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Fisherwomen's Indigenous and local knowledge - the hidden gems for the management of marine and freshwater resources in Fiji

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Fisherwomen in Fiji play a vital role in the daily sustenance of their families and they use their Indigenous and local knowledge to harvest resources. Marine and freshwater resources harvested by fisherwomen contribute to the primary protein intake of their families, particularly for those who have limited or no access to other animal products or plant proteins. Over a span of three decades, Fiji experienced an influx in the documentation of women's contribution and need for fisherwomen's recognition in the fisheries sector; in areas of cultural and/or socio-economic, resource management and decision-making processes. This study examines the Indigenous and local knowledge which fisherwomen utilize to identify their targeted marine and freshwater resources and gauge the population health of their resources. Furthermore, fisherwomen's perceptions on the conservation status of their resources is used to provide the basis for improved management of culturally, economically and ecologically valuable species. The results of this study compiles Indigenous taxonomic classifications and associated species knowledge which fisherwomen from 11 communities use to help them in identifying and capturing resources. Moreover, the fishing methods, ecological knowledge and perceptions on environmental changes over thirty years provides temporal background on the fisherwomen's knowledge. The results address knowledge gap between fisherwomen's Indigenous and local knowledge and science by marrying the well-developed knowledge systems. Finally, this study provides recommendations on how the Indigenous and local knowledge of women can contribute to practical and efficient resource management for localized challenges in Fiji.

KEYWORDS

fisherwomen, ILK, keystone species, knowledge transmission, resource management, traditional taxonomies

1 Introduction

Indigenous and local knowledge (ILK) are "beliefs, knowledge, customs, management systems, taxonomy and language, that a given culture, including modern science has for biodiversity (Thaman, 2008:103). This knowledge system evolved over millennia with human-environment interactions, creating a time-tested knowledge system, which is qualitative and holistic (Gadgil et al., 1993; Kitolelei et al., 2021). This means that ILK provides a strong foundation which encourages environmental cohesiveness and creates cultural identity as a basis for sustainability (Thaman, 2013; Pollard et al., 2015). Over the years, Indigenous people were able to adapt to change, sustainably utilize resources and conserve their biodiversity by using their ILK, skills, customary management systems, taxonomic systems and traditional practices (Huntington, 2000; Lauer and Aswani, 2009). Moreover, ILK is also used by Indigenous people to systematically exploit resources (Veitayaki, 1994; Kitolelei et al., 2021).

Daily contact with the environment provides Indigenous people and women with basic biological and ecological knowledge on marine species, where they identify resources using traditional taxonomies. For this reason, the conservation of biodiversity and its associated ILK needs to be considered of equal importance (Caillaud et al., 2004). Although ILK evolves over time and is slowly being documented, it still suffers heavy erosion due to its lack of transmission (Ruddle, 1993). Thaman (2008) mentioned that, the "hidden crisis" of ethno-biodiversity extinction is more serious for humanity than biological taxa extinction because it means loss of ILK and its associated taxonomic expertise. This is because loss of ethno-biodiversity undermines attempts at using ILK to sustain human wellbeing and local conservation (Pollard et al., 2015).

ILK influences women and men's resilience and coping mechanisms to natural and anthropogenic stressors which interfere with their local environment. As a result gendered perceptions of environmental change are created and impacts the ability of women and men to adapt to changes (Lauer and Aswani, 2009). Throughout Fiji and the wider Pacific, ILK transmission is focused on commercially targeted marine and freshwater resources, and this knowledge is transmitted and documented. However, knowledge of non-commercial marine and freshwater resources of little or no economic value is often overlooked or forgotten amongst today's fishers as they pursue the locally present and commercially valuable resources such as sea cucumbers, mangrove crabs and selected finfishes such as the rabbitfish and trevallies (Kitolelei et al., 2021).

Globally, women have contributed to the harvest of fisheries resources through their roles as traditional and artisanal fishers (Solano et al., 2021); contributing 56% of subsistence and commercial catch of invertebrates and smaller finfish for household consumption (Harper et al., 2020). In some Pacific Islands, including Fiji, women were/are the main fishers harvesting shellfish and smaller finfish for subsistence use (Levine and Sauafea-Le'au, 2013; Vunisea, 2016; Kitolelei et al., 2021).

This study provides insights into fisherwomen's ILK and how they are hidden gems needed to inform more holistic resource management efforts at the community level. This paper creates an awareness on the importance of women's ILK and its contributions fisheries management. In doing so, this study discusses how fisherwomen interpret the effects of environmental changes on their marine and freshwater resources. Furthermore, an emphasis on the value of using local vernacular names and local dialects the conservation will be discussed. Finally, this study provides recommendations for the incorporation fisherwomen's ILK into management practices which can benefit the communities, fishers and the resources.

2 Materials and methods

2.1 Study sites

This study is based on the ILK of fisherwomen from eleven fishing communities in Fiji (Figure 1). The communities were selected as Fiji's traditionally renowned fishing communities or suppliers of resources to the nearby fishing markets or towns. Eight of the eleven communities have access to both freshwater and marine resource and utilize the fishing areas from the rivers all the way to the reef edges (Table 1). Seven communities belong to the Rewa Province (Vunisinu, Nalase, Nukui and the villages of Vanua Navakavu - Muaivuso, Nabaka, Waiqanake and Namakala). Vunisinu, Nalase and Nukui are located on the Rewa Delta along the Rewa River, while the villages of Vanua Navakavu are located on the Muaivuso Peninsula west of the Suva Peninsula. Two communities, Ucunivanua and Qoma belong to the Tailevu Province which is on Viti Levu. And lastly, Batinivuriwai and Denimanu belong to the Bua Province which are part of Vanua Levu (Table 1). In all communities, women fish for subsistence use and for sale.

2.2 Data collection

Four data collection methods were used: 1) in-depth interviews with elder fishers; 2) questionnaire guided group interview; 3) participatory iketekete surveys (catch per unit effort surveys) and 4) talanoa (informal iTaukei storytelling) with selected fisherwomen (Table 1).

Three sampling methods were used to select the study participants. i) Judgement sampling method was used by community members to select the elders as in-depth

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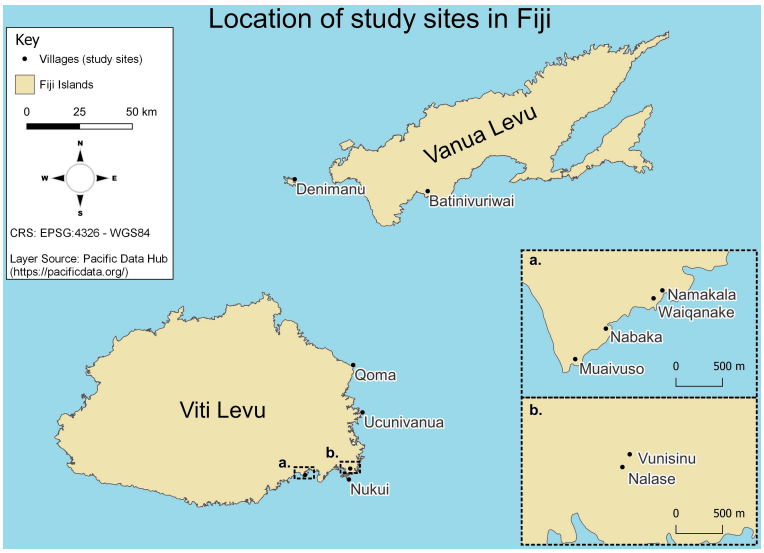

FIGURE 1
Map showing the study in the Fiji Islands. Inset map **(A)** villages in Dreketi (Vunisinu and Nalase; **(B)** Vanua Navakavu (Muaivuso, Nabaka, Waiqanake and Namakala). Source: Flanders Marine Institute (2022). Maritime Boundaries Geodatabase, version 11. Available online at https://www.marineregions.org/ http://doi.org/10.14284/382.

interviewees. Community members (women and men) nominated the names of their most knowledgeable elder fisherwomen in the community for the in-depth interviews. The elder fisherwomen who were nominated either used to actively participate or still participated in fishing, gleaning and passed their knowledge of resources to their community through stories or in-field training with younger fisherwomen. ii) Questionnaire guided group interview participants were selected through cluster sampling method and the women were contacted through the Women's Group leader then were interviewed in respective clusters. iii) Simple random sampling was done for the iketekete surveys to record the catch per unit effort (CPUE) from both in-field and on the shore survey of daily catch. A combination of judgement and simple random sampling was used to select talanoa session participants. Talanoa participants were selected by the researcher with the

TABLE 1 **Number of fisherwomen who participated in the in-depth interviews,** talanoa **sessions and questionnaire-guided interviews in a group setting.**

Division	Province	Village name	Access to fresh-water and/or marine environment	Elders interviewed 60+ years (in-depth interviews)	Number of women participated in group questionnaires	Number of women participated in talanoa	Number of iketekete surveys accompanied/ surveyed (on the shore/ on the fishing boats)
Central	Tailevu	Qoma	M	5	9	3	3
		Ucunivanua	M	2	3	2	0
	Rewa	Nalase	FW and M	4	6	3	2
		Nukui	FW and M	2	3	2	1
		Vunisinu	FW and M	6	7	6	2
		Muaivuso	FW and M	4	7	2	5
		Nabaka	FW and M	3	8	3	4
		Namakala	FW and M	4	6	1	4
		Waiqanake	FW and M	5	11	2	6
Northern	Bua	Denimanu	M	9	12	2	3
		Batinivuriwai	FW and M	7	9	5	2
TOTAL				51	81	31	32

Access to freshwater and/or marine environment key: M, marine; FW, freshwater.
A total of 163 women were part of this study from 11 villages in 3 provinces (Tailevu, Rewa and Bua).

assistance of the turaga ni koro (community spokesman) and the leader of the Women's group from the community. In some instances, participants in the talanoa sessions also participated in the group interviews, however potential overlap in the information was avoided because the questions used in the two data collection methods were different. Quantitative and qualitative data were collected and analyzed through Microsoft Excel (Table 2). Due to cultural sensitivity, information such as traditional place names for fishing areas, customary practices and rituals and the location of customarily significant spaces were documented separately and omitted from this study to protect the resources and customs associated with those areas and activities.

2.2.1 In-depth interviews

Fifty-one fisherwomen over 60 years of age were interviewed using in-depth interviews. The fisherwomen were former and current fishers who were expert gleaners (dauvivili) and crab catchers when they were younger. These fisherwomen were also highly sought after for their knowledge on resources. The in-depth interviews were conducted in the interviewee homes to avoid unnecessary movement that could inconvenience some of the elder fisherwomen and to provide a comfortable environment which allowed elders to answer interview questions with less disturbance from outside participants. Four questions were used to guide the in-depth interviews: i) what major events have occurred in the marine or freshwater areas during your lifetime? ii) how have the changes affected the resource size, abundance and distribution in your marine/freshwater environments? iii) which resources are now rare, in short supply or extirpated? iv) what can be done to restore the fisheries resources in the marine and freshwater environments that are now endangered? The interview questions were open-ended which allowed the fisherwomen to talk about their experiences and perceptions on temporal changes in their target fishing areas. Qualitative data collected through in-depth interviews included 30 years of environmental changes and resource abundance/absence in the 11 communities. A timeline of events which greatly influenced the environmental changes was documented which coincided with the disappearance/appearance of some organisms, which in turn affected the habitats within the fishing grounds.

2.2.2 Questionnaire guided group interviews

An in-depth questionnaire was used for the group interviews and a researcher administered the sessions. Open-ended questions were used to allow open responses from the participants. The groups were made of 5 – 8 women and meetings were arranged with the fisherwomen on a time when participants were available (on evenings or during the Women's group weekly community meeting). A total of 81 fisherwomen between 18 – 59 years of age participated in this survey. The questionnaire was designed with repetition, focusing on the same questions from several standpoints. For example, introductory questions required fisherwomen to identify the marine or freshwater plants and animals which are culturally or ecologically important then elaborate their values. The follow up questions separated marine and freshwater resources into families and further into species while documenting the species biological, cultural and ecological knowledge from the fisherwomen's perspectives (Figure 2). The fisherwomen were required to use only the local names when identifying resources. The local names of species were linked to scientific names using reference books including Allen and Steene's Indo-Pacific coral reef guide (2007), Colin and Arneson's *Tropical Pacific Invertebrates* (1995), Bergbauer and Kirschner's *Reef fishes of the Indo-Pacific* (2020), Wye's *Pocket guide to shells* (2007) and Randall's Reef and shore fishes of the South Pacific (2005). Quantitative information on the number of species identified and the number of local names were counted and tallied for all communities and represented in the tables and graphs.

2.2.3 Participatory iketekete surveys

The iketekete surveys were done to assess the target finfish and the CPUE, photograph target resources and assign local names to resources which were harvested or sighted. A total of 33 surveys were done, where the researcher either accompanied fishers on their fishing trips and participated in fishing or surveyed fishers' catch upon their return from fishing trips. The local names of target resources recorded and later assigned a scientific name by the researcher, with the assistance of the fishers checking the reference books and comparing the field photos to reference books. Quantitative data was collected through the participatory iketekete surveys. The data included information on the most targeted resources used for either subsistence or sale. Descriptive statistics including the

TABLE 2 Data collection and analysis methods used in this study.

Data collection method	Type of questions	Type of data collected	Analysis method
In-depth interviews	Open-ended	QTY and QLT	CA and NA
Group questionnaires	Open-ended	QTY and QLT	CA and NA
iketekete surveys	Closed-ended	QTY	DS
Talanoa	Open-ended	QLT	CA and NA

Type of data collected key: QTY, Quantitative; QLT, Qualitative; CA, Content analysis; NA, Narrative analysis; DS, Descriptive statistics.

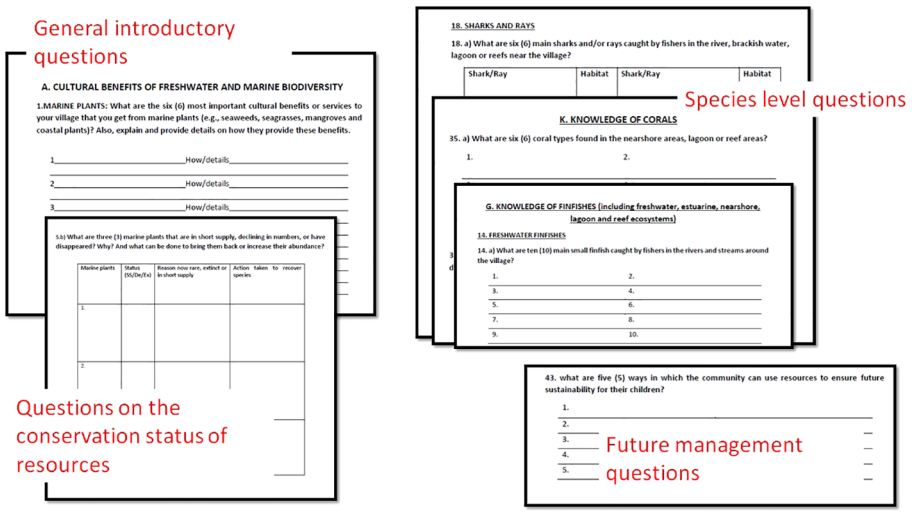

FIGURE 2
Snippets of the questionnaire used in this survey.

frequency and percentages of CPUE were calculated and compared to the fisherwomen responses on the most captured resources and the presence/absence of resources.

2.2.4 Talanoa sessions

Thirty-one women participated in talanoa sessions. Talanoa was conducted with individuals or groups in a relaxed setting where fisherwomen were able to share their stories on fishing. No formal structure given to the talanoa, and questions which the interviewer used were open-ended questions based on the responses from the previous questions. For example, if the fisherwomen mentioned an environmental change, the next question would find out the kind of change, its effects on the organisms and the year in which the events occurred. Qualitative data was collected through talanoa and the results were analyzed using content and narrative analysis and classified according to the themes listed in the in-depth interviews. The data collected through talanoa sessions included information on important environmental changes, fishing gear and technique changes and the ILK gap between generations.

There were a total of 163 interviewees participated in this research summarized in Table 1. A summary of the type of questions used for each data collection method, the type of data collected and how the data was analyzed is provided in Table 2.

2.3 Data analysis

Qualitative data gathered through the field work was analyzed using content and narrative analysis. All the information was classified into themes which were coded on Excel sheets. The codes were based on the questions and the kind of answers which were given. Some of the codes included in the content and narrative analysis include: Keystone status (cultural [CSK] or keystone [KS]), ecosystem benefits (ESB), conservation status (CS), taxonomic classification (TC), organism information (OI) and resource management (RM). Patterns which emerged from the in-depth interviews were classed into similar themes according to the questions and coded on Excel as: ecosystem changes and effects on fishing grounds (EC), temporal changes (TC), population dynamics (PD), resource conservation status (CS), management implications (MG) and suggestions.

Information related to Indigenous taxonomic classification was analyzed as qualitative and quantitative data. All generic local names of species as they are known by in the Bau dialect (standard iTaukei language) or by their trade name is noted alongside the unique local names identified from communities. The unique local names of species include the names in the local dialect, distinct names for size classes, colour phases, growth stages and sex. The local names which were recorded were compared to past reports, books and thesis research done in communities or in nearby communities including Passfield (1997) for Ucunivanua; Thaman et al. (2008) and Thaman et al. (2017) for Vanua Navakavu – Muaivusu, Nabaka, Namakala and Waiqanake; Veitayaki (1990) for Qoma, Tuiwawa et al. (2013) for Rewa (Nukui, Nalase and Vunisinu); Morrison et al. (2009) for Tailevu; Wildlife Conservation Society (2012) for Denimanu and Batinivuriwai. Due to the variation in dialects across some provinces, fishers were asked to identify species by describing them and also pointing them out in the reference books. The names are also checked against a Fijian-English dictionary by Gatty (2009). The number of names for

each species were counted and included as statistics for Indigenous taxonomic classification and presented in tables.

Information on species ecology and symbiotic relationships was compared to existing literature globally and in Pacific. The information which women shared about species ecological relationships was also compared with information from global species databases including FishBase, World Register of Marine Species (WoRMS) and the Global Biodiversity Information Facility (GBIF). Throughout this study, we refer to keystone species, cultural keystone species, plants as indicators, ecological knowledge and ILK. Keystone species are those species which hold an ecosystem together and their disappearance can affect an ecosystem (Paine, 1969; Terborgh, 1986). Cultural keystone species are those species which are of exceptional significance to people or their culture and can be identified in their local languages, diets, traditions, totems or cultural practices (Garibaldi and Turner, 2004). Indicator species are those species which are used to monitor the health of an ecosystem by reflecting the changes which occur in its environment (Niemi and McDonald, 2004). The ecological knowledge of species refers to knowledge of species and their relationships within their ecosystems. ILK is used in place of Indigenous Knowledge (IK), Traditional Ecological Knowledge (TEK), Local Knowledge (LK), Fisher Ecological Knowledge (FEK) and citizen science. This study uses ILK because it reflects both Indigenous Knowledge of a whole community and the local knowledge of individual fisherwomen who were interviewed.

The sites in this study are centered around western Vanua Levu and eastern Viti Levu therefore cannot be used to make generalizations on fisherwomen's ILK in Fiji. However, this study is the first of its kind for Fiji and the Pacific in relation to women's fishing and associated ILK. The eleven communities discussed herein provide a snapshot of the kind of information which can be collated from a marriage between fisherwomen's ILK and Western science.

3 Results

3.1 Traditional taxonomic classifications

A total of 568 organisms belonging to 149 families were identified in their 616 local names, where fisherwomen were using the local dialects (Table 3). The 568 organisms include 324 finfish species from 142 genera in 64 families. There were some finfish species identified by fisherwomen in all eleven communities (Table 4). These include the emperors (*Lethrinus* spp. [6 species] – kabatia), snappers and sea-perches (*Lutjanus* spp. [3 species] – kake), goatfishes (*Upeneus* spp. [3 species]- ki), Parrotfish (*Cetoscarus bicolor*, *Hipposcarus longiceps and Scarus ghobban* - ulavi), groupers (*Epinephelus* spp. [5 species]- kawakawa) and rabbitfish (*Signus vermiculatus* - nuqa).

TABLE 3 Number of species within specified higher taxonomic categories that have been identified by women through in-field experience.

TAXON	Number of families	Number of species	Number of local names used to identify species
Sharks	4	8	16
Rays	3	7	14
Eels	5	15	32
Other finfish**	52	294	304
Echinoderms	9	27	30
Crustaceans	21	54	71
Gastropods	11	76	56
Bivalves	17	35	41
Cephalopods	3	4	6
Other mollusks	2	6	7
Worms	3	11	2
Anemones	2	6	5
Seagrasses and Algae	10	13	14
Reptiles	1	3	7
Corals	6	9	11
TOTAL	149*	568	616

*Total number of families:
Finfishes** (64 families); invertebrates (75 families); marine plants (10 families).
** Finfishes refers to sharks, rays, eels and other finfish, a biological group of fishes which distinguishes them from other animals which are have common names which end with "fish" such as shellfish or cuttlefish. Other finfish refers to fish families outside of the shark, ray and eel taxon.
Mollusks are in *italics*.

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TABLE 4 Resources identified by all eleven communities using their generic iTaukei names.

Scientific name	Taxon	Family	Generic local name	No. of species
Lethrinus spp.	Finfish	Emperors	Kabatia	6
Lutjanus spp.	Finfish	Snappers and sea-perches	Kake	3
Upeneus spp.	Finfish	Goatfishes	Ki	3
Cetoscarus bicolor, Hipposcarus longiceps and Scarus ghobban	Finfish	Parrotfishes	Ulavi	3
Epinephelus spp.	Finfish	Groupers	Kawakawa	5
Siganus vermiculatus	Finfish	Rabbitfish	Nuqa	1
Actinopyga mauritiana	Echinoderm	Surf redfish	Tarase	1
Holothuria (Microthele) fuscogilva	Echinoderm	White teatfish	Sucuwalu	1
Stichopus chloronotus	Echinoderm	Brownfish	Sucudrau	1
Charonia tritonis	Gastropod	Giant triton	Davui	1
Octopus cyanea	Mollusk	Common octopus	Kuita	1
Austruca lactea	Crustacean	Yellow fiddler crab	Toto	1
Cardisoma carnifex	Crustacean	Giant land crab	Lairo	1
Scylla serrata	Crustacean	Green mangrove crab	Qari	1
Penaeus spp.	Crustacean	Prawns	Ura	4

Moreover, 228 invertebrate species from 122 genera in 73 families were identified by the women. Of these 228 species, 10 were identified across the eleven communities (Table 4) including 3 sea cucumbers (surf redfish – *Actinopyga mauritiana* - tarase; white teatfish – *Holothuria* (*Microthele) fuscogilva* - sucuwalu and brownfish – *Stichopus chloronotus* - sucudrau), the giant triton trumpet (*Charonia tritonis* - davui), octopus (*Octopus cyanea* - kuita), 3 crabs (yellow fiddler crab – *Austuca lactea* - toto; giant land crab – *Cardisoma carniflex* - lairo and green mangrove crab – *Scylla serrata* - qari) and prawns (*Penaeus* spp. [4 species]). For the invertebrates, the crustaceans, gastropods and bivalve taxa had the highest number of species identified by fisherwomen, however, majority of the species were identified using their generic names such as the hermit crabs (family Diogenidae) are identified as uga or kasikasi, prawns (family Penaeidae) identified as ura, moon snails (family Naticidae) identified as dredrevula/drevula and cone shells (family Conidae) identified as vuru, golea or koi ni masi. Some of the actual local names of species are either lost or forgotten because the species were no longer sought after or have become rare from overexploitation or extirpated from found within the fishing areas.

Thirteen marine plant species from 11 genera in 10 families were also identified. Seven of the marine plants are identified by their generic local names including lecau for padina (*Padina* sp.), halimeda (*Halimeda* sp.), sargassum (*Sargassum* sp.) and brown algae (*Hydroclathratus clathratus*); and vutia for the seagrass species (*Halodule uninervis* and *H. pinifolia*). The remaining 6 marine plants species were all edible and highly exploited by fisherwomen and are known by unique local names among the fisherwomen including nama, nama balavu (sea grapes – *Caulerpa racemosa*), lumi karo, lumi karokaro (spiny red seaweed – *Acanthophora spicifera*), lumi wawa (red algae – *Hypnea spinella*), lumi cevata (tattered sea moss - *H. pannosa*), lumi wa (red algae – *Gracilariopsis logissima*) and lumi boso (green algae – *Ulva (Enteromorpha) intestinalis*).

Fourteen local names are repeated for finfish species in families like cumu in the Monacanthidae and Ballistidae families (Supplementary Table 1). There are 51 distinct names for 39 finfishes which refer fish size classes (small, medium, large), color phases, growth stages (initial phase, terminal phase, juvenile, adult) and sex (Supplementary Table 2). The most used feature which fisherwomen use to identify the finfish are the growth stages and size class (Figure 3). For example, in the family Scaridae (*Scarus spinus*) is known as bubute in its initial stage and kakarawa in its terminal phase. In the family Mullidae (*Parupeneus cyclostomus*) is known as cucu in its juvenile stage and cucu dromo as an adult. And in the family Mugilidae (*Crenimugil crenilabis*) is known as sevou when it is small, senikanace as a medium sized fish and kanace as a large fish or as keteleka when small, tumō as medium size, kanace as a large fish and yawa as a very large fish.

3.2 Behavior of target organisms

The ecological knowledge of species includes the roles of species in their habitats, feeding habits, symbiotic relationships and seasonal indicators for spawning and aggregation periods. Fisherwomen identified marine plants such as the seagrasses (vutia, vutia dina), macro-algae (lecau, luluwa, lumi karo) and seagrapes (nama, nama dina) as important water filters, habitats for juvenile fish and seahorses, crustaceans, mollusks and food for sea turtles (Table 5). The giant triton (*Charonia tritonis* - davui) is identified as an important gastropod as it feeds on mollusks including the crown of thorns starfish (*Acanthaster*

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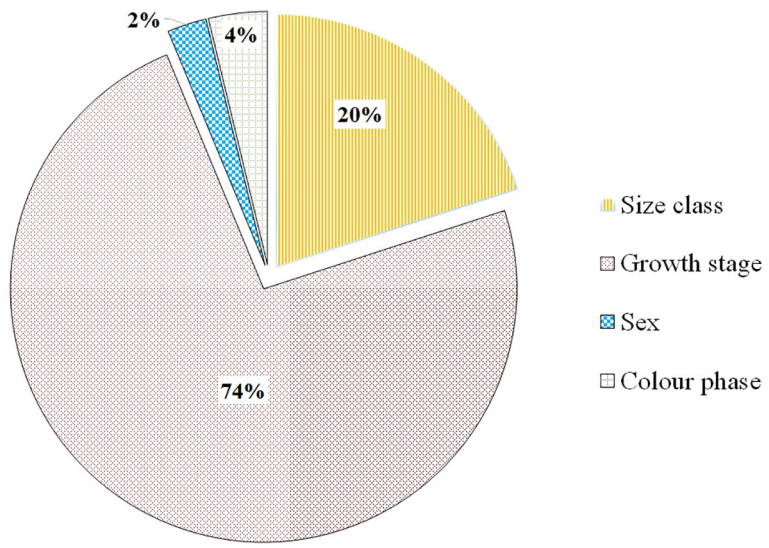

FIGURE 3
Categories for distinct local vernacular names as identified by fisherwomen in the study sites.

planci - bula). Several gastropods including the nerite snails (Neritidae - sisici, sici), top shells, trochus (Trochidae - sici dina, tovu), conches (Strombidae - yaga, wega), true cowries (Cypraeidae - buli) and cones (Conidae - vuru, golea, koi ni masi) were described as shells used by hermit crabs and some of the species were prey for octopus. The bumphead parrotfish (*Bolbometopom muricatum* - kaliā) is a large reef fish identified as one which cleans the reef and produces sand. The rabbitfish (*Siganus* sp. - nuqa) clean the benthic area by feeding on benthic algae and macro-algae. Freshwater prawns (*Palaemon concinnus* - moci, *Macrobrachium equidens* - ura kadikadi, *M. lar* - ura ni waidranu) are identified as prey for eels in the rivers. Finally, the Samoan silverside (*Hypoatherina temminckii* - cavu, vaya) is abundant in areas of healthy corals.

According to interviewees, seahorses (*Hippocampus* sp. - ose ni waitui) are found in areas of where seagrass is abundant and their presence indicates the health of the seagrass and seaweed habitats. Seahorses are often absent from areas disturbed by anthropogenic activities. The gold-ring cowrie (*Monetaria annulus* - bulibuli) was identified as an organism which is abundant during afternoon low tides and the sargassum crab (*Varuna litterata* - teimave) is abundant during floods when it is carried downstream on debris such as bamboo, driftwood or on water hyacinth (*Pontedaria crassipes* - bekabekairaga). Two groupers known as senikawakawa– the honeycomb grouper (*Epinephelus merra*) and the netfin grouper (*E. miliaris*) are targeted when pregnant because they are known to be drowsy when pregnant.

Three symbiotic relationships between species were also identified during interviews. The broad head sleeper fish (*Eleotris melanosoma* - batua, kurukoto) swims with the snakehead gudgeon (*Giuris margaritacea* - sika, ikabau) and sometimes jump out of the water together. The reef stonefish (*Synanceia verrucosa* - lewamatua, novu) is usually found with the coral banded shrimp (*Stenopus hispidus* - ura, moci). The white-spotted spinefoot (*Siganus canaliculatus* - nuqa vatu) is usually found with a cleaner shrimp in the seagrass meadows.

3.3 Keystone species and cultural keystone species

Fisherwomen described several species from their fishing areas as keystone species such as the seagrass, green bumphead parrotfish and the giant triton (Table 5 and Supplementary Table 2). These species are found in fisherwomen's frequently visited fishing habitats. Fisherwomen fish extensively within the mangrove areas, seagrass meadows and coral reef areas, therefore they understood the value of these individual habitats to organisms. For example, seagrass and mangroves are known as important nurseries for many marine and freshwater organisms like the sharks and many reef fish. Some women identified the seagrass, mangroves and coral reefs as keystone habitats, because their destruction led to the loss of many of their resources. An example was given by one of the fisherwomen, who mentioned that the heavy use of chemicals on land destroyed many of their seagrass areas, and led to a heavy loss of their shellfish. Another example is the removal of coral heads and using of fish poisons in them, killing large populations of fish and other marine resources in the vicinity. Moreover, the

TABLE 5 Keystone species identified by women.

Organism	Ecological role (as described by fisherwomen)	Scientific findings summarized over the years	Citation for scientific findings
Seagrass (vutia) *Halodule uninervis, H. pinifolia*	Food for fish, trap sediments, home for juveniles, habitat for shellfish, food for sea turtles (kakana kedra na ika, vanua ni vuni kei na moce ni luveni ika, vanua dau vuni kina na sici, kena kakana na vonu, vesuka na duka)	Feeding, nursery, refuge habitat for fishes, invertebrates and other animals. Bioengineers of the marine environment.	Allen & Steene, 2007; Kelkar et al., 2013; Nordlund et al., 2018
Green bumphead parrotfish (kalia/ulurua) *Bolbometopon muricatum*	Cleans the water, corals and produces sand (kania na duka lalai e loma ni wai, vasavasavataka na lase, buli nuku)	Ecosystem engineers which cause bio-erosion and produces sand. Feeds on both benthic algae and live coral	Randall, 2005; Thomson et al., 2021
Giant triton (davui) *Charonia tritonis*	Feeds on crown of thorns starfish and cleans the water. Food for people (kania na bula, vakasavasavataka na wai, kakana kedra na tamata)	Preys on echinoderms, mollusks, tube worms and sea squirts including sea urchins and the crown of thorns starfish (*Acanthaster planci*)	Allen & Steene, 2007; Schlaff et al., 2020
Rabbitfishes (Nuqa) *Siganus* spp.	Cleans the water by feeding on benthic algae (vakasavasavataka na wai baleta ni kania na duka)	Feeds mainly on benthic algae and sometimes sponges. Grazes on reef turf algae and off reef detrital aggregates	Randall, 2005; Fox et al., 2009
Cone shell (Golea/Vuru) *Conus* spp.	Empty shells used by hermit crabs as (vale ni uga)	Highly specialized predators which feed on worms, molluscs or fishes. Empty shells used by hermit crabs.	Allen & Steene, 2007; Thaman et al., 2017
Mudskipper (tido/tidoloko/ tidrai) *Periophthalmus kalolo*	Indicates clean environment, early warning system for other organisms upstream on approaching flood (ni levu na tidrai, e vakaraitaka na savasava ni veidogo kei na uciwai – yali na veimataqali wainimate dau vakamate co. E dau cabe cake na tidrai e na gauna sa voleka mai e dua na ualuvu me vakaraitaka vei ira na veikabula ni sa vakarau yaco mai na draki ca)	Potential bio-markers and bio-indicators for pollutants. Graze on algae and diatoms and preys on crustaceans and on mudflats. Mudskippers are prey for many predators. Ecological indicator for coastal and inorganic pollution	Ansari et al., 2014

Ecological roles described by the fisherwomen were compared to scientific information gathered about the identified species. iTaukei translation from the field included beneath the English version of the ecological roles identified by the fisherwomen.

removal of mangroves to create space for development, led to heavy sedimentation in nearby ecosystems and the loss of many crab and mud lobster habitats where fisherwomen went to hand collect the crustaceans.

Cultural keystone species were also identified by the fisherwomen. One particular example was the kanace (mullet - *C. crenilabis*) which has several rituals involved when it is harvested. The mullet is used as an important cultural food and bait. Another example is the nuqa (rabbitfish - *Siganus* spp). This fish is known to spawn in December and January and fishers take great care in reading the lunar cycle in order to harvest the fish. Another important finfish which is harvested by fisherwomen and plays an important role in many dietary needs of the local families is kabatia (*Lethrinus* spp.). The mangrove prawn (moci - *P. concinnus*) is a used as a chiefly delicacy and prepared by women in Rewa, who wrap deshelled shrimp balls in taro leaves, cook them in coconut milk and present the dish to their paramount chief. Cultural keystone species identified by fisherwomen were also used as totems, ceremonial food and are identified by several unique local names.

3.4 Factors driving fisher behavior, fishing locations and gear

The fisherwomen from the eleven study sites mentioned that the weather, fish aggregation/spawning seasons, tidal movement and lunar cycle influenced their fishing decisions. A fisherwoman mentioned that during bad weather, fish warily nip at the fisherwomen's bait therefore bad weather was not a good time for fishing. Fisherwomen who used nets in rivers paid attention to the tidal movements when targetting prawns or freshwater fish. Some of the fisherwomen mentioned the importance of following the lunar cycles when they went out at night to look for crabs in the mangrove areas. Seasonal aggregations for many marine resources were understood by fisherwomen as they systematically targeted certain species to feed their families. Other factors which influence women's fishing include community customs and protocols such as the harvest of mangrove prawns (moci) which are made into a delicacy for a paramount chief. Generating income is also another driving factor influencing fisherwomen's fishing

behavior. In some instances, fisherwomen needed to earn money to send their children to school, purchase household essentials and help their family with monetary obligations required from the church or community.

Fisherwomen utilize resources from the rivers to the reef edge. Whenever possible, fisherwomen accompany their husbands to open sea and fish over submerged reefs. While fishing in the rivers or gleaning in the mangrove areas and seagrass beds (Zone 1) (Figure 4), fiisherwomen captured their target resources in small channels and streams, on branches or roots of the mangroves, near fallen trees or branches deposited in the waterways by natural extreme events and on sand flats, seagrass areas and mudflats of the intertidal zone. In these areas, women are able to capture crustaceans including the green mangrove crabs (qari), red-clawed crab (kuka damu), black mangrove crabs (kuka loa), ghost crabs (kawiki), fiddler crabs (toto), prawns (ura), shrimps (moci) and mud lobsters (manā); mollusks including several gastropods, bivalves and cephalopods; freshwater and brackish water finfishes and eels.

In Zone 1, fisherwomen used a hook and line, hand held fishing nets (taraki) and gleaning/hand collecting resources. Further out, between the lagoon to the fore reef (Zone 2), fisherwomen utilized the lagoon area and blue holes, coral reefs, rock crevices and sandy areas. In these areas, the fisherwomen were able to capture crustaceans, mollusks (those found in Zone 1 and including other mollusks such as sea hares (veata, senikavere), seagrass and macroalgae and premium coral reef fishes (Supplementary Table 2). In these areas, women use their hook and line, diving, fishing nets and spear fishing to capture their target resources. Finally, in Zone 3 fisherwomen use hand-held lines to fish in deep reef areas and capture large premium finfish. The majority of the fishing activities which fisherwomen are involved in utilizes Zone 1 and 2, where about 70% of their catch from Zone 1 is used for subsistence purposes and those captured in Zone 2 and Zone 3 are sold out of necessity to provide income for their family commitments such as church obligations or family fundraisings or to assist and/or manage finances of the family.

Fisherwomen identified plants which were used as seasonal cues for presence/absence of marine resources. For example, when manderines (*Citrus reticulata* - madarini) bear fruit, this signifies the presence of the otomebora mullet (*Planiliza melinoptera* - molisa, wabubu) in the nearshore waters. When the ti plant (*Cordyline fruticosa* - vasili) and coral tree (*Erythrina variegata* - drala) flowers, these plants signify octopus season. Finally, when the blinding tree (*Excoecaria agallocha* - sinugaga) flowers, this signifies the season when sharks give birth in the major rivers of Fiji, therefore, women and elders inform their children to refrain from swimming or making noise while swimming.

3.5 Exploitation or threats

Ninety-three species were identified as decreasing, in short supply, rare or extirpated (Table 6). Of these species the most affected taxa include seaweeds and macroalgae (3 species), bivalves (17 species), gastropods (17 species), crustaceans (13 species), echinoderms (3 species) and finfishes (40 species) (Table 6). In terms of the species conservation status, bivalves make up 43% of the total species identified as extirpated and gastropods make up 20% of the total species identified as rare.

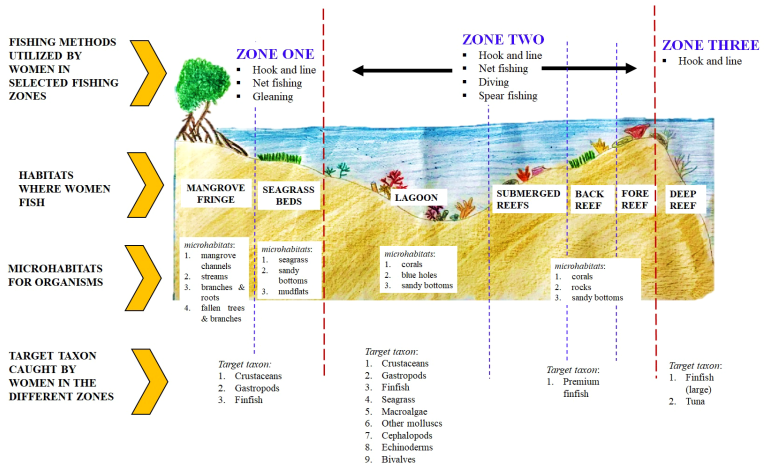

FIGURE 4
Fishing methods, location and target taxon which the fisherwomen in this study utilize when fishing in their fishing boundaries. Zone One includes the mangrove fringe (**veidogo**) and seagrass beds (**veivutia**), Zone Two includes the lagoon (**tobu**) to the fore reef (**cakau**) and Zone Three includes the deep reef (**batilili**) and open ocean (**wasawasa**).

Finfishes make up 66% of the species identified as in short supply and 91% of the species identified as decreasing. Moreover, from the fisherwomen's perspectives on exploitation and their knowledge on the status of their fisheries, finfish are the most exploited resource followed by the shellfish (bivalves and gastropods) then crustaceans. When compared to the total number of species identified per taxon (as listed in Table 3), the exploitation level includes 23% of the identified seagrass and algae, 49% of the bivalves, 22% of the gastropods, 24% of the crustaceans, 8% of the echinoderms and 14% of the finfishes (Table 6).

Fisherwomen reported environmental changes which they noticed over 30 years of fishing. One hundred percent of the fisherwomen reported the decrease in resource abundance and size. Fifty seven percent reported species diversity decreased; 50% reported changes in migration patterns of species; 72% reported changes in benthic substrates within fishing areas; 61% reported changes in rivers and stream morphology and resource exploitation due to commercialization has increased (Table 7 and Figure 5). The heavy exploitation which occurred is due to the target of high value commercial species, use of destructive fishing methods such as fish poisons and gill nets; no size controls; clearing of mangroves and coastal vegetation for development or firewood and the use of chemicals on farms and overgrown roadside weeds.

3.6 Management implications and suggestions

In order to address the challenges, fisherwomen mentioned actions which could be done to address the seven challenges identified in this study. These methods include 1) setting an appropriate quota on target species; 2) maturity size awareness and size controls; 3) banning the use of destructive fishing methods and gear including fish poisons and gillnets; 4) total ban on the capture of species during spawning periods; 5) restoring plants in wetland areas including the mangroves and mangrove associates; 6) ban the use of harmful chemicals and suggest alternative methods to remove weeds and insects; 7) appointing fishing wardens to monitor fishing boundaries and equip them with power to seize illegal catch and 8) reintroducing the extirpated or endangered species (Table 7).

Fisherwomen suggested they teach their children the importance of catching what they need and the importance of passing on their ILK on fishing knowledge to their children because it creates an awareness of the importance of the resources. Finally, fisherwomen emphasized the importance of using local names for species and using local dialects to pass knowledge because it insures the protection of their resources when their children are aware of the names of the resources in local names.

4 Discussion

4.1 Fisherwomen as environmental managers and conservationists

Resource use and management needs to include fisherwomen's insights because fisherwomen are able to give their perspectives on challenges faced locally and provide ways to address the challenges. The fisherwomen from all eleven communities in this study understood the value of organisms and the ecological roles which organisms play in their environment. As firsthand observers, fisherwomen were able to describe their observations on the temporal environmental changes which occurred in their fishing environment over a span of three decades, the causes of these changes and provided solutions to solving their localized challenges. As key players in conservation, women's ILK have contributed to the collective Indigenous knowledge and sustained the communities through generations (Morales et al., 2017). Knowledge and skills of women are important contributing factors to resource and habitat management. This is especially true for the resource use in rivers, mangrove areas and the intertidal area.

Fisherwomen in this study understand the importance of their roles as mothers who nurture their children and often strive

TABLE 6 Table showing the number of species in the identified taxa as extirpated, decreasing in number, in short supply or rare.

Taxon	Ex	De	SS	R	Total no. of species identified per taxon
Seagrass and macroalgae	1	1	1	0	3 (23%)
Bivalves	9	0	5	3	17 (49%)
Gastropods	3	0	6	8	17 (22%)
Crustaceans	3	0	6	4	13 (24%)
Echinoderms	1	0	2	0	3 (8%)
Finfishes	4	10	21	5	40 (14%)
TOTAL*	21	11	41	20	93 (16%)

*total number of the species either extirpated, decreasing, in short supply or rare.
Ex, extirpated, De, Decreasing, SS, in short supply and R, rare.
All figures collected according to fisherwomen observations.

TABLE 7 Perceived changes which are identified by women within their fishing habitats, the reasons for changes, effects the changes brought to resources and suggested ways to counter the effects of the changes.

Perceived changes	Observation	Number of responses (percentage)	Reasons	Effect on resources and environment	Suggested ways to counter
Fish size	Larger fish were caught in the past (30 years ago)	163/163 (100%)	• High value species targeted for sale • Use of nets • Use of fish poisons • No size control • Diving • Poaching	• Fish of all sizes and life-stages are caught without any control • Many commercial species such as the groupers, trevallies, emperors and snappers do not mature as they are targeted in their sleep	• set quota for target species being sold in the markets • ban use of gillnets and fish poisons, monitor catch • instill size control mentality into fishers
Fish abundance	More fish (of the same species) were 30 years ago	163/163 (100%)	• More fishers • Efficient gears utilized • Fish not allowed to spawn or aggregate during their aggregation or spawning season • Fish targeted at night and in their hiding spots with juveniles	• Removal of important ecological species such as benthic and coral cleaners, seagrass grazers, sand producers • Some top predators removed giving way to smaller and sometimes aggressively carnivorous/piscivorous species	• advise fishers to catch only what they need • do not catch pregnant females or juvenile species • avoid targeting resources during aggregation and spawning period
Benthic changes	Substrates changed: mudflats changed to grave and sandy areas congealed	117/163 (72%)	• Loose sediments washed down streams due to heavy rain • Deforestation • Road construction and mining	• Species unable to breath under solidified surfaces of sand, therefore they die out or migrate • Seagrass areas and corals are affected by sediments washed and deposited causing gaps in the population • Loss of habitats for many fish, birds, crustaceans and other invertebrates which rely on mangrove or other deforested areas. • Blocked migration routes by constructions	• plant trees inland and along the coast. • Restore wetlands and seagrass areas. monitor development occurring in the areas particularly areas close to streams and rivers
Species diversity	Less species diversity compared to past. Some species in short supply, endangered or extirpated. Some species thrive	86/163 (57%)	• overfishing, habitat destruction, removal of species prey or predators, high value species targeted, ecologically important species removed	• Some niches become empty and filled by other organisms • Some habitats are affected such as coral reefs when diversity of coral cleaning species are reduced	• monitor fishing activities by fish wardens • include fines for fishers who catch small fish or use destructive fishing methods
Rivers and streams morphology	Streams are smaller and shallower	99/163 (61%)	• road construction, heavy rainfall	• Migration routes blocked by construction • New locations for species to hide	• plant trees along roadsides and restore mangrove areas along streams
Fishing locations	Fishers utilize fishing grounds further away and exploit resources in these areas	124/163 (76%)	• exploitation, more fishers, use of destructive methods, nets	• Wider area of exploitation of resources especially during the night when they are hunted while asleep • Species targeted are smaller and in great numbers, not allowed to mature	• monitor fishing activities by fish wardens and include fines for fishers who catch small fish or use destructive fishing methods
Migration patterns	Fish aggregations and migration occurs closer to the shore or in selected parts of the rivers (30 years ago)	82/163 (50%)	• use of nets, construction of bridges or dams	• New migration route leaves some species more exposed to predators than their past migration route.	• limit the use of store-bought nets • consult with fishers and locals before any development takes place

to teach their children basic ecological information on species. Some of the fisherwomen also encourage their children to keep an open mind while fishing so they can also add to their own ILK and suggest ways to improve current challenges faced within fishing boundaries. Furthermore, Knudtson and Suzuki (1997:159) stressed the need to "re-instill environmental conscience in our youths" and their "moral obligations to the biosphere". This means, the role falls on the individual families,

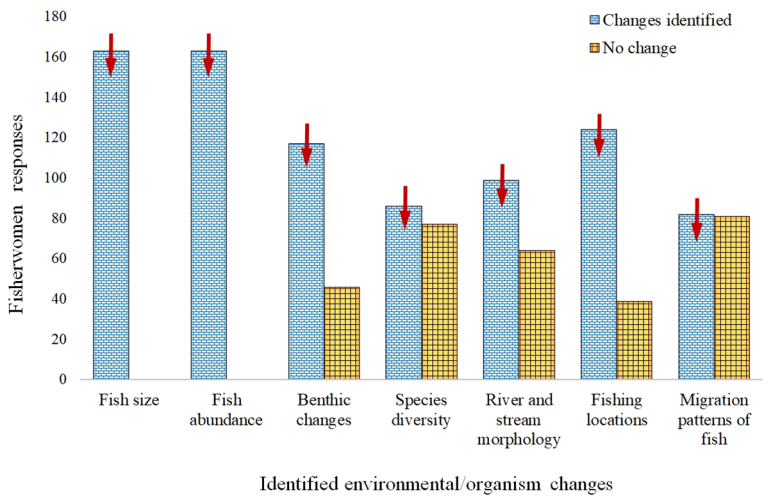

FIGURE 5
Fisherwomen perceptions on species abundance, species behavior and environmental changes which have occurred in their iqoliqoli over the past 30 years. Red arrows on the graphs show negative changes.

community and Fiji's educational system pave the way forward for future conservation.

Women's fishing activities often involve going fishing with their children (Chapman, 1987). Ram-Bidesi (2015) discusses the importance of grounding children with environmental values, respect their elders, respect for one another and the authority (veirokorokovi), value community relationships (veiwekani) and fear God. Moreover, early understanding of the ecological dynamics of the fisheries environment can help instill a guardianship mentality in future fishers. Knowledge about species, local taxonomies and fishing skills are passed between mother to child passively (Kronen, 2004). This study supports Ram-Bidesi's (2015) statement about the vast knowledge base and skills which women have and remains untapped due to institutional and cultural constraints. While living in communities, fisherwomen in this study are constrained by the social structure and sometimes have a minority voice through under-representation or are entirely excluded from decision-making processes, and this contributes to poor resource management strategies in some places.

4.2 Fisherwomen perception on resource conservation

Through daily in-field experiences, fisherwomen identified threats to their resources and ways to deal with the threats. Through this study, 16% of the identified resources were categorized as vulnerable or extirpated due to exploitation. Using ILK, fisherwomen systematically exploited resources and over a span of 30 years, they reported the changes their environment and resources. The findings highlight substantial information fisherwomen have on the temporal changes which occur and how the changes affect resources. Due to the loss of some of their resources and fishing habitats, women from this study provided ways to recover their currently degraded habitats and restore the resource base close to what it used to be, for the future fishers. This is done through the restoration of mangroves, restoration of important habitat areas such as river mouths and deltas, banning the use of chemicals on land and creating awareness on the link between the ridge to reef ecosystems.

Fisherwomen's ILK adds to their individual community's time-tested Indigenous fishing knowledge which is passed to the next generation of fishers. Solano et al. (2021) stated that women's ILK is vital in generating data which contributes to biological, acoustic and oceanographic data of their resources. This study highlighted the wealth of knowledge which fisherwomen in Fiji's fishing communities generated through daily in-field experiences. Moreover, the fisherwomen in our study also explained the vulnerability status of species found within their fishing grounds. The current generation of fishers accept the current state of fisheries as "normal" because their knowledge of the status of the seas, as compared to the past, is replaced by new baselines which are normalized through personal experiences (Roberts, 2008). This means that fishing targets they set lead to further declines in resources according to how they perceive the environmental status rather than restoring it.

Realistically, fisherwomen face limitations to fish further away from home due to time burdens and multiple responsibilities that are home-bound in addition to lack of accessing or controlling (owning) more modern means,

example, motorized boats and fishing gear (Thomas et al, 2021). As a result, most of the fisherwomen concentrate on fishing in the nearby habitats including mangrove areas, intertidal flats and nearby reef systems. Through this study, mangroves, seagrass and corals were described as habitats which support a large group of organisms that pass through them in different life stages. These habitats were described as areas where finfish, crustaceans and mollusks find food and shelter as juveniles or adult species. Individually, these habitats play similar roles in providing food, shelter from predation and a living space for organisms. Fisherwomen's perceptions report that these habitats have gone through severe degradation over time, which in turn affects the diversity and abundance of species which rely on these ecosystems. Moreover, identifying mangroves, seagrass and corals reefs as keystone habitats shows the value which fisherwomen place on the habitats as these are key areas they fish. Possessing spatial knowledge of where to harvest cultural keystone resources is important for fisherwomen particularly when it comes harvest and preparation of ceremonial food. Additionally, the significance of the cultural keystone species is shown in the naming of the resources. For example, the netfin grouper (*Epinephelus miliaris*) is identified using 3 different names as an adult and 1 name as a juvenile.

Western knowledge on fisheries biology, environmental histories and biodiversity which is taught fishers through educational documentaries focused on other parts of the world instead of Fiji or the Pacific (Thaman, 2013). In order to properly manage resources, fishers (men and women) must understand the contributions of their ILK and skills to informing knowledge gaps in scientific data for their communities. fisherwomen and fishermen, as resource users, hold unique local knowledge of their resources and environments, particularly those which they target. While decision-making at the local level remains predominantly a male dominated arena (Kleiber et al., 2015), including women's ILK when managing local resources, will provide women's perspective to the time-depth knowledge base needed to improve the collapsed fisheries resources and biodiversity loss faced in different communities. At the community level, due to traditional taboos and the culture of silence in iTaukei communities, women are only given an opportunity to voice their opinions through their Women's Group representatives.

4.3 Continuity in fisherwomen's ILK and future prospects

This study highlights the ILK of fisherwomen by bringing their knowledge on resources to the forefront instead of the socio-economic contributions. Within the eleven communities, fisherwomen emphasized the importance of including passing their knowledge through their local languages. While using the local language is a challenge today, women still work with their children and women newly married into their communities to pass their knowledge of resources, particularly the local names of their resources. Because ILK relies predominantly on memories and testimonials from the most knowledgeable fisherwomen, data needs to be collated with existing publications of qualitative surveys from the area to correctly address problems identified pertaining to species within traditional fishing boundaries (iqoliqoli) (Thaman et al., 2017). Working with ILK has its shortcomings in relation to species identification because some species are either rare, extirpated or are not targeted anymore within the traditional fishing grounds. Many young fisherwomen today use generic iTaukei names or trade names of species rather than the names of species in the local dialects. Knowledge of the small food fishes which were sought after in now forgotten knowledge amongst today's fishers and these fish which used to be targeted as "emergency food" before extreme natural events such as cyclones are no longer caught but replaced by canned substitutes available in supermarkets (Thaman et al., 2008).

Documentation of fisherwomen's contribution to ILK in fishing is an important step toward improving future management strategies for communities. The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), which strengthens "science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, and long-term human well-being" (UNESCO, 2010) recognizes that ILK is "verified, implemented, challenged and applied within their own validation processes" (Hill et al., 2020:9). Moreover, the value of ILK in filling knowledge gaps on species is also acknowledged by the International Union for Conservation of Nature (IUCN) as they established guidelines for using unique ILK to identify species which need to be included in the IUCN Red List of Endangered Species (IUCN, 2022). In order to improve Fiji's resource management, we recommend that community-based participatory observation is done by both fisherwomen and fishermen and documented. This information can be collated for the benefit of the community.

Moreover, because of the culture of silence in iTaukei communities, third parties such as non-governmental organizations or academic institutions can work alongside communities to create awareness on the differences and the value of fisherwomen and fishermen's ILK. This will not only improve resource management, it will also enable the community to protect their endangered ILK and pass their knowledge to the next generation of fishers.

Indigenous customs dictate generational knowledge transmission – which is usually done through oral transmission (Janif et al., 2016) and pre-defined traditional gender roles (Vunisea, 2002) of women and men within their traditional communities. The strict division of labour and social

constraints which occur within traditional communities creates an environment where women and men develop different experiential knowledge (Warren and Loeffler, 2000). This is evident in the fisheries sector, as women and men's knowledge develops alongside their fishing experiences and their taxonomic knowledge of resources varies for different habitats (Thaman et al., 2008). In Fiji, ILK plays a key role in providing information for data poor areas (Ruddle, 1994) and also provide insights to problems from the local perspective. Surveys in different fishing communities across Fiji showcase the incredible wealth of local knowledge on species, their habitats and health, different growth stages, feeding and breeding habits and seasons, target fishing methods and strategies used to address challenges and manage resources (García-Quijano, 2007; Thaman et al., 2008). Fisherwomen also have knowledge and skills which they gained through in-field experiences and share with their children.

5 Conclusion

Fisherwomen's ILK presented in this paper shows an in-depth understanding of their environment the resources. Using their ILK of species, women are able to feed their families and earn income. Fisherwomen demonstrate an understanding of their environment and the challenges faced through activities and the lack of knowledge transmission to their children or to young women newly married into their communities. The study highlights the importance of using the local dialects and transmitting this knowledge of traditional taxonomy to the next generation so that the knowledge can provide an understanding of the basic biology and ecology of resources within their fishing grounds. This study reinstates the concepts discussed by Thomas et al. (2021) on why women must be counted, but it also highlights the significance of women's local ecological knowledge as baseline for further investigation into data deficient areas in Fiji. Through creating an understanding and appreciation of the importance of women's ILK among all ages and all levels of society, a community takes a step toward addressing biodiversity extinction (Thaman et al., 2014) from the grassroots level, a way forward for Fiji in marine conservation.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

SK: conceptualization, data curation, formal analysis, methodology, investigation, visualization, writing – original draft, writing – review and editing. AB and JK: supervision, validation, writing – review and editing; NM: validation, writing – review and editing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmars.2022.991253/full#supplementary-material

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