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A low-cost and adjustable methodology for surveying marine species diversity within reef passages

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Case Study

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Abstract

Reef passages are ecologically, socio-economically and culturally important habitats in Pacific Island Countries (PICs), yet remain poorly understudied and inadequately documented. We developed and deployed an adapted, low-cost, adjustable, suspended, baited remote underwater video (suspended-BRUV) system, specifically designed to monitor marine species diversity across three reef passages around Ovalau in Fiji, in the southwest Pacific. The suspended-BRUV deployment protocol and design were guided by local ecological knowledge and expertise from local fishers. A total of 36 deployments were conducted across three barrier reef passages, yielding 31 valid videos from which 1,001 individuals representing 60 species across 18 families were identified. Individuals cross-referenced with the IUCN Red List of Threatened Species revealed that two Critically Endangered, three Endangered, four Vulnerable and one Near-Threatened species were observed, demonstrating the effectiveness of this suspended-BRUV system in documenting conservation-relevant taxa. The system's application demonstrated a strong potential as an effective tool for improving fisher-led biodiversity monitoring, even in highly dynamic environments such as reef passages, while also supporting community engagement, knowledge sharing and informing local management and conservation efforts. This study contributes to highlighting the importance of reef passages as biodiversity hotspots and encourages the need for inclusive, contextualized monitoring of coastal ecosystems.

Vakasama (Fijian)

Na daveta kei na icurucuru ni waqa e dau vakayagataki ena Wasa Pasifika. E vanua mareqeti baleta e rawa mai kina na noda vurevure ni ilavo se bula e na veisiga, e vanua era vakararavi kina na veika bula ka tiko talega na kena itukuni makawa se itovo. E dina ni vanua yaga vakalevu na daveta, ia e se bera ni vaka dikevi vakavinaka se volai vakaivola na veika me baleta na kena yaga. Na vakadidike oqo, e vakayagataka na iwalewale ni kena katoni vakaiyaloyalo na veika bula era kune ena loma ni daveta, ka vakayagataka na baca me rawa ni ra volekata mai na ika kei na veika bula ena daveta me ra tabaki. Na vakadidike oqo e katona na iyaloyalo ni veika bula e na tolu na daveta mai Ovalau. Na kena navunavuci mai na iwalewale ni katokatoni oqo e sema ki na nodra kila na dausiwa kei na daununu e Ovalau. E 36 na iyaloyalo era rawa mai ena tolu na daveta. E 31 na iyaloyalo era vakasavasavataki e dikevi ka laurai kina e 1,001 na ika, ra wasei ki na 60 na kenamataqali ka sema ki na 18 na vuvale vaka-ika. Ni ra sa dikevi vakamatailalai na veimataqali ika, e sa qai semati ki na iVola me Baleta na Veika Bula era sa Tekivu Seavu se Kawaboko e Vuravura ka vakatokai na IUCN Red List. Na vakadidike oqo e vakaraitaka na bibi ni kena vakayagataki na iwalewale ni kena katoni vakaiyaloyalo na veika bula ena loma ni daveta ka vukea na kena vakasokomuni na itukutuku me maroroi kina na iyaubula kei na nodra kila na dausiwa se daununu me baleta na daveta e na veiyanuyanu.

Impact statement

Community engagement in managing endangered, hard-to-monitor and locally targeted marine species is more powerful and effective than scientific reporting alone. By adapting and simplifying a conventional ecological method, that is, baited remote underwater video (BRUV) surveys, for implementation in reef passages by local actors, stewardship, awareness and inclusivity across genders and age groups can be encouraged at the local level. Such

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approaches can help bridge the gap between scientific monitoring and community-led management, particularly where financial, technical or logistical constraints limit long-term monitoring. Reef passages are vital 'gateways' between coastal reefs and the open ocean, supporting high biodiversity and facilitating important ecological processes. In Pacific Island Countries (PICs), reef passages also support local fisheries and contribute socio-economically to the livelihoods of coastal communities. Despite their ecological and social importance, reef passages remain relatively understudied and are often not managed as distinct ecosystems within broader coastal management frameworks. In this study, integrating local fishers' traditional and ecological knowledge of three reef passages around Ovalau in Fiji, with respective BRUV surveys, provided complementary perspectives on fish biodiversity within these reef passages. By combining scientific rigor with practical application, standardized ecological methods can support long-term sustainable management, be adapted to include traditional and local ecological knowledge through citizen science and encourage more informed and inclusive decision-making in the management of data-deficient systems such as coral reef passages.

Introduction

Reef passages are important social-ecological components of coral reef systems. Breckwoldt et al. (2022a) describe reef passages as the 'arteries' of these systems, as they facilitate water exchange, transport nutrients between habitats and enable the movement of reef-associated (e.g., Fisher et al., 2018), pelagic, hard-to-monitor, endangered and megafaunal species. Reef passages often support high levels of biodiversity and trophic interactions shaped by their unique geomorphic features (Breckwoldt et al., 2022a, 2022b). As described in a recent typology (Breckwoldt et al., 2022b), different passage types can be identified (e.g., coastal, lagoonal and open water). Coupled with hydrodynamic processes (e.g., tidal currents, upwelling and temperature regimes) and nutrient-rich waters, reef passages can aggregate reef fishes and other marine taxa (Fisher et al., 2018). In addition to enhancing ecological processes, reef passages are significant contributors to the socio-economic livelihoods of local coastal communities in the Pacific (Breckwoldt et al., 2022a). They are viewed as areas for recreational and commercial fishing, places of value connected to personal identity and of management concern. Reef passages, therefore, have important ecological and fisheries functions, as well as socio-economic and cultural values, yet they remain comparatively understudied relative to other coral reef habitats. Moreover, their strong and variable currents, complex individual geomorphology (e.g., depth, width and reef slope) and limited accessibility can make conventional ecological surveys (e.g., underwater visual census) difficult, particularly for mobile pelagic species. Survey approaches are needed that can reliably document marine taxa under these dynamic and variable environmental conditions.

Over the last two decades, baited remote underwater video (BRUV) surveys have been used as a non-extractive and standardized approach for surveying fish communities present in different aquatic geomorphological habitats (Ellis and DeMartini, 1995; Harvey et al., 2013; Langlois et al., 2020), such as mangroves and seagrass beds (Unsworth et al., 2014; Grimmel et al., 2020), shallow coastal reefs (Andradi-Brown et al., 2016; Richardson et al., 2026), mid-water environments (Heagney et al., 2007; Letessier et al., 2013) and deep-sea habitats (Baletaud et al., 2023). While BRUVs have been widely deployed on coral reefs and other benthic habitats to explore fish assemblages (e.g., Brandl et al., 2019), their use in highly variable wave-energy environments such as reef passages remains less documented (Whitmarsh et al., 2017).

Reviews of 161 BRUV studies (Whitmarsh et al., 2017), as well as publications spanning 60 years (1952–2012) of underwater video techniques (Mallet and Pelletier, 2014), highlighted that it is common for studies to modify standard methodologies by using extra ropes, buoys, cameras and other additions to fit study-specific objectives. Conventional BRUV systems are typically expensive to produce, maintain and deploy, and are mostly designed for either mid-water deployment or stable benthic substrates (e.g., van Elden et al., 2022), which can limit their applicability for dynamic environments such as reef passages. Strong and highly variable tidal currents can further constrain deployment options in passages, particularly where snorkelling or SCUBA is required, and may affect camera stability and effective field of view (Clark et al., 2024). These logistical and environmental challenges highlight the need for alternative BRUV configurations that can operate effectively across reef slopes, mid-water habitats and variable current conditions. Some studies have successfully combined and deployed benthic and pelagic (mid-water) BRUV systems simultaneously (e.g., Clarke et al., 2019; Rastoin-Laplane et al., 2026). However, reef passage conditions require BRUV configurations that retain the advantages of suspended systems that can be non-intrusive, balance robustness with ease of deployment and remain simple, reproducible and accessible for use in data-deficient locations, particularly those where research infrastructure and resources may be limited. Such characteristics could facilitate wider use of BRUVs by researchers, students, resource managers and local communities while maintaining a standardized approach to biodiversity assessments.

The use of suspended mid-water BRUV systems is widely established and has been successfully adapted for a range of marine environments (Mallet and Pelletier, 2014; Whitmarsh et al., 2017; Bouchet et al., 2018). Recent studies have begun exploring video-assisted methodologies in reef passages, for example, using non-baited underwater surveys and acoustic telemetry to assess shark residency in Fakarava Pass, French Polynesia (Mourier et al., 2016) and for studying fish spawning aggregations in Kouaré Pass, New Caledonia (Saulnier et al., 2025). However, to our knowledge to date, no studies have used BRUVs or any video techniques in Fiji's reef passages. As part of a broader interdisciplinary study investigating the passages' social-ecological importance (https://socpacific.link/), we adapted existing suspended-BRUV systems for use in reef passages along the coastline of Ovalau in Fiji. We used the basic principles of a mid-water BRUV system, positioning the camera and bait in the water column rather than directly on the seabed (Heagney et al., 2007; Letessier et al., 2013). The deployment protocol (i.e., site selection) was informed by initial semi-structured interviews with local fishers (Bishwa et al., 2026b). The design was refined to address practical deployment challenges, such as maintaining a stable field of view during mid-water deployment, reducing substrate contact and sediment interference (Robalino-Mejía et al., 2026).

Therefore, this study reports the development of a simple, robust, accessible and replicable adaptation of a suspended-BRUV system for deployment in reef passages. We describe the system's design, construction and field deployment considerations, providing a concise

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methodological framework that can be readily adopted for biodiversity surveys by researchers, students, managers, fishers and other actors working in passages and similarly challenging marine habitats. Here, accessibility and replicability are defined by a system that is low cost, simple to assemble, easy to transport, non-destructive to the environment and adjustable across a wide range of depths and hydrodynamic conditions. Clearly, the resulting videos require analytical skills and time. Yet, in data-deficient reef passage systems, this BRUV system can generate critical information to support ecological studies and local fishery management decisions (Léopold et al., 2009; Exeter et al., 2025); for example, by identifying fisheries zones, heavily targeted or endangered species and their potential aggregations (Goetze et al., 2015; Storer, 2020; Jessop et al., 2022; Ward-Paige et al., 2023).

Material and methods

Study sites

This study was conducted on Ovalau, Fiji (Figure 1A and B), between November and December 2025. Ovalau's eastern coast is surrounded by barrier and fringing reefs, interspersed with reef passages that connect the lagoon to the open ocean (Figure 1C). These reef passages vary in width, depth and hydrodynamic exposure. BRUV deployments were conducted in three of these reef passages, namely Toki Passage, Natubari Passage and Nalulu Passage (hereafter, Toki, Natubari and Nalulu), which were selected as they represent commonly used fishing grounds and habitat types identified during fact-finding semi-structured key informant interviews conducted in September 2025 (Bishwa et al., 2026b). Following Breckwoldt et al. (2022b), Toki, Nalulu and Natubari can be classified as lagoonal passages (type 2), that is, connecting the open water to a shallow lagoon. All are regularly used by local fishers (both women and men) and are recognized as ecologically and socio-economically important (WCS, 2022). Toki flanks Vatukalo Village's '*tabu*' area (i.e., where a community-based fishing ban is in effect), situated around the sandbank named '*Cakau Bulibuli*' (Nata et al., 2026). Natubari is also connected to a '*tabu*' area, part of the Port of Levuka. Whereas Nalulu itself is part of Tokou Village's '*tabu*' area (https://www.seacology.org/project/58-fiji/).

Suspended-BRUV system design and construction

Five suspended-BRUV systems were constructed for deployment, with a sixth system for presentation purposes in the local communities and local schools. Each suspended-BRUV frame was constructed using four sections (1, 0.7, 0.3 and 0.1 m length) of Polyvinyl Chloride (PVC) pipes (0.015 m diameter), with two tee

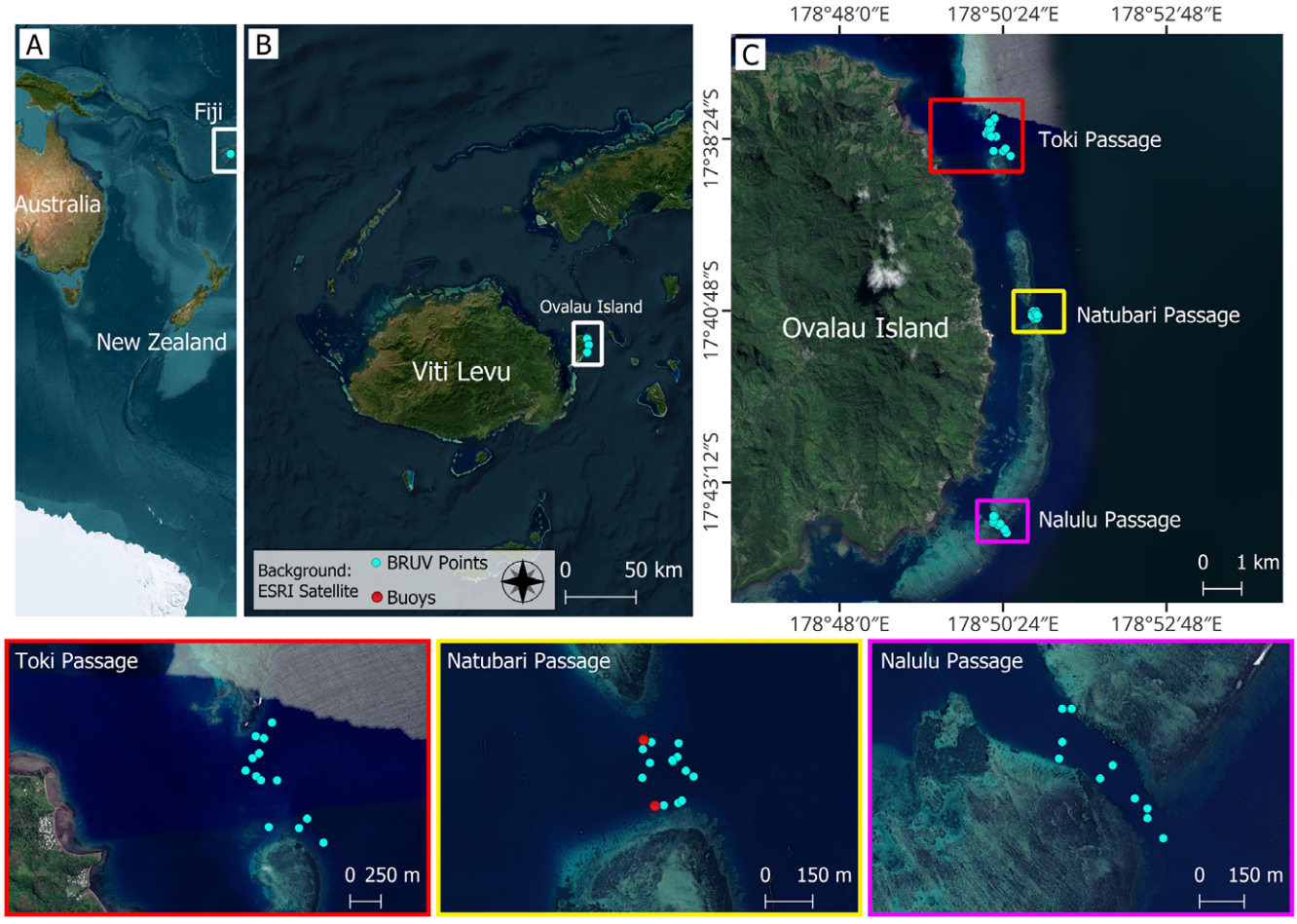


Figure 1. (A) Location of Fiji. (B) Map of Viti Levu and location of Ovalau, in the Lomaiviti Province. (C) Coloured map borders refer to individual reef passages, and blue points refer to places where suspended-BRUV systems were deployed. Red points indicate the two permanent buoys in Natubari Passage used for vessel navigation. Red border: Toki Passage with 13 deployments; yellow border: Natubari Passage with 13 deployments; purple border: Nalulu Passage with 10 deployments (map created using QGIS v3.44.7; http://www.qgis.org).

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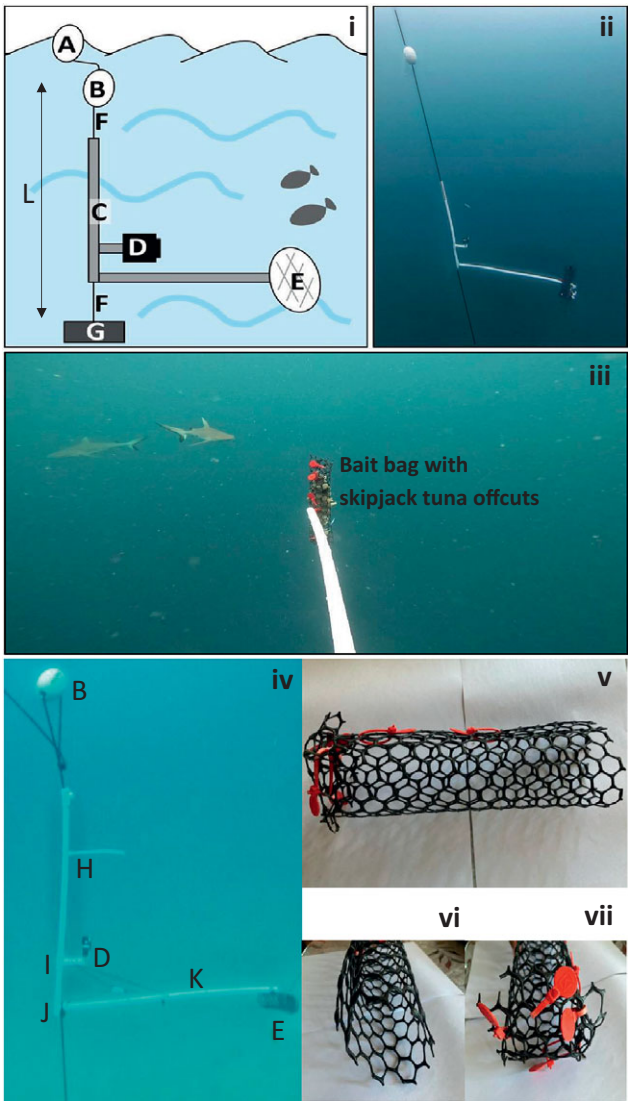


Figure 2. (i) The suspended-BRUV system underwater with (A) a surface buoy (marker for retrieval from the vessel), (B) a sub-surface buoy (holding the frame straight), (C) PVC pipe frames with (D) a GoPro camera inside an underwater housing facing the (E) bait bag; (F) a 22 kg tensile-strength rope runs between the vertical frame pipe connected to the buoys and the (G) weight on the bottom to hold the frame in one location. (L) Arrow showing the frame upwards to the surface and downwards to the weight. (ii) The suspended-BRUV system. (iii) Image captured from video of two grey reef sharks (*Carcharhinus amblyrhynchos*) swimming towards the bait bag. (iv) Detailed BRUV frame showing the (B) sub-surface buoy holding the frame upright, tied to a 10 m rope running through the vertical PVC pipe tied by a (H) cable tie through a drilled hole. (D) GoPro camera in underwater housing attached to a PVC plain elbow on a PVC handle attached to the main frame by a (I) PVC plain Tee. The (K) horizontal bait arm is connected to the vertical pipe by a (J) PVC plain Tee through which the rope is exiting from below and looped around **K** to help main stability. (v) Bait bag attached to the pipe through a drilled hole by cable ties, with an (vii) entrance permanently closed and an (vi) open entrance for placing bait that can be closed by cable ties for reusability. *Panel (i) by Alexandra Nozik.*

connectors and one 90° elbow joint (Figure 2 and Supplementary Table 1). The vertical frame was assembled from top to bottom by connecting the 0.7 m section to a tee, followed by the 0.3 m section and a second tee, aligning both tees in the same direction. The 1 m horizontal bait arm was connected at a 90° angle to the lower tee, with the bait bag attached at its distal end. The 0.10 m section was fitted to the upper tee and capped with a 90° elbow to support the camera mount. All joints were secured with PVC cement. A small hole was drilled into the elbow for camera attachment, and additional holes (three to four holes per 0.7 m and 1 m sections) were added along the frame to facilitate water entry and rapid sinking during deployment.

Each BRUV system was equipped with a single GoPro camera (one Hero 9, two Hero 10 and two Hero 11 Black; GoPro Inc., San Mateo, CA, USA) in an underwater housing. The camera was mounted onto the PVC elbow joint (with housing eyelets seated inside the PVC elbow) and secured using cable ties threaded through pre-drilled holes. The camera was oriented to face the bait bag, constructed from a large-pore crab net filled with skipjack tuna (*Katsuwonus pelamis*) offcuts, as recommended by fishers. However, any available large-pore mesh net and suitable underwater video camera can be used, provided the camera is housed and fitted securely into the elbow for stability.

To suspend the BRUV system, a rope was threaded through the vertical frame, entering at the top of the 0.7 m section and exiting through the lower tee connector. The frame was secured in position using a bowline knot. Deployment depth was controlled by adjusting the rope length below the frame. A small sub-surface buoy (~0.1 m fishing net buoy) was attached to the rope ~1 m above the frame, providing sufficient buoyancy to keep the system upright and under tension while remaining sufficiently small to be held submerged. Above this, excess rope extended to a larger surface marker buoy (0.2 m) attached to facilitate visual detection and retrieval of the system. The 'anchor', attached at the base, consisted of either three 1.36 kg lead dive weights or a single 0.15 m concrete block (~10 kg) depending on availability. By adjusting rope lengths above and below the frame, the BRUV system was adjusted rapidly in the field for different deployment depths, and allowed for flexibility in near-benthic, mid-water or surface positions.

Deployment protocol

A total of 36 deployments were conducted, including 13 deployments each in Natubari and Toki, and 10 in Nalulu. During each trip, two, three or five suspended-BRUV systems were deployed simultaneously in a given passage. Deployments were conducted during ebb and flow tides, and targeted two habitat strata: mid-water column (deployments in the middle of the passage) and reef slopes (near benthos at passage edges). During each trip, deployments were spaced as far apart as practicable within the confines of the passage while maintaining the intended habitat positions. Therefore, the distance between each deployment was opportunistically selected, also depending on prevailing weather and sea conditions and passage profile. Date, time and GPS coordinates were recorded, and a Depthmate Portable Sounder was used to obtain depth estimates, after which rope length was adjusted to ensure the camera was positioned at the intended deployment depth. For Natubari, deployments were conducted within the confines of the two navigation buoys, starting at their edge. The BRUV systems were left to record for 60 min on average (range: 34–97 min), during which the vessel was moved away from the deployment area to minimize disturbance. Camera settings were standardized to record at 1920 × 1080 pixel resolution with a linear frame at 30 frames per second (fps) to maximize battery life while maintaining video quality (for full deployment metadata, see Bishwa et al., 2026b). All deployments were conducted with local fishers, who transported the team to sites and provided advice and/or support.

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Video analysis

All videos were manually analysed in VLC Media Player (v3.0.23, www.videolan.org/vlc) by a single observer (DB) for consistency. From each video, raw counts of individual species were recorded as the number of times an individual of the same species was observed, while relative abundance was quantified using MaxN, defined as the maximum number of individuals of a given species observed simultaneously within a single frame (Colton and Swearer, 2010) or a 30–60 s video segment (Grimmel et al., 2020) (see data template in Supplementary Table 2). MaxN is a conservative and widely used metric intended to minimize the risk of double-counting an individual (Heagney et al., 2007; Langlois et al., 2020).

Individuals were identified to the most precise taxonomic level possible (species, genus or family) using local and regional guides (Moore and Colas, 2016) and expert consultation when required. Current strength was visually scored in three categories ('low', 'moderate' or 'strong') depending on how much the bait arm undulated. Visual conditions (such as turbidity) occasionally limited species identification. In such cases, footage hue, brightness and contrast were adjusted manually to enhance visibility of diagnostic features and enable identification to the lowest confident taxonomic level (Supplementary Figure 1). In a small number of instances, recording duration was shortened due to battery overheating or technical malfunction; these deployments were retained only where marine taxa were observed (Bishwa et al., 2026b). All individual identifications were uploaded as occurrence data to the Global Biodiversity Information Facility (GBIF, Bishwa et al., 2026a).

Dataset summary

To provide a proof-of-concept assessment of the adapted suspended-BRUV system, deployment-level summary statistics were computed and summarized at the passage scale. For each passage, the number of deployments, species richness, total MaxN and threatened species richness were summarized using R version 4.6.0 (R Core Team, 2026). Individuals that were only identified to genus or family levels were not included in species richness calculations (Supplementary Table 3).

Spatial distribution of deployments was described at the passage × date × tide level, as deployments were conducted (excluding one deployment in Toki on November 25, flow tide) in batches. Distances between deployments conducted on the same trip were calculated from geographic coordinates, and nearest-neighbour distances were summarized as mean, minimum and maximum. Deployments conducted on different days were not included in the same distance calculation as they did not represent simultaneous sampling effort.

Additionally, we defined reef passage width as the shortest distance across the passage between the two opposing reef boundaries at the BRUV survey area. This was measured using the QGIS ruler by drawing a perpendicular transect to the main axis of the passage and measuring the approximate distance between the two reef boundaries.

Results

A total of 36 suspended-BRUV systems were deployed at depths ranging from 12 to 64 m, with an average depth of 26.7 m. Nearest-neighbour distances (NND) among deployments varied across passages. Mean NND ranged from 96.8 to 493.5 m at Toki, 101.3 to 127.3 m at Natubari and 245.2 to 296.2 m at Nalulu, and their estimated passage widths were 889, 417.1 (~217 m within the confines of the two navigation buoys) and 171.4 m, respectively (Supplementary Table 4). Of the 36 deployments, 31 successfully generated footage where marine taxa could be identified. Twelve videos in Natubari, 11 in Toki and 8 in Nalulu captured marine taxa. Consequently, Natubari had the highest mean species richness (7.08 species, SD = 5.48) and total MaxN (56.7 individuals, SD = 51.4), followed by Nalulu (4.57 species, SD = 3.51; 10.3 individuals, SD = 8.58) and Toki (2.20 species, SD = 1.03; 5.20 individuals, SD = 5.37). Threatened species richness, however, was highest at Nalulu (1.29 species, SD = 0.76), followed by Natubari (1.00, SD = 1.13) and Toki (0.60, SD = 0.70). Across all passages, a total of 1,001 individuals were recorded, with 898 individuals representing 60 species across 18 families. A further 46 individuals could only be identified to 11 genera, and 57 individuals to 4 families. After cross-referencing with the IUCN Red List of Threatened Species (IUCN, 2026), 9 species and 1 genus ranging from Critically Endangered to Near-Threatened were identified (Table 1; Figure 3). Additionally, 25%, 19% and 15.9% of the species detected in Toki, Nalulu and Natubari, respectively, were threatened on the IUCN Red List.

Table 1. Summary of IUCN Red-Listed individuals identified from suspended-BRUVs in the three reef passages, with 'x' indicating presence

Fijian name	Common name	Latin name	IUCN Red List status	Toki passage	Natubari passage	Nalulu passage	Total maxN
Vonu taku	Hawksbill sea turtle	*Eretmochelys imbricata*	CR		x		1
Qio ulutuki	Hammerhead shark	*Sphyrna* sp.	CR	x		x	5
Vai Vuka	Ocellated eagle ray	*Aetobatus ocellatus*	EN		x	x	11
Varivoce	Humphead wrasse	*Cheilinus undulatus*	EN	x	x		6
Qio [rewa]saqa	Grey reef shark	*Carcharhinus amblyrhynchos*	EN	x		x	5
Qio dina	White-tip reef shark	*Triaenodon obesus*	VU		x	x	4
Vai	Round ribbontail ray	*Taeniura meyeni*	VU			x	9
Qio dina	Black-tip reef shark	*Carcharhinus melanopterus*	VU		x		1
Qio dina	Silvertip shark	*Carcharhinus albimarginatus*	VU	x	x		2
Walu	Spanish mackerel	*Scomberomorus commerson*	NT	x	x		4

Note: IUCN Red List Status is arranged as: Critically endangered (CR), Endangered (EN), Vulnerable (VU) and Near Threatened (NT). The Fijian names are those given by local fishers of Ovalau; we acknowledge other local names also exist in other localities in Fiji.

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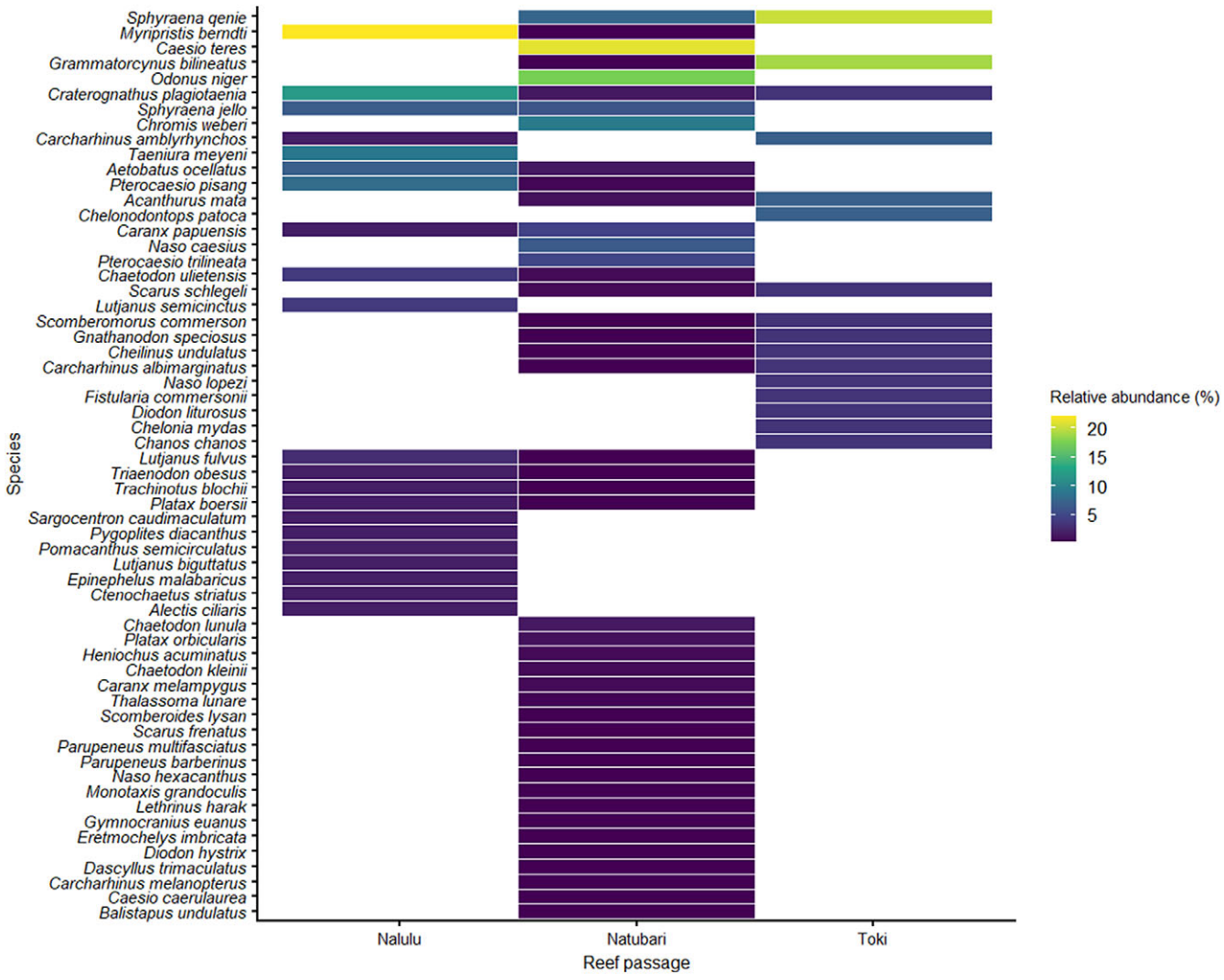


Figure 3. Heatmap of 60 species' relative abundance across the three reef passages. Colour intensity represents the mean MaxN, with lighter shading indicating greater relative abundance recorded at Nalulu, Natubari and Toki reef passages. Species are arranged according to their overall mean MaxN across passages.

Discussion

This study reports the first deployments of suspended-BRUV systems in reef passages in Fiji and demonstrates their potential to effectively document marine species diversity. Across the 3 reef passages studied on Ovalau, the suspended-BRUV system recorded 60 species across 18 families, including 9 species and 1 genus of conservation concern, and several commercially important food fishes. These results are comparable to similar studies elsewhere, for example, Letessier et al. (2013), who identified 761 fishes and sharks in Shark Bay, Western Australia, using modified stereo-BRUV systems in 66 mid-water deployments, and Exeter et al. (2025), who deployed single camera (mono-BRUV) and stereo-BRUV systems in non-reef passage sites, and identified 64 species across 44 families from a total of 11,950 individuals observed from 280 deployments. Contrasting deployment effort and species richness, our results also demonstrate the high biodiversity present in reef passages. For example, using the suspended-BRUV system, we documented both reef-associated and pelagic species moving through the passages, reflecting the importance of complementing conventional benthic-BRUV surveys with pelagic deployments (Whitmarsh et al., 2017; Fields et al., 2026). This approach allows identification of not only reef-associated species on reef slopes, but also pelagic species traversing the passages at different depths (Clua et al., 2015). For example, *Cheilinus undulatus* (Humphead wrasse) was observed in Toki and Natubari; a species of high conservation importance due to its Endangered status (IUCN, 2026) and its ecological role as a predator on coral reefs (Sadovy et al., 2003). Four shark species were also recorded in the surveyed passages, highlighting the ability of the system to detect mobile, hard-to-monitor megafauna (Mourier et al., 2016).

Moreover, at least five IUCN Red List species were present across all three passages. Of the species detected during this short-term survey, 25%, 19% and 15.9% in Toki, Nalulu and Natubari, respectively, were classified as threatened on the IUCN Red List. These findings suggest that well-designed, long-term monitoring of these sites could provide crucial information for assessing the status of conservation-concern marine taxa (Espinoza et al., 2020). In Nalulu, despite having fewer deployments, the presence of

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threatened species such as *Taeniura meyeni* (round ribbontail ray) may reflect the influence of the community-managed '*tabu*' area, illustrating how local management can support species diversity (Hamilton et al., 2011; Clements et al., 2012). Additionally, the Near-Threatened status of *Scomberomorus commerson* (Spanish mackerel), observed in Toki and Natubari, underscored the value of these surveys in detecting locally and regionally important food fishes that are commonly targeted in the Pacific and globally (Moore and Colas, 2016; WCS, 2022). In Fiji's reef passages, this information can guide fishing area zoning, protection of heavily targeted species and monitoring of conservation-concern species. The method's accessibility and simplicity make it suitable for community-led monitoring, empowering stakeholders to contribute to ongoing ecological assessments and adaptive management.

The passage width and area have a fundamental role when deciding deployment locations, as passage size can contribute to different current strengths during tidal changes (Breckwoldt et al., 2022a). The definition of the reef passage width used in this study, along with that described by Breckwoldt et al. (2022a), requires further research in establishing a standardized working classification. Additionally, in this study, no inferential statistical comparisons among passages were conducted, as this study was designed to evaluate the feasibility and utility of the adapted suspended-BRUV system. Given these complexities, future studies should evaluate the influence of spacing between suspended-BRUV deployments within reef passages, including the potential for bait plume overlap and attraction of highly mobile species, to establish appropriate minimum deployment distances for these dynamic environments (Westerberg and Westerberg, 2011; Taylor et al., 2013).

Beyond data collection, this suspended-BRUV system functioned as an effective communication tool in local communities. Summarized video footage enabled the visualization of species, facilitating engagement with fishers, other knowledge holders and also schools. Resulting video footage and posters, with the permission of the villages, were also shared on social media (Dehm et al., 2025). In this way, local ecological knowledge can be jointly validated, thereby stimulating discussions on resource use and awareness around reef passage biodiversity, use, threats, management and on respective local agencies for informing policy-relevant decisions. Community knowledge holders in this study were not simply sources of local ecological information, but contributed experiential knowledge developed through repeated and long-term interactions with reef environments. Their knowledge supported the development of the deployment protocol, advised the team on what results should be reported back to the communities and provided – and can continue to provide – further spatial, temporal and ecological context that complements our observations. Integrating these knowledge systems into ecological assessments strengthens the consideration of reef passages both as ecological features and as socially and culturally significant spaces (Ban et al., 2026; Kaitapu et al., 2026).

Conclusions

The suspended-BRUV system tested in this study performed consistently and reliably across a range of depths (12–64 m) and hydrodynamic conditions, demonstrating that its modular design and adjustable rope lengths enable deployment in both mid-water columns and near-benthic reef slopes. Its low-cost simple construction facilitated rapid assembly, transport and deployment, making it feasible for small research teams and local stakeholders. The combination of sub-surface and surface buoys maintained stability in strong or variable currents, while rope adjustments allowed precise depth control. Compared to conventional, heavy rigid-frame, bottom-mounted benthic-BRUV systems, the suspended system minimized sediment contact and maintained good visibility in strong currents. Future research can modify such systems into stereo-BRUV systems to measure fish length – while our design prioritized modularity, affordability and ease of use in challenging conditions. Minor frame movement occasionally occurred in strong flow, slightly reducing video stability, but the system always faced the direction of the current and did not rotate freely. The generated data are directly relevant to management and conservation, including species presence, abundance and occurrence of threatened taxa. Despite a relatively small sample size constrained by field logistics, the suspended-BRUV system provided an ecological snapshot of mobile reef passage faunal communities. Some minor improvements could optimize future applications. Long deployment ropes occasionally tangled during handling and retrieval; using a rope spool would help maintain organization and smoother depth adjustment. Deployment in very deep areas is limited by rope length and light regimes if bathymetry is unknown or cannot be measured accurately, so we recommend carrying extra rope to account for variable depths. This simple suspended-BRUV methodology can thus be extended to include factors such as variable width and depth of the reef passages, oceanographic conditions and other types of locally validated bait in deployment protocols.

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AI statement. The authors declare that OpenAI ChatGPT was exclusively used to refine grammar, sentence structure and improve R codes for graphing. All suggestions and software codes were critically reviewed and edited further by the authors. No AI tools were used for direct image generation, analysis or review of scientific literature.

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Inclusivity statement. As part of the SOCPacific2R project, the plans of the project in Ovalau were openly shared with all the communities involved throughout the start and end of the study. Local fishers from Tokou, Levuka Vakaviti, Levuka Town and Vatukalo took us to the reef passages on their boats, reflecting actual areas of interest and encouraging local engagement. The results were also shared and discussed with communities, including local schools. At the end of the study, we presented and shared the resulting videos, infographic posters on the BRUV protocol, fish names and species and reports back to the respective communities through both hard and soft copies. All resulting material is available in the outcomes section on https://socpacific.link. Supporting knowledge exchange and mobilized conservation interest strongly aligned with the priorities of the local schools, fishers and other actors.

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