown by the links made between flying-foxes, other species, and the ecosystem. Conversely, about one-fifth of participants were disconnected or minimally connected to nature. These individuals associate less with nature and although they may be concerned about environmental issues, concerns tend to be focused on issues that directly affect themselves/others (Schultz et al. 2004).

Based on the disparate focus of residents, different approaches to conservation communication are required. Taking an environmental communication approach, which concerns communicating the natural world and environmental issues, public perceptions, and the influence on human-nature relations (Jarreau, Altinay & Reynolds 2017) can be useful. For example, responses suggest that for those who are highly connected to nature, communication content should support and extend knowledge, and provoke curiosity, attention, and interest. Content should be research based, offer calls to actions (what can be done to protect flying-foxes), collaboration efforts, consultation with management strategies and updates on outcomes of community and Sunshine Coast Council actions.

Messaging for those who are less connected to nature, those in proximity to flying-fox roosts and those who are negatively disposed to flying-foxes should consider the audience frame of reference. For example, in the context of climate change, Nab, Jansma and Gosselt (2020, p. 1) found that "homeowners' pro-environmental intentions are stronger when the messages" were "presented in a loss frame with a reference to the self than when the message is presented in a loss frame with a reference to the environment". This may also be effective for those who have mixed responses to co-existing with flying-foxes.



Know the audience, use local stories, build relationships with target audiences, and use targeted messaging, source credibility, and to talk about issues, impacts and solutions in ways the target audience is able to relate to.

(Jarreau, Altinay & Reynolds 2017)

Discussion

Statements about flying-foxes revealed higher agreement for the important role of flying-foxes in the environment and functioning of our ecosystem, the importance of flying-fox conservation and protection, the setting aside of conservation spaces and the need for humans to coexist with flying-foxes. Participants strongly disagreed that flying-foxes attract other species such as rats, pose a threat to other animals and that we should not be concerned about the habitat of flying-foxes. These topics are within messages used by Sunshine Coast Council and confirm participants had received and interpreted these messages as intended.

By asking participants to identify their sources of flying-fox information, what information was recalled about flying-foxes and the preferred communication modes and type, aided in further investigating communication effectiveness. The source of information can influence participant opinions (Brewer & Ley 2013) of environmental issues (Easman, Abernethy & Godley 2018). Participants cited a range of media platforms on which they had seen flying-fox communication with most messages being seen on the Sunshine Coast Council website, social media sites hosted by community or Sunshine Coast Council, at Community Events or via newsletters. For 35% of participants, mainstream media (websites, newspaper, radio, television; 17%) and social media (18%) were the most accessed sources. Brossard and Scheufele (2103) suggest that mainstream and social media can be sources of unreliable and sensational information thus, information may be inaccurate and misunderstood. Building and maintaining trust when using social media as communication tools is a management imperative. Participants also recalled conversations and comments by others. This information may also be inaccurate or misleading such as flying-foxes being disease carriers, that they should be moved on, and that flying-foxes may take priority over residents' peace and quiet. Sources of information and how they are used, managed, and monitored is important to ensure accuracy and consistency.

Raising public awareness and knowledge on environmental management promotes the adoption of sustainable and equitable use of natural resources. This helps communities make informed choices, develop positive attitudes and sustainable solutions for biodiversity conservation

(UNEP 2020)

Discussion

When asked what communication sources were preferred, the majority of participants chose email. The length of email mattered to participants with shorter, fun, easy and quick to consume content preferred. Vignettes or shorter, emotive, evocative communication content, based on scientific information, and of a positive nature, was repeatedly suggested. Positive messages can be more effective at motivating pro-environmental actions than those focused on negative behavioural impacts (O'Neill et al. 2013).

Overall, when communication evaluations raised three key points:

1. Over half (n=186; 59%) of the participants had not seen any communication campaigns provided by Sunshine Coast Council about flying-foxes in the last 5 years. This shows reach, the distribution range or coverage communication has within the targeted audiences, requires further attention. While the sample is a small portion of the population, it suggests that to achieve the aim of effectively communicating the importance of flying-foxes to Sunshine Coasters, further examination of the audience is needed to identify suitable modes to increase reach.

2. For those who have seen campaigns from the Sunshine Coast Council about flying-foxes, the information did increase knowledge, has been consumed via most of the sources employed but the preferred medium, email, was under-utilised.

3. The target audiences are diverse with divergent opinions and responses to living in proximity to flying-foxes. A key rule in effective conservation and environmental communication is know they audience. This links to the first point, and suggests consideration of who the audiences are with respect to connectedness to nature, frames of reference, proximity to roosts and knowledge of flying-foxes will aid in framing content that is relevant, meaningful, and actionable.

Raising public awareness and knowledge on environmental management promotes the adoption of sustainable and equitable use of natural resources.
This helps communities make informed choices, develop positive attitudes and sustainable solutions for biodiversity conservation
(UNEP 2020)

Discussion

Effective communication strategies are important due to the diversity of stakeholders (e.g., government, conservation groups, residents, visitors). Well-designed communication can offer meaningful contributions to the people, places, and species for effective biodiversity management to offer education and connection to those directly and indirectly impacted. In addition, help bridge the communication gaps for effective knowledge creation and sharing between community, scientists and managing agents.

Conservation messages can be strategically framed in a variety of ways to achieve specific objectives (Kusmanoff et al. 2020). Message framing involves emphasising specific features of communication to promote understanding, interpretation, evaluation, or intervention (Entman 1993) and engage different audiences within financial budgeting (Kusmanoff et al. 2020). Key considerations for strategically framing communications that achieve intended aims include accenting the topics that matter to the audience, activating social norms, reducing psychological distance, are emotive, and tested with target groups (Kusmanoff et al. 2020). Understanding the audience and their preferences is key to any communication efforts.

Image Source: Sunshine Coast bat Night vid https://youtu.be/VKAwFkFTxrk

Recommendations

Recommendations have been derived from the results of this study, participant comments and reviewing conservation communication research. The recommendations commence with responses to a survey question requesting participant suggestions on how to increase their, and other residents' awareness of flying-foxes on the Sunshine Coast.

Increasing awareness: participant recommendations

One hundred and seventeen participants provided suggestions on how to increase awareness of flying-foxes on the Sunshine Coast. Suggestions were thematically analysed and divided into three categories: i) where and how to share information, ii) topics and iii) potential audiences.

Where and how to share information

Participants highlighted the need for freely available, easily accessible information, with a focus for sharing when flying-foxes become a problem. Posting information on social media (n=13) with Facebook generally and regional community social media pages, as well as Instagram and *TikTok* were mentioned.

Ensuring the information provided is accurate is key to increasing the reliability of these sources. Participants proposed the development of education programs (n=14) with different groups such as:

- *schools, including adding flying-foxes to primary school curriculum that taught about the importance of our wildlife*
- *workplaces*
- *communities that host flying-fox roosts*
- *offering short courses at Community Centres and workshops focused on educating about the importance of protecting flying-foxes that included bat food trees planting and bat box making classes*
- *education sessions for developers about habitat loss*
- *primary producers (n=3) focused on bat friendly netting and fencing.*

Suggestions made that are beyond the scope of the Sunshine Coast Council should be made clear to residents , Being clearer may assist in helping residents understand what is possible thus setting realistic expectations.

Television was the least nominated source of information participants said they had seen flying-fox information. However, local television news (n=12) was identified as a possible means for information sharing. The recommendation was to develop TV content in an advertisement style format, that uses fun and engaging content.

Other media-related suggestions included print media (e.g., Preview, Gazette, Hinterland Times, Sunshine Coast News) (n=4), radio (e.g., ABC) (n=3), newspapers (n=2), newsletter (such as the one shared by the Sunshine Coast Council) (n=2) and Post/letterbox drop (brochures) (n=2).

Providing information with rates notices or in short emails that just give a few educational points at a time (as long emails would not be read), that focus on a specific point at a time with a link if people want to read further. Poster and brochures could be shared in hot spots areas (locations of roosts) such as at local service stations and news agencies (n=5).

Recommendations

Where and how to share information

Participants suggested

- on-site, interpretive signage on walkways near roosts (n=8) including signage that advises bat management in progress and the issues of pool fencing (n=2), noticeboards (n=8) and billboards (n=2)
- Roost tours and information nights (n=5)
- Expos and community events (n=5) such as more Bat nights (n=4)
- Library presentations (n=4), information stalls at local markets or in local parks on the weekends (n=3) at which volunteers could speak to community groups (n=3), researchers (such as UniSC) could offer scientific and research presentations (n=2)
- Sunshine Coast Regional Council could collaborate with wildlife carers for community presentations (n=3) at which eco-friendly cleaning products could be provided.

Some 'out of the box thinking' proposed the following ideas:

- the creation of *public murals*
- *podcasts* (n=2)
- *mental health sessions* to support those stressed by living near flying-foxes
- publish or share children's *fictional book* portraying flying foxes in a compassionate way and in a way children identify with
- create events that *celebrate seasonal change & movement* - birthing, welcome back, start of bloodwood flowering time etc
- engage with *citizen science* tools such as iNaturalist
- *employ more specialists* to help build a large flying fox management team
- utilise the *Mascot* (n= 2)
- *tourism* i.e., flying-fox viewing and education
- *sharing up to date trends* in flying-fox management and Sunshine Coast specific challenges

Community social media, positive and educational news stories, community meetings for Q&A with representatives of local specialist bat groups.

(NFP participant response)

Recommendations

Suggested topics

When asked to suggest ways to increase awareness of flying-foxes on the Sunshine Coast, participants recommended the following topics:

- An increased use of positive stories about flying-foxes (n=3) and reframe language (n=5) that considers but goes beyond the issues and community conflict.
- Communications that encourage compassion for wild native inhabitants who make this area special and diverse and remove peoples fear; highlight seasonal benefits and the essential role flying-foxes play [Sky-Puppies] to a healthy ecosystem.
- The general importance of flying-foxes (n=8), importance of flying-foxes to ecosystem (n=4), flying-foxes as key pollinators (n=5) and increased information on flying-fox habit preservation (n=3).
- Participants focused on habitat protection and those seeking to find a solution to proximity of flying-foxes to homes had similar suggestions around setting up a nature reserve specifically for flying-fox habitat and zoned bat friendly suburbs.

As it is important for residents to co-exist with roosts near our homes, University could help residents to mentally deal with the noise, especially at night, smell & how to clean bat poo from cars, house & pool

Maybe suggest eco-friendly cleaning products that are not too expensive

Other topics included:

What steps are being taken regionally, statewide and nationally to address reducing populations

What time of year flying-foxes breed

What flying-foxes eat

Using real footage

Share research

Timely information on food sources and season

Real data on population numbers and population changes + reason for the change

Warm, emotive stories to help make a connection

Recommendations

Addressing community expectations and conservation of flying-foxes requires urban flying-fox roost management. The Queensland State Government "recognises the important role local governments continue to play in managing issues around flying-fox roosts in urban areas" (DES, 2022).

Globally, the aim of many local governments is to drive sustainable outcomes (economic, environmental, cultural, social). The United Nations Sustainable Development Goals (SDGs) offer a framework to do so. There are 17 inter-related SDGs. In the context of regional flying-fox management, the SDGs can be implemented at the local level. Regional context is important as local areas feature smaller populations that are less homogeneous (Szetey et al. 2021). Drawing on SDG11, Sustainable cities and communities, aligns with the Sunshine Coast Council smart sustainable cities to utilise integrated information ecosystem and technology to generate economic benefits, resilience and a safer community which may contribute to this SDG (SCC 2022).

Public participation

> Public participation turns usual policy making on its head to include those most affected by its outcomes.
>
> (IISD, 2019)

Smart cities can improve public participation and equity, advance human well-being, protect the environment (including flying-foxes) and strengthening local action and empowerment (Szetey et al. 2021). Empowerment of local communities engenders collective ownership of sustainability priorities and advocacy to "ensure responsive, inclusive, participatory and representative decision-making at all levels" (SDG16, Target 7) (Szetey et al. 2021).

Public participation is essential for both government and society (Piercy, Cheek & Teemant 2011), and key to responding to the sustainable development goals. Public participation is the involvement of individuals and groups who are/perceive to be interested and/or affected by a proposed intervention, decision or issue (Lee & Sun 2018). Public participation can offer informal benefits that are not always possible through traditional education (Makmor, Salleh & Nordin 2021).

Participant comments revealed that public participation can be facilitated through information communication technologies i.e. platforms such as social media and email. This has been referred to as e-participation. However, public participation whether traditional or via e-participation, requires careful consideration as using e-communications may reduce participation, being one-way interactions from government to community. Effectively applied, e-participation actions can make access and engagement easier and simpler (Santamaría-Philco, Cerdá & Gramaje 2019).

Recommendations

Public participation

The Sunshine Coast received UNESCO biosphere status in 2022 based on the region being an international site of excellence of natural beauty. Similarly, one of the values of the Sunshine Coast Council recognises the abundance of flora and fauna with "the protection and use of landscape to shape places and contribute to their enjoyment is a fundamental characteristic of good Sunshine Coast design" (SCC 2022). To maintain UNESCO status and implement policies and practices that reflect values, requires collective action.

The International Association of Public Participation (IAP2) identified five levels of participation between government and residents: (i) Inform; (ii) Consult; (iii) Involve; (iv) Collaborate; and (v) Empower. Authentic and purposeful engagement of residents allows for government to gain and act upon the knowledge of the people in which cultural respect, relationships and context are critical for open and informed discussions (SDG10: Reduced inequality). Planning should consider ways to diffuse power relationships and take a coordinated, collaborative approaches.

Reduced inequalities include all species. Taking an anthropocentric only view means human need is considered of greater importance. With regards to flying-fox conservation and co-existence, public participatory communication (*two-way communication*) could be directed to identifying collective transformation of attitudes.

SCC Value:
We live within and cherish our landscape

The abundance of green, the presence of plants and trees, and the blessing of a rich, biodiverse landscape is what makes the Sunshine Coast so special. Whether natural, rural or urban, the landscape connects us, reduces stress, and supports an enviable lifestyle. We are proud to be situated within a nationally recognised natural environment, with its beauty a part of our daily lives. The protection and use of landscape to shape places and contribute to their enjoyment is a fundamental characteristic of good Sunshine Coast design.
(SCC 2022)

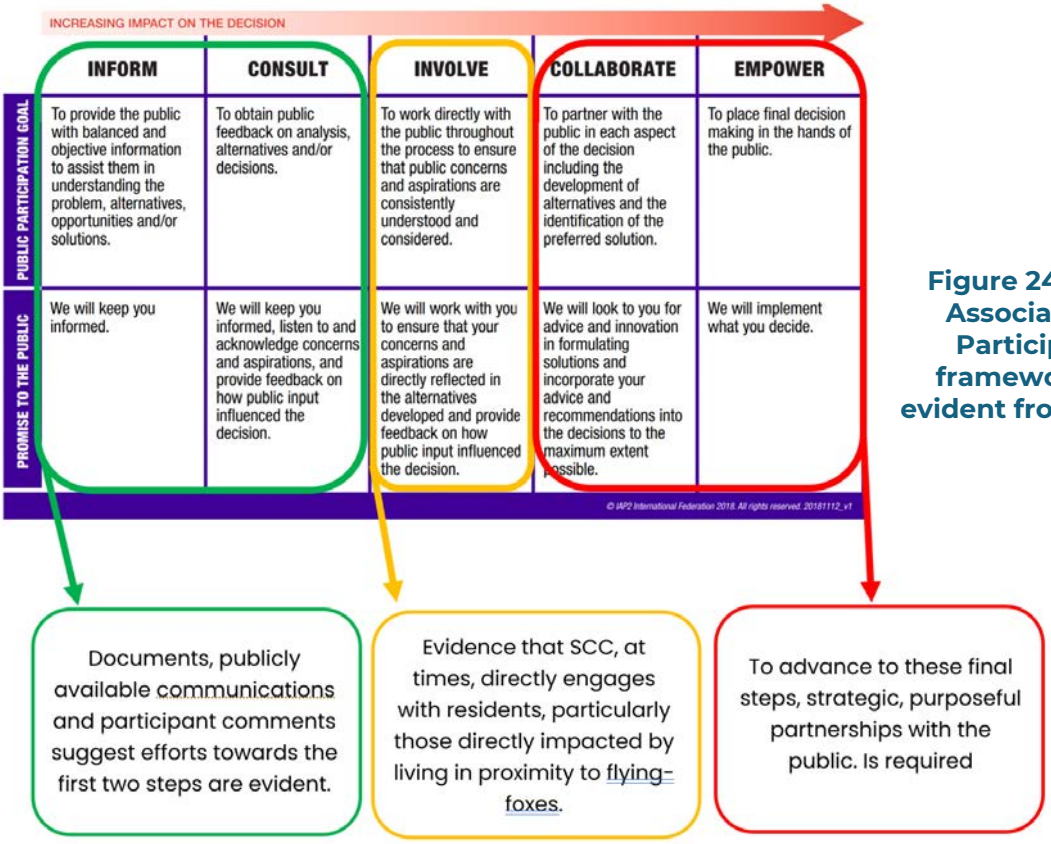


Figure 24 International Association of Public Participation (IAP2) framework with levels evident from study results.

Recommendations

Public participation

To gain and extend existing trust, to identify localised strategies (bottom-up) facilitated by champions such as carers, not-for-profits groups and those in proximity to roosts, initiatives could be communicated using direct contact, email and social media. For example, public participation that recognised diverse inclusion, uses storytelling rather than interviews as a means to reduce perceptions of power and allow residents to voice not only their concerns but ideas. Sunshine Coast Council may also use this approach to lead collaborative inter-local government projects that commission good research to elicit, evaluate and reflect the knowledge of the people to identify and implement a collective vision for change. This is particularly important given the nomadic nature of flying-foxes that cross inter-regional boundaries and the need for effective management of fiscal and human resources.

Participants suggested innovative approaches such as artworks (murals) and the engagement of community-based flying-fox champions. Innovative research undertaken by Frantz, Petersen and Lucaites (2021) used community voiced messages and found these to be "potentially valuable for stimulating cultural change" due to significant increases in "social norm perceptions, concern about environmental issues, commitment to action, and optimism". Innovation in communication can be enhanced by inclusive approaches to elicit perspectives from diverse stakeholders, including youth.

Public murals, City of Salisbury

The mural aims to raise awareness of the importance of sustainability and its effect on our local wildlife. The flora and fauna in the artwork consist of species which inhabit the nearby Little Para River Corridor. Our mural recognises the conservation status of each of the species which are threatened, obscure, or beneficial to the ecology of the corridor.
We encourage onlookers to research and discover the importance of sustainability, and how their ecological impact plays an important role in sustaining the future of the Little Para River Corridor's diverse wildlife.

Little Para Wildlife Mural

Located on the Carisbrooke Park toilet block, this mural represents flora and fauna species that inhabit the nearby Little Para River Corridor.

Double click to access link

Recommendations

Public participation

> From conserving endangered species to fighting climate change, young people are key in protecting our planet.
> (IFAW 2019)

Based on various previous research Doyle (2020) suggests participatory environmental education actively involves young people to support adolescents to talk about environmental issues (e.g., climate action) and form personal and collective responses. Further, participatory environmental education can help students to envision alternatives and facilitate cognitive, emotional, and behavioural engagements with environmental issues.

From this perspective, United Nation's Environment Program highlights the call for inter-generational responsibility and the role of young people in policy-making for climate action. By targeting younger generations, the efficacy of science communication and outreach can be increased. The delivery methods preferred by participants such as social media, APPs, podcasting, photography, story telling and through play, can be used to engage youth. Participants suggested flying-fox education for young people should include sustainability, biodiversity, and environmental ethics with studies revealing multi-disciplinary educational integration can be effective for engaging youth in environmental issues (Dreyfus et al. 1999) for engendering empowerment and learning (Stern et al. 2014). Impactful social media campaigns using short, interactive educational videos, can be used for youth outreach (Morar & Peterlicean 2012). Inter-generational collaboration should also draw on, and enhance, the knowledge of older residents.

Figure 25 Innovation in action using technology to engage youth - BatPod, a fun choose-your-own-adventure incorporating expert guidance, First Nations knowledge and flying-fox facts to inspire solutions on living alongside flying-foxes

Recommendations

Innovative communication approaches - Interpretation

Innovative communication can be achieved by taking an interpretation-based approach to inform content creation that addresses the needs of diverse audiences. Definitions have evolved since Freeman Tilden (1957) first suggested that "interpretation is an educational activity which aims to bring meaning and relationships through use of original objects, by firsthand experience with the resource or by illustrative media, rather than simply to communicate factual information".

Consistent with comments provided by participants, Ham (1992) included the need for the translation of technical natural science language into easily understand messages presented in engaging, entertaining and interesting ways. One of Tilden's six principles of interpretation states messaging should be provocative which should include calls to action such as how and where to obtain more information to satisfy audience curiosity, stimulate thinking and offer actions for addressing concerns e.g., human and flying-fox safety and protection. Conservation messaging incorporating interpretation techniques can facilitate participatory, experiential, and emergent contexts that facilitate empowerment (Peake et al. 2009). Interpretation can simplify complicated topics for more general audiences that aids in creating connects between and, in this case, flying-foxes. Storytelling within interpretation can connect and initiate responses to calls to action.

Participants suggested engaging flying-fox advocates and champions, for the co-creation of communication between Sunshine Coast Council and residents, carers, volunteers and not-for-profits. Utilising storytelling by these stakeholders, can be a powerful tool. Innovation, technology, and storytelling can combine digital audio and visual content to create short videos for sharing on various platform for reflective and emotional messages (Lambert & Hessler 2018) that offer personal experiences or incidents that link to the lives of other residents (Davey & Benjaminsen 2021).

Stories of attitudinal and behavioural change may influence those who currently have mixed feelings towards flying-foxes. Participants shared ideas for attitudinal change for greater acceptance, co-existence, and understanding flying-fox behaviours. When someone other than an authority, someone like us who we can relate to tells us a story, it can have a profound impact. Digital storytelling shared on social media (e.g., videos, photos) offers broad reach at a lower cost to traditional media (Shreedhar 2021). Memory studies suggest stories can generate emotion, focus attention, are more memorable and may have value as mnemonic devices (Negrete 2021). Flying-foxes were repeatedly described as *super cute*. Also, *misunderstood, disgusting, disease carriers and dirty*. Participants suggested communication should aim to change public perception and *make them as cute and cuddly as a koala*, and *remove fear that flying-foxes spread disease*. Storytelling can be useful tool for species considered to be less charismatic.

Recommendations

Innovative communication approaches - Interpretation

Like many management documents, the RFFMP includes a lot of information and is is therefore, difficult to digest. Participants from all three groups suggested breaking the content into smaller sections and highlighting key points and sharing in different formats such as short videos (e.g., vignettes), or short email messages.

Taking an interpretation approach may be useful in sharing relevant and important topics from the RFFMP.

Linking environmental psychology theories in the crafting of messages to increase comprehension of scientific and managerial content. Consider the audience. Consider how long the audience has to absorb the message. Then, confirm what the required message is. This could be linked to seasonality of species behaviour to increase relevance. Fernández-Llamazares et al. (2020) highlight that emotionally driven stories are more likely to be retained in memory. This may not necessarily be emotion about flying-foxes. Messaging may be emotive for the audience connected to broader ecology issues, a sense of place and space, altruism, or civic responsibility.

Positive messaging was suggested by participants. Previous studies have found that well-informed optimism can be important in motivating societal change towards sustainability (Balmford & Knowlton, 2017; Knowlton, 2018). If content is provocative, the message must give options for action that are achievable and relevant. If there is no autonomy or the issues appears overwhelming, may initiate stress, resulting in limited action and potentially close the audience off to future communications. Messaging from the RFFMP could be provided taking an interpretation style approach to highlight actions and accomplishments to motivate residents to take purposeful action.

Interpretation theory suggests for to generate idea/s requires cohesive, relevant, provocative, and meaningful messaging. Tilden purported that all interpretation must be personally relevant to the audience. For example, taking a section from the RFFMP such as the Purpose of the RFFMP, and presenting the information in a manner that enables the main idea to be considered, comprehended, be reacted to, build upon, and take action. This type of message could be based on research by Dr David Westacott who described flying-foxes as "perpetual backpackers" and roosts (camps) as more like motels (Williams 2019) to increase relate-ability. The chosen message can be shared in rates notices, short emails that advise of a seasonal event related to flying-fox behaviour or a community event at which flying-fox conservation will be presented. This may be an effective approach to sharing information requested by participants such as what the plan aims to achieve and updates on progress towards these aims.

Innovative communication approaches

Sunshine coast Council has invested in innovative approaches such as BatMap.

Participants wanted to know where roosts are located, population numbers and current management actions. Bat Map provides this information in an interactive map. Awareness of the map appears to be limited. Bat Map was not mentioned by participation as a source of information.

As investment in, and implementation of, several innovative tools has taken place, the first steps would be to undertake

an evaluation of existing innovative communication tools

When investing in future innovative communication, clear strategies should be established. When used as an information tool for conservation, public involvement (public participation) in the planning, implementation and evaluation stages are key. Encouraging feedback on the type of tool used, formatting, accessibility and content, and gaining feedback can increase awareness of the tools/approaches used to create a sense of collective ownership and engagement. This can take more time but may be balanced by effective resource deployment and the achievement of intended goals.

Conservation actions (e.g., recycling, donating) are higher when the cause of the issue is man-made, referred to as the 'outrage effect' as people are more upset by anthropocentric induced degradation (Kahneman et al. 1993) such as habitat loss (Shreedhar 2021). Habitat loss was an often-raised cause of flying-fox deaths by study participants. Highlighting the human induced impacts to flying-foxes, may increase the appeal charisma-challenged species like the flying-fox. Making charisma-challenged species more relatable and fun can help children and adults better understand flying-fox importance which may result in excitement when viewed in the wild and inspire an interest in flying-fox protection (Glas 2016). This could be accomplished through increased exposure of residents to Frankie the flying-fox or further use of the flying-fox marketing characters on Sunshine Coast Council communications.

Bat research found the public were blind to the reality of bats (e.g., natural history, ecology, and conservation) and emphasised the urgent need for availability of accurate and engaging information (Lunney & Moon 2011) to increase positive perceptions towards bats. Straka, Greving and Voigt (2021) suggest photographs of vulnerable and distressed bats may temporarily create emotive responses and support for bat conservation. Messaging should be monitored and evaluated to ensure emotive messaging meets intended aims.

Co-existence challenges are evident. A small number of responses referred to management actions by the Sunshine Coast Council such as the management of unsuitably located colonies using smoke or sprinklers. A not-for-profit participant suggested removing the dispersal option from the SCC RFFMP, citing a study that found dispersal can be expensive, ineffective, and may create additional community problems (cited research was Roberts et al. 2021). When asked if the Sunshine Coast Council routinely monitor flying-fox roosts to identify flying-fox movements, 46% were unsure (n=147).

To identify innovative solutions, previous research by Tanalgo and Hughes (2021) report on how bat-watching raised public awareness through a coordinated media campaign that started with a community crusade to remove bats from Congress Avenue Bridge in Austin, Texas. The bridge now hosts 1.5 million Mexican free-tailed bats. Approximately, 140,000 visitors come to see the bat colony each year. Bat-watching provided economic benefits and promotes awareness activities such as a viewing area, educational kiosks, tours, and a bat festival (Tanalgo & Hughes 2021).

This links back to public participation as an avenue for identifying management options but this depends on effective communication between managing agents and the public (Alcock 1995).

Recommendations

Flying-fox conservation through tourism and leisure

Conservation tourism is defined as "commercial tourism which makes an ecologically significant net positive contribution to the effective conservation of biological diversity" (Buckley 2010, p. 2). Flying-foxes are important to maintaining the rich biodiversity and natural heritage, which are key reasons tourists and visitors choose a destination. As part of the Biosphere designation, IDSA (International dark sky association) recognition, may benefit not only flying-foxes but other regional and migratory species. In addition to environmental conservation, dark sky parks and reserves offer economic opportunities through tourism and leisure. Properly planned and managed tourism and leisure activities could be incorporated into existing offerings such as dark sky and astronomy activities, and nocturnal wildlife tours. Well-managed sustainable and regenerative tourism and leisure can support environmental conservation. For example, Duffus and Dearden (1990) suggest that successful wildlife viewing is most effective when species have behaviour predictability. Flying-foxes on the Sunshine Coast, roost in colonies within proximity to humans and have predictable mating, rearing and emergence times (e.g., in the evening) making viewing relatively easy. Linking flying-foxes to other species that require dark skies such as loggerhead and green turtles, could help people understand ecosystem connectivity.

Opportunities exist from the pandemic-related travel restrictions imposed over the past few years related to 'resident tourists', or locals exploring their own community (Hoogendoorn & Hammett 2021). Engaging locals does not necessarily require commercial product development. Residents can be encouraged to simply look up at dusk.

One of nature's greatest spectacles - a flying-fox fly out

Bat cruises: (2016)
Residents and visitors could take a cruise on the Maroochy River to view flying-fox fly outs at Goat Island
(SCC news 2016)

Recommendations

Flying-fox conservation through tourism and leisure

As with all wildlife tourism and leisure, flying-fox watching must be planned and managed based on scientific research to ensure populations and habitat protection and community wellbeing. Broad stakeholder collaboration and co-creation is required (e.g., various local government agencies, not-for-profit and conservation groups, and researchers). Bat tourism is emerging and growing, with offerings in New South Wales, Australia, where flying-foxes can be seen at the Royal Botanic Gardens in Sydney (Sunset Spotlight Tour) and tens of thousands of bent-wing bats can be seen in Mt Etna Caves National Park in Queensland (Department of Environment and Science 2018). Bat tours were mentioned several times by participants.

Wildlife tours offer locals and tourists an opportunity to participate in a working conservation program and first-hand information on the actions needed to conserve flying-foxes in their own habitat. For instance, bat tourism in the Monfort Bat Cave Sanctuary, Philippines was examined via visitor surveys pre- and post following the completion of a conservation lecture and bat cave-watching tour. Tourist knowledge of bat ecosystem services and willingness to support bat conservation were measured to reveal that knowledge about bat ecosystem services doubled (44% to 87%) and willingness to support bat conservation increased from 44% to 61% (Tanalgo & Hughes 2021). This suggests that communication directed at the local community (leisurists) and tourists, that seeks to increase knowledge of flying-foxes, will aid in achieving Sunshine Coast Council aims to provide access to accurate information. Tours could incorporate other recommendations provided by participants in this study regarding the engagement of advocates, carers and champions and enlist their skills to lead bat tours, or assist to train tour guides, into which stories can be interwoven to create memorable, emotive experiences.

Recommendations

Flying-fox conservation through tourism and leisure

Conservation promotion is defined as "the planned effort to influence public opinion through good character and responsible performance, based upon mutually satisfactory two-way communication" (Fazio & Gilbert 1986, p. 8). People are most likely to respond to contact that engages their interest in some way, treats them with respect, and relates to their experience of life. As Tilden (1977, p. 11) wrote in the national park context: "any experience that does not somehow relate . . . to something within the personality or experience of the visitor will be sterile." Further, this reveals opportunities for First Nation people to design and implement immersive experiences and storytelling to share with visitors the thousands of years of shared history with Garrimundi/Girrimundi (flying-fox in Kabi Kabi language).

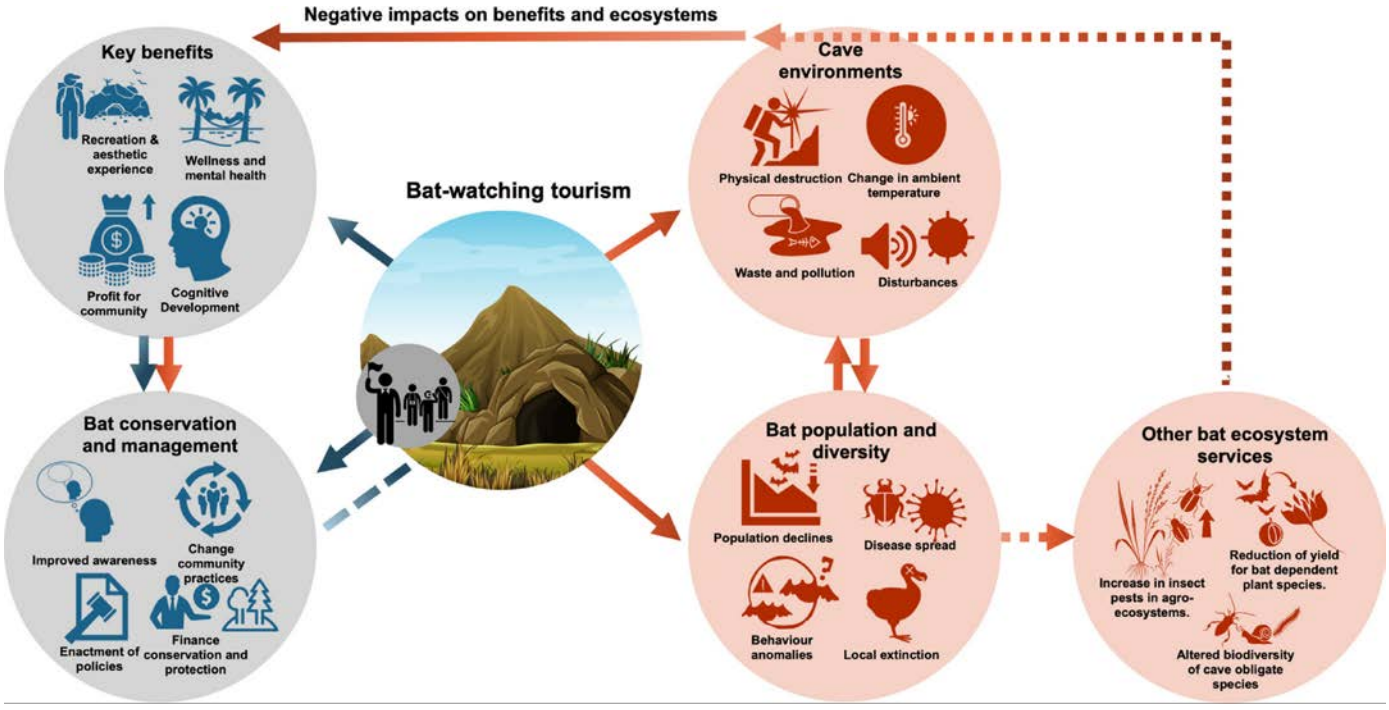


Figure 26 Potential positive and negative impacts of bat-watching tourism (Tanalgo & Hughes 2021)

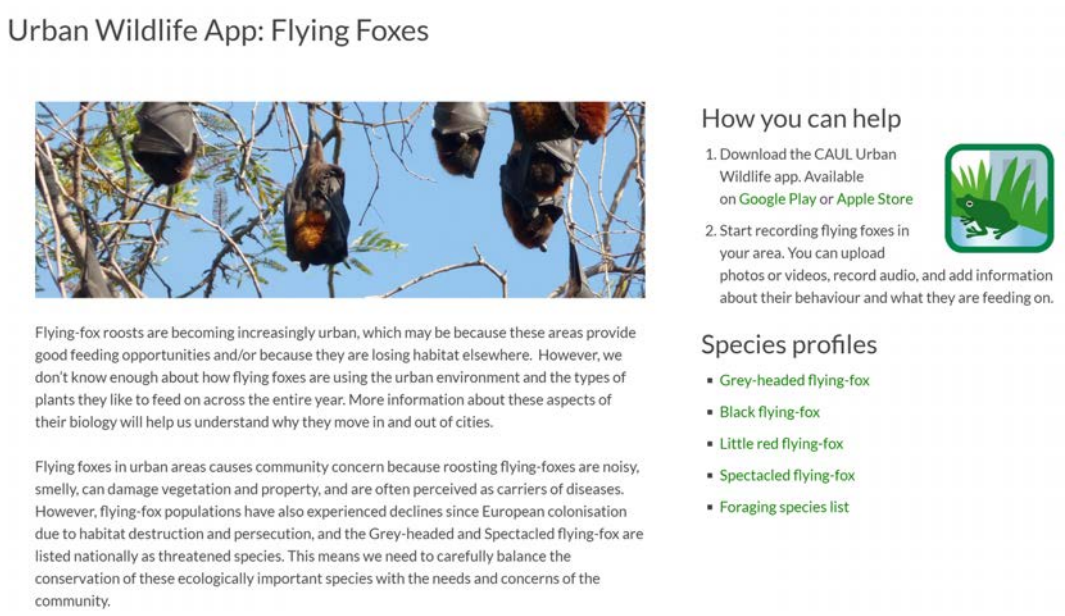
Recommendations

Flying-fox conservation through citizen science

Public contact (physical or psychological) is an important element of natural resource management to engender empathy and awareness while meeting specific management-related objectives (Hockings, Carter & Leverington 1998). To identify possible means for consulting and engaging to facilitate appropriate contact, incorporating elements within a citizen science framework can be useful. Citizen science variably, and often voluntarily, engages resident and tourist scientists (Schaffer & Gregory 2022) in onsite or online research to address identified or to reveal as yet poorly understood or identified problems or issues (Newman et al. 2010; Silvertown 2009).

As a form of public participation in research, citizen science can be a cost-effective approach with broad benefits to participants, researchers and managing agents. Benefits can include the diversification of viewpoints and increase scientific knowledge, personal growth, capacity building and nature connectedness (Schaffer & Tham 2019). Citizen science projects can enlist diverse stakeholders to stimulate various perspectives based on co-created and collaborative projects exploring ways to co-exist with flying-foxes (and other species). Citizen science projects often have an environmental focus and can illuminate the life of flying-foxes using in-field observation research and online crowdsourcing (e.g., uploading of photographs, videos or GPS sightings) to collect data such as flying-fox abundance, habitat mapping, co-habitation with other species, and various behaviours. This data could be linked into the Bat Map and other tools currently used by Sunshine Coast Council.

Examples of Flying-fox related citizen science include Urban Wildlife App: Flying Foxes



Urban Wildlife App: Flying Foxes

Flying-fox roosts are becoming increasingly urban, which may be because these areas provide good feeding opportunities and/or because they are losing habitat elsewhere. However, we don't know enough about how flying foxes are using the urban environment and the types of plants they like to feed on across the entire year. More information about these aspects of their biology will help us understand why they move in and out of cities.

Flying foxes in urban areas causes community concern because roosting flying-foxes are noisy, smelly, can damage vegetation and property, and are often perceived as carriers of diseases. However, flying-fox populations have also experienced declines since European colonisation due to habitat destruction and persecution, and the Grey-headed and Spectacled flying-fox are listed nationally as threatened species. This means we need to carefully balance the conservation of these ecologically important species with the needs and concerns of the community.

How you can help

1. Download the CAUL Urban Wildlife app. Available on Google Play or Apple Store
2. Start recording flying foxes in your area. You can upload photos or videos, record audio, and add information about their behaviour and what they are feeding on.

Species profiles

- Grey-headed flying-fox
- Black flying-fox
- Little red flying-fox
- Spectacled flying-fox
- Foraging species list

Recommendations

Flying-fox conservation through citizen science

Applying methods such as citizen science may generate results that reveal innovative solutions to critical flying-fox issues. Increasing frog death in Australia urgently called for new ways to collect large samples. FrogID is a highly successful citizen science project with thousands of Australians recording and uploading approximately 700,000 frog calls (Knight 2022). FrogID has resulted in new frog species being identified and increases in scientific and public knowledge and interest in frogs. Similarly, in the Great Pollinator Project, almost 90% of participants reported an increase in appreciation for bees, greater confidence in telling others about native bees (74%), and over half (55%) indicated increased interest in community-related environmental issues (Toomey & Domroese 2013). In this way, flying-foxes could be more overtly identified as 'great pollinators' to enlist community support for their conservation by referring to them as, and with, other great pollinators.

The use of existing platform and projects (e.g., Atlas of Living Australia) is another cost-effective and collaborative way to engage in citizen science that provides a sense of purpose and altruism. Jones, Riddell and Morrow (2013, p. 15) found that participants in citizen science projects who "reported a knowledge gain were more likely than the average to report an increase in environmental attitudes and behaviour". For those Sunshine Coast residents with positive perceptions of flying-fox, citizen science may facilitate an increase in broader community conservation. Increasing knowledge of flying-foxes for residents with negative or mixed perceptions or with no knowledge of flying-foxes, being involved in citizen science could result in increases in awareness, appreciation, and positive environmental attitudes and behaviours towards flying-foxes. Furthermore, participants indicated that the communications shared by Sunshine Coast Council had been effective at increasing their knowledge about flying-foxes.

Examples of Flying-fox related citizen science include Count flying foxes

Count flying foxes

Help us keep an eye on threatened grey-headed flying-foxes and their camps across eastern NSW.

Do you have a flying-fox camp near you? If so, we need your help to monitor threatened grey-headed flying-foxes and their daytime roosts.

By volunteering to monitor this threatened species, you will be joining a national program to learn more about trends in its distribution and population.

Your results will also help inform responses to public concerns about the impact of flying-foxes on industry, agriculture and public health, including any potential Hendra virus outbreaks.

Summary of recommendations

Communication plays an important role in flying-fox conservation. Globally, various techniques are being employed to manage the interface between residents and flying-foxes. Within conservation and management, communication is a critical component for achieving program aims, increasing learning, and raising awareness. Understanding that communication is the act of communicating, the *exchange* of thoughts, information and feelings between individuals or groups can drive two way communication. Two way communication is integral to public participation. Actions taken by Sunshine Coast Council officers and the perceived effectiveness may influence, or be influenced by, community attitudes. For example, acknowledging the impact flying-fox roosts have on residents' quality of life. Also, recognising that not all interactions between residents and flying-foxes are negative. This diversity requires different communication techniques and messaging. Currey et al. (2018) highlight that within human-wildlife conflict literature, management actions that do not consider the human-species nexus will have limited effectiveness. Further, in flying-fox management, stakeholder perspectives must be sought and incorporated into decision-making process (Currey et al. 2018).

It is evident that Sunshine Coast Council have actively applied communication messages in various formats. Bat Pod and other innovative approaches are publicly available. The approaches that have been successful (identified by participants and have increased awareness and knowledge) should be continued. However, as many participants had not seen communications from Sunshine Coast Council, a review of current efforts, participant responses and recommendations, may offer ways to rectify this.

There are few studies that examine communication plans in flying-fox management, with most focused on the effectiveness of dispersal methods. The results of this study can aid informed decision making and reiterate the importance of communication within urban flying-fox management.

Summary of Recommendations

Moving forward, actions should take a participatory approach.

Environmental management could be considered a wicked problem due to dynamic, complex and conflicting issues. Wicked problems require the work of collaborative teams of people with a range of expertise over space and time as discussed, with public participation a key recommendation. Traditional consultation approaches may intend to exchange information and opinions to reach a better understanding or make a decision. However, can be one way, thus lacking the progressive, two-way dialogue, sharing of ideas, deep listening, and use of respectful methods that allow diverse and inclusive participation.

Call to Action: Embedding the Sustainable development goals

The targets of SDG17 call for partnerships for collaborative action. with finite resources, partnerships between governments and private enterprise to deliver positive outcomes. Public participation can support the broad foci of the SDGs: social and economic prosperity, fairness and social equality, and environmental protection. City of Melbourne identified avenues for integration of nine key SDGs driving management plan directions. Similarly, Eastern Metropolitan Regional Council in Perth incorporated the SDGs into their Regional Environment Strategy. SDGs give a common language and framework that is increasingly recognised by residents and industry.

Internal partnerships aimed at empowerment and the building of community capacity for collaborative action could be facilitated by investigating programs such as TurtleCare to identify avenues of support and guidance for aspects of flying-fox management (linked to SDG13, 14 and 15). Within the 10 year plan, a framework for partnering could be developed to link with not for profits and educational institutions to source co-funding and co-ownership of education and community outreach, that has a clear direction and vision and drive self-management. Starting with one area such as education (SDG4), embedding systematic evaluation and clear accountability goals, framed around specific SDGs, can identify additional opportunities (e.g., tourism, long term, externally funded citizen science projects).

Foster long-term relations can aid in effective resourcing. Co-creating projects with schools, colleges and universities, increases learning, knowledge and skill development and capacity building. As intermediaries, Sunshine Coast Council can link carers, not for profits and education providers with aged care to initiate inter-generational engagement. Capitalising on the knowledge of residents (crowd sourcing) can advance community and council knowledge, reveal new ideas and facilitate serendipitous discovery (the cornerstone of citizen science).

Summary of Recommendations

Transdisciplinarity

Being interdisciplinary involves the coordinated and coherent analysis, synthesis and harmonising of links between disciplines. Transdisciplinarity however, integrates the natural, social and health sciences in a humanities context that transcend traditional boundaries. From this perspective, trans-departmental approaches tap into the skills and knowledge found broadly throughout Sunshine Coast Council to not only integrate, but innovate. As species require different management strategies and community responds variably to co-existence, half-yearly inter-departmental think tanks could explore specific issues in new ways. Design thinking takes a human-centred problem-solving approach to deal with wicked challenges. Design thinking requires identifying the real problem, which may not be the problem currently being addressed. Based on design thinking, a change of perspective from human-centred to flying-fox-centred, may reveal new ideas for communicating conservation. This may benefits from an extension of the think tank recommendation to include ICT, data management, customer service, marketers, researchers, wildlife volunteers, entrepreneurs, first nations people and youth to spark 'out of the box' thinking.

Managing people for flying-fox conservation is a global challenge. Extending peoples gaze from regional to global can give another perspective. As leaders, Sunshine Cost Council can initiate partnerships with large national and multi-national organisations to source external funding to run international think tank competitions within schools and universities.

Evaluate existing programs and tools

Innovative approaches have been implemented by Sunshine Coast Council. Co-creation of new tools for communicating conservation messaging is the ideal. Once implemented, evaluating their effectiveness for achieving intended aims is crucial for success. Systematic evaluation and gathering of feedback on what works and what does not reveals future iterations to enhance longevity of the resources. Sunshine Coast Council have initiate tools such as Bat Pod. This innovative tool should be evaluated. One way to do this could be to gather a suitable group of the intended audience, and let them use Bat Pod. Observation and focus group can then gather data to reveal important feedback. This could also be undertaken as part of a schools led-project where story ending could be written by students. The adoption of the great ideas generated can be celebrated publicly.

BatMap addresses suggestions made by participants in this study. However, there appears to be limited awareness of the tool. Usability assessment of specific tools was not in the scope of this study. However, evaluating awareness and usability of BatMap could reveal ways to increase use. Including BatMap in various community presentation along with a short online survey. For example, placing BatMap on a large screen to demonstrate how it works at the Nambour Garden Show, then asking simple questions, using an anonymous online survey, such as were you aware of BatMap before today? Would you use BatMap? Why/Why not? What do you like/dislike about BatMap?

Reflecting these innovative tools and on study findings and discussion about nature-relatedness, reveals the tools could be conduits to counteract decreasing contact and connection with nature by an ever more urban global society. For those unaware of flying-foxes, and less connected to nature (lower on nature-relatedness scale), interaction with online tools may introduce the topic. If the interaction is positive, this may inspire further exploration.

Summary of Recommendations

Preferred communication method

Findings in this study revealed email is the first choice for receiving communication about both flying-foxes and the RFFMP. According to research from Litmus, on average, email drives a ROI of AU$36 for every dollar spent, higher than any online platform (Avilia 2022). Email marketing statistics (Statista 2020) reveal Australia had the second-highest click-to-open rate of marketing emails in the world at 14.9%. Australians are spending less time reading each email though, so messaging is critical.

> By 2025, the daily number of emails exchanged globally is set to climb to 376.4 billion.
>
> (Statista 2020)

- More emails were opened on mobile (37%) than on desktop (30%)
- Marketers send the most emails (22.2%) on Thursday
- The ideal weekly limit is up to 5 emails
- There is a 5% higher chance for inbox placement after 12 pm
- Personalised emails have a 29% higher open rate
- The unsubscribe rate was higher in Australian emails
- Australians read food-related emails 2x the global average (i.e. link to fruit tree pollination)
- Email marketing is still the second most efficient way to gain new customers (i.e. create awareness)
- Almost two-thirds of readers open emails based on the "from" address, whereas only a quarter opened based on the subject line.

(WSBA 2022)

Tips for using email for effective communication:

- Email is a predominantly one way communication tool. Seek ways to facilitate information exchange. For example, aim to use a personalised email that people can reply to. Depending on the reply topic, emails could be redirected to appropriate Council officers or external people such as champions, carers or not for profits.
- Based on the findings, discussion and recommendations, storytelling and interpretation can create precise email message, focused on one key message with a call to action using emotive, relevant content.
- To build relationships and create momentum, inform the reader on how, by taking the proposed action, they can contribute to positive change. Aid the reader to visualise themselves as part of the solution and perceive what it is in it for them. For example, enlist the skills of internal colleagues or external parties such as UniSC design students, provided conservation communication at the Letaba Elephant Hall, Kruger National Park, South African to increase awareness of elephants. The visual designs were used to create posters, art gallery exhibits and in other communications.
- Personalise the email to the recipient. Software can assist in adding the recipients name to email communication.
- Be authentic, genuine, highlight shared values, connect and remind recipients of how important they are to the future of flying-foxes on the Sunshine Coast. Research indicated that people respond to anthropocentric caused damage. Creating messages about the human contribution to the plight of the flying-fox (not blaming or shaming but awareness raising) can shift perspectives and elicit change.
- Ensure emails are highly structured, focused and create flow.
- Establish a suite of "active voices" such as specific Council officers and Frankie.
- Be clear and specific. Use appropriate tone and vary according to the intended audience.

> Everyone's time and attention are precious resources therefore, each email should focus on one action.

Limitations

This study was focused on the Sunshine Coast, Australia and with one local government, Sunshine Coast Council. The focal species were the three flying-fox species that can be found on the Sunshine Coast. Viewed from this context, the findings may inform other local governments regions.

Steps were taken to reduce response bias. It is a caveat of survey data collection methods that there is the possibility of sample bias due to the potential pre-existing values and ideals of some groups/individuals to participate in surveys (Tourangeau, Rips & Rasinski 2000) and to engage with the focal topic – flying-foxes. This should be considered when interpreting the results.

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