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The Role of Indigenous Knowledge in Fisheries Research in Ogbia Creek, Niger Delta

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Abstract: **The role of Indigenous knowledge of fishers in Ekperiama along Ogbia Creek was assessed for its quality between August 2013 and April 2015. Quality time was spent with the fishers to study their daily activities. During this period one of the authors (SA) embarked on monthly trips to the community where she stayed for eight days a month. She participated in the daily life of the people and worked regularly with the local fishers, to gain as wide as possible understanding of the local fishing system. Interviews were conducted on monthly basis to obtain knowledge about habitats, spawning, recruitment, fish diet, and the trophic network of the Sciaenid community. Information collected was systematically compared with that of scientific information collected in parallel surveys and with published data for reliability. Indigenous knowledge compared favourably with scientific knowledge in the different areas investigated. In the event of limited resources, Indigenous knowledge could be used as a supplementary source of scientific studies and basis for new scientific investigation to obtain knowledge relating to the entire creek.**

Keyword: **diet; ecosystem; fishers; interview; local knowledge; recruitment; scientific knowledge.**

I. INTRODUCTION

The practical use of Local Ecological Knowledge (LEK) as a source of information has been on the increase, though it is yet to be fully recognised in fisheries science (Soto, 2006; Hind, 2012) ,it is described as an asset to fisheries science. Local Ecological Knowledge refers to a body of knowledge held by a specific group of people about their local ecosystems. This includes traditional and indigenous knowledge. It is usually considered to be subjective, intuitive, engaged, holistic, spiritual, qualitative and anecdotal (Ousman ,*et.al*, 2011). Local knowledge combined with specialised knowledge of the outside researcher is considered by advocates of the participatory action- research (PAR) to be more potent than either knowledge alone in understanding reality (Chistie and White,1997).

Many studies have focused on the relationships and associations between local knowledge and scientific knowledge (Johannes and Neis, 2007). Most of these studies recognize the complementary nature of LEK (García-Allut, *et. al*. 2007; Williams and Bax 2007) to various degrees, as well as enhancing scientific knowledge (D'Incao and Reis 2002; Aswani and Lauer 2006; Berkes, *et. al*. 2007).

Scientific research in ecological information (SEK) is considered to be objective and neutral, quantitative, and rigorous. It is limited in scope, time, and in applicability to changing environmental conditions (Ousman ,et.al, 2011) and has evolved from focus on species identification and taxonomy, to ecology, behavior and biomass estimates and then to ecosystem approaches to fisheries management**.**

The reliance on SEK as the primary source of information in resource management is gradually shifting to the use of local ecological knowledge as a basis of management decisions. Though it remains a matter of debate, and various approaches for increasing its validity have been proposed (Davis and Wagner 2003; Maurstad et al. 2007), the use of LEK has been described as an asset for the implementation of an Ecosystem Approach to Fisheries (Garcia and Cochrane 2005; Gray and Hatchard 2008; Paterson and Petersen 2010). An ecosystem approach to fisheries (EAF) strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries(FAO,2000). The aim is to conserve ecosystem structure, processes and interaction between fisheries and the ecosystem as a whole for sustainability.

Problem statement:

This study was carried out in Ekperiama along Ogbia creek with the aim of assessing the Indigenous Knowledge of the fishers. Wide-ranging ecological knowledge was obtained from fishers and compared with knowledge from equivalent scientific sources. The focus was on knowledge of the environment (seasons and habitats), reproduction (location of nurseries, reproductive cycle), and feeding (diets of fish, trophic network).

II. METHODOLOGY

Study area:

The study was conducted in Ekperiama within the Ogbia creek in the Niger Delta (Fig 1). Ekperiama is located on latitude 4^0 38' 19''N and longitude $6^0$17'46'' E of the equator, with an altitude of 110 meters (www.worldplaces.net).

Ogbia creek is one of the tributaries of River Nun with substantial seasonal variations due to heavy rains and wind. The creek is tidal and it is characterized by both estuarine and freshwater macrophytes. The riparian vegetation is composed of a tree canopy made up of *Rhizophora racemosa* (Red mangrove) *Raphia hokeri*, *Costus after*, *Bambosa vulgonis*, *Alchornia cordifolla*, *Alstonia boonei*, submerged macrophytes which include, *Eicchornia crassipes* (water hyacinth), *Nyphea lotus* (watere lily) *Cytosperima senegalensis*, *Ludwiga erecta*, *Pistia stratiotes*(water lettuce). Dry season peaks in early January and is usually marred with occasional rains. The rainy season peaks from July to September. The annual rainfall of the Niger Delta ranges from 2000mm – 3000mm per year (Abowei and Hart 2008). The dry season lasts for four months (November- February) with occasional rainfall**.** The creek is also subjected to pollutants from petroleum exploration and expliotation activities in the Niger Delta that may have impacts on the ecosystem (Jamabo and Ibim, 2010).

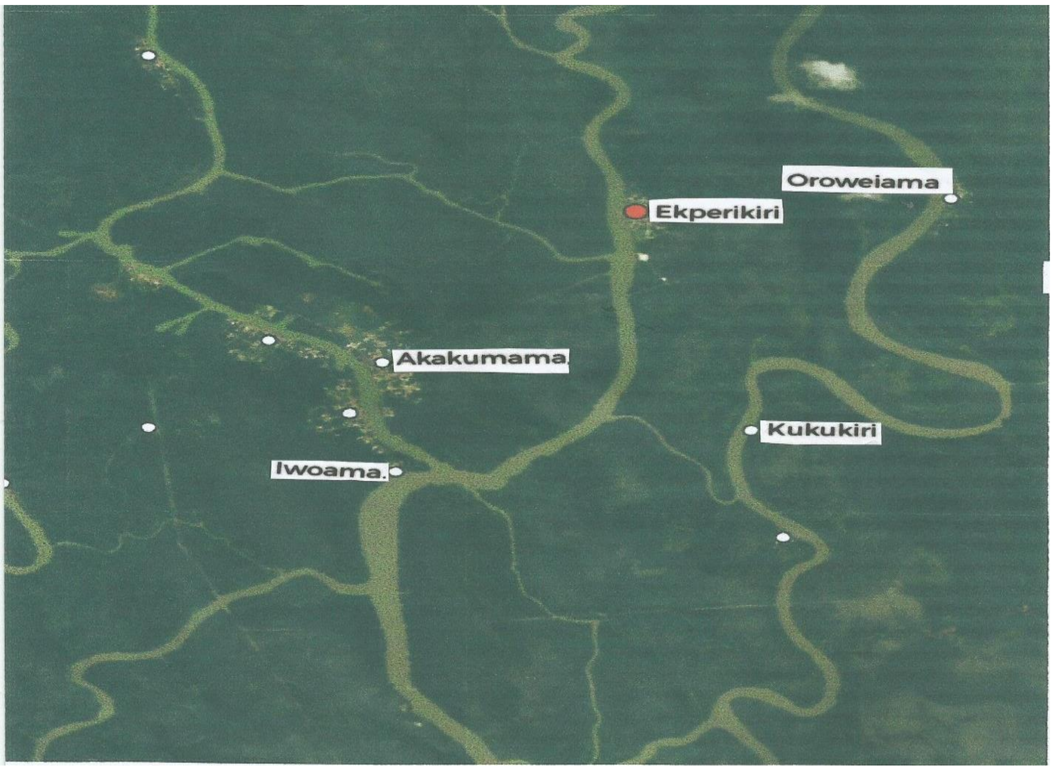

Fig 1: Map of study area

The data and samples for this study were collected between September 2013 and April 2015 from artisanal fishers operating in the study area. During this period one of the authors (SA) embarked on monthly trips to the community where she stayed for eight days a month. She participated in the daily life of the people and worked regularly with the local fishers, to gain as wide as possible understanding of the local fishing system. During the period of the fieldwork records were taken of:

Fish reproduction:

The reproductive cycle of fishes identified were collected from individual and group interviews. Results were compared with field observation and the reproductive cycle of the selected fish species described in literatures in the Niger Delta.

Fish diet:

Fishers usually open the fish they catch during the treatment of the catch. This provides them with information about the stomach content and diet of the fish. They were then asked about the feeding habits of the fish, such as “What do you find when you open the belly of the fish?”. In parallel, fishers knowledge of the diet of the fish caught were compared with the results of stomach content analyses.

Diet analysis:

The stomach and some part of the oesophagus were dissected out in each specimen and placed in a glass petri dish containing some freshwater to neutralize the effect of the formalin for a short while. Each stomach was open and the content removed by scrapping the inner mucosa with a spatula. The weight of the contents was then taken and food items identified. This was done by spreading out the food items over a slide, a little at a time. Two drops of water was added to spread out the food contents. Large food items were easily recognized with the naked eyes, while microscopic ones were spread on a cleaned slide and examined under a Binocular Microscope. Finally, the number of each taxonomic entity was recorded on data sheet for each stomach. All recognized food items were identified according to (Kadiri, 1987 and Kadiri, 2002).

The frequency of occurrence method identifies and records different food items. The number of food item occurred in each fish was recorded and expressed as a percentage of the total number of stomach examined. This method being qualitative portrays which organisms were best being used as food. Basic information on indigenous taxonomy and fish names were acquired through formal interviews conducted in local Pidgin English language, which is the local lingua franca. Local fish names were collected and then cross checked against standard fish guides .(FAO,1990; Fishbase,2014;2015)

III. RESULTS

Catch composition of shellfishes in Ekperiama along Ogbia creek:

As shown in table 1, five families are represented in the catch Palaemonidae is represented by two species namely: *Macrobrachium macrobrachion* , *Macrobrachium vollenhoveni*,. Donacidae represented by *Galatea* paradoxa, Potamididae represented by *Tympantus fuscatus* and Thiaridae represented by *Pachymelania aurita*. Atyidae and represented by *Caridina africune* and *Callinectis palidus* and *Callinectis amnicola* are of Portunidae family.

Catch composition of finfishes in Ekperiama:

Sixteen families of fish are represented in the catch (Table 2). The Clupidae has the highest number of representatives. The family is represented by five species; *Ethmalosa fimbrita, Sardinella maderensis, Ilisha africana , Pellonola leonensis and Sierrathrissa leonensis.* Cichlidae is represented *by Tilapia guinessses, Oreochromis niloticus and Heterotis niloticus.* Clariidae have two representatives namely; *Clarias gariepinus* and *Heterobranchiun longifilis*. Mormyridae represented by *Mormyrus rume* and *Hyperopisus bebe*. Bagridae represented by *Chrisichthhys nigrodigitalus* and *Bagrus bayad*; *Dasyatis garouaensis Urogymnus ukpam* (Dasyatidae).

Families represented by one species includes; Mullidae represented by *Lisa grandisaquamis*; *Trichiurus lepturus* of the Trichiurdae family; *Galeoides decadactylus* of Polynemidae family and *Lutajanus dentatus* of Lutajanidae family and *Bukis koilomatodon* (Eleotridae),Citharinidae represented by *Citharinus citharus*. Others are: *Alestes baremoze* and (Alestidae) *Diaphus taaning* (Myctophidae).

Table 1: Catch composition of invertebrates in Ekperiama along Ogbia creek

Family	Species	Common name	Nembe name
Palaemonidae	*Macrobrachium macrobrachion*	Prawn	Opro
	Macrobrachium vollenhoveni	Prawn	
Atyidae	*Caridina africune*	Small crayfish	Opro
Donacidae	*Galatea paradoxa*	Clam	
	Eqeria radiata		Otoku
Portunidae	*Callinectis palidus*	Crab	
	Callinectis amnicola		
Potamididae	*Tympantus fuscatus*	Periwinkle	
Thiaridae	*Pachymelania aurita*		
			Ikoli
			Isam

Table 2: Catch composition of fish in Ekperiama along Ogbia creek

Family	Species	Common name	Nembe name
Bagridae	*Bagrus bayad*	Silver catfish	Okpokikpoki
Lutajanidae	*Lutajanus agennes*	Red snapper	Agbara
Trichiurdae	*Trichiurus lepturus*	Silverfish/Hair tail	
Polynemidae	*Galeoides decadactylus*	Threadfin/shinenose	Nda
Bagridae	*Chrysichthhys nigrodigitalus*	catfish	Isingi
Eleotridae	*Bukis koilomatodon*	Mud sleeper	Ikuli
Mormyridae	*Mormyrus rume*	Snoutfish	Abebeyanaideiburufihga
	Hyperopisus bebe	snoutfish	Abebeyanaideiburufigha
Clariidae	*Clarias geriepinus*	Mud atfish	Elegele
	Heterobranchiun longifilis	Mud catfish	Enumetandi
Citharinidae	*Citharinus citharus*	Citharinid	Ofu
Cichlidae	*Tilapia guinessses*	Tilapia	Atabala
	Oreochromis niloticus	Tilapia	Atabala
Osteiglossida e	*Heterotis niloticus*	Heterotis	Agia
	Ethmalosa fimbrita	Bonga	Afaru
Clupidae	*Sardinella maderensis*	Sardine	
	Ilisha africana	Shad	
	Pellonola leonensis	-	
	Sierrathrissa leonensis	-	
	Alestes baremoze	Alestes	Ikolokolo
Alestidae	*Diaphus taaning*	Diaphus	Ogbolokaka
Myctophidae	*Lisa grandisaquamis*	Mullet	
Mullidae			
	Dasyatis garouaensis	Stingray	Sika
Dasyatidae	*Urogymnus ukpam*	Stingray	Sika

Knowledge on fish reproduction:

Reproductive period:

During processing of catch, the fisher notice the fish belly gets bigger during the raining season. Harvest of gravis fish species begins from April which the beginning of the early rains. The number of gravids captured increases as the intensity of the rains increases with the months. Between June, July and August, the percentage of gravid fish species caught increases to the extent that almost all fishes caught were gravid, indicating the laying period. This period is assumed the laying period, since the fish belly is filled with eggs. Comparison with scientific data confirmed fishers report.

Recruitment and location of nurseries:

Fishers could not exactly identify nursery areas, but could explain that most juvenile fishes were caught between April and December. Juveniles were identified by their morphology. This was done by observing the size and the appearance of the fish. In small fish species such as *Ilisha Africana*, *Pellonola leonensis*, *Sierrathrissa leonensis* and *Alestes baremoze* the juveniles were identified by checking the belly to see if the fish is gravid and if the fish is smaller in size. Fishers report confirmed scientific report.

Knowledge on trophic relationships:

Fish diets:

Fisher′s were able to give detailed account of the stomach content of each fish caught. Information from fisher′s confirms results of stomach content analysis of fin fish (Table 3). Both sources of information indicated a high proportion of shrimp in the diets of fish from this ecosystem. Other food diet were small fish, perewinkles, crabs,plants and debris. Fresh palm nuts were used as bait to catch *Heterobrachus longifilis* . The local fisher′s nick named *Chrysichthys nigrodigitatus* as "long throat" because they feed on anything. Which means they are ominivores. Fish species such as *Lutjanus dentatus*, *Trichus lepturus*, *Clarias geriepinus* and *Bukis koilomatodon*, were also describe as fishes that eats anything, but worse with *Chrysichthys nigrodigitatus*. Fisher′s did not identify planktons and insects as food for fish. All they were able to identify were shrimps, crabs, perewinkles, debris, small fish and nuts as food for fish.As shown in table 3, comparing fishers account of fish diet with scientific analysis revealed 71% agreet report, 13% partially agree report and 16% disagree report.

Invertebrate diet:

Detritus nature of invertebrates such as crabs (*Callinectis palidus*), periwinkles (*Tympanotus fuscatus* and *Pachymelania aurita*), clam (*Galatea paradoxa*) were not given. Diet of shrimps such as (*Macrobrachium macrobrachion* , *Macrobrachium vollenhoveni* and *Caridina africune*) were impossible for fishermen to identify.

Table 3: Comparison between fisher account of fish diet and scientific analysis of fin fishes

Species	Common name	Fisher′s account of diet	Stomach content analysis (frequency of occurrence)	Remark
Bagrus bayad	Silver catfish	Small fish and shrimps	Small fish ,crustacean	**Agree**
Trichiurus lepturus	Silverfish/Hair tail	Small fish and shrimps	Small fish,shrimps	**Agree**
Lutajanus dentatus	Red snapper	Small fish and shrimps	Smallfish,shrimps,plankton	**Agree**
Galeoides decadactylus	Shine nose	Small fish and shrimps	Shrimps,small fish, crustaceans	**Agree**
C. nigrodigitalus	Catfish	Small fish,shrimp,palm nuts,worms ,anything	Fish,crustacean,seeds, decapods	**Agree**
Bukis koilomatodon	Mud sleeper	Small fish, shrimps	Small fish,crustaceans	**Agree**
Mormyrus rume	Snoutfish	Shrimps	Shrimps, insects	**Agree**
Hyperopisus bebe	Snoutfish	Shrimps	Shrimps, insects	**Partial**
Clarias geriepinus	Catfish	Shrimps, crabs and perewinkles	Insects,detritus,shrimp	**Agree**
H. longifilis	Mud catfish	Shrimps, crabs, palm nuts, small fish	Small fish,insects,plant	**Agree**
Citharinus citharus	Citharin	Shrimps and debris	Shrimps,planktons,detritus	**Agree**
Tilapia zilli	Tilapia	Shrimps	Insects,planktons,detritus	**Disagree**
Oreochromis niloticus	Tilapia	Shrimps and small fish	Planktons,detritus,shrimps	**Agree**
Heterotis niloticus	Tilapia	Shrimps and small fish	Shrimps, small fish	**Agree**
Ethmalosa fimbrita	Bonga	Shrimps	Shrimps,planktons,detritus	**Agree**
Sardinella maderensis	Sardine	Shrimps	Shrimps, zooplanktons	**Agree**
Ilisha Africana	Shad	shrimps	Shrimps, zooplanktons	**Agree**
Pellonola leonensis	Sungu	Shrimps	Smallfish,plankton	**Agree**
Sierrathrissa leonensis	Sungu	Shrimps	Smallfish,plankton	**Agree**
Alestes baremoze	Alestes	Shrimps	Zooplanktons,detritus	**Disagree**
Diaphus taaning	Diaphus	Shrimps	Zooplanktons,detritus	**Disagree**
Lisa grandisaquamis	Mullet	Shrimps	Zooplanktons and plants	**Disagree**
Dasyatis garouaensis	Stingray	Shrimps	Shrimps, small fish, clams	**Partial**
Urogymnus ukpam	Stingray	Shrimps	Shrimps, small fish, clams	**Partial**

Trophic network:

From the diet of the different species fishers could effectively identified the relationships between the feeding habits of the various biological groups and explicitly reconstituted trophic networks. The trophic network constructed from the fisher's accounts could be compared with the equivalent scientific results obtained by Guénette and Diallo (2004a, 2004b). The fisher's identified four levels, as the standard trophic webs. The Ecopath scale was used as a reference similar to that of Lindeman, (1942) in Gascuel, (2005), with a trophic levels of 1 for primary producers and debris, 2 for secondary producers, 3 for their predators, and a maximum trophic level of 4 to cover top predators. In the fisher's account, level I corresponds to debris which was accounted for as food for some organisms such as crabs and perewinkles, since it is found in the stomach. Fishermen's trophic level II comprises species feeding on crabs, shrimps and perewinkles, which a mixture of detritus eaters. Fisher's trophic level III corresponds to the catfish (*Chrysithes nigrodigitatus*),a full omnivore which feed on anything . This fish feed on both the primary subtrate and individuals from levels I and II. Level IV corresponds to strictly canivorous fishes, such as: silver catfish (*Bagrus bayad*) and silverfish/hairtail (*Trichiurus lepturus*). These last animals do not feed on organisms below level II.

IV. DISCUSSION

Local knowledge is directly related to fishing success, hence it is very important to fishers, because such knowledge is essential for successful fishing practice (Symes, 2008) in using the right fishing gear and mesh size. Hence, it is reliable with a high level of confidence. Repeated observations can also increase the level of confidence (Williams and Bax 2007),such as observing the seasons and in the gutting of fish during processing to identify the diet of the fish.

Systematic comparison of Local ecological knowledge (LEK) with that of scientific knowledge gave an estimate of the reliability of LEK as a source of knowledge. From the study, about 71% of fishers knowledge on diet of fish agreed with that of scientific knowledge. This finding corroborates those of Le Fur, *et.al.*, (2011)**.**The major discrepancy was that fisher's did not identify planktons and insects as food for fish. This could be due to the fact that planktons are microscopic organisms and the parts of insects on the other hand looks like parts of shrimp. Hence, all they were able to identify were shrimps, crabs, perewinkles, debris, small fish and nuts, because these food items have distinctive features that are easily identified. The diet of *Citharinus citharus, Heterobranchiun longifilis* and *Alestes baremoze* given by fishers were totally different from scientific report. Scientifically, these fish species are classified as omnivores, which is different from fishers report as solely shrimp feeders. However, both sources of information appeared to give similar levels of knowledge with a certain number of common traits, such as; the diverse diet of *Chrysichthys nigrodigitatus*, the ominivorous nature of *Lutjanus dentatus*, *Trichus lepturus*, *Clarias geriepinus* and *Bukis koilomatodon*, the predominance of shrimp as the principal food source in this food web, and the diversity of relationships between groups, most of which were identical for both reports. Differences indicated did not reflect discrepancies in knowledge, but rather reflected the complementary nature of scientific and fisher's knowledge or the local condition.

Apart from addressing specific questions, as a source of information, LEK, seems to address all the different areas including ecology, fish reproduction and trophic relationships of ecosystem functioning simultaneously. Fishers classified the seasons on climatic classifications (dry season – wet season) and could identify a set of criteria that are directly related to the seasonal clocks of the resources exploited (abundances, arrivals, departures and weather). This indicates that they make use of a coherent synthesis of all the elements in a single scheme. This holistic approach has been reported before, in more general (Berkes, *e.t al*., 2007; Symes, 2008) or specific situations, such as the description of water characteristics (Barthélémy, 2005) or traditional ecosystem resource knowledge and management (Poepoe, *et. al*., 2007). Overall comparison (Appendix A) of both sources of information on reproductive cycle was successful. There were no discrepancies found between both knowledge.

Fishers gave detailed knowledge about the diets of the various species and trophic relationships within the fish assemblage. The differences between the Scientific knowledge and Local Ecological knowledge is that the relationships described by the fishers is based on food actually ingested, while, the Scientific trophic level is an indirect indicator based on estimates of biomass transfer between levels (Christensen and Walters 2004; Gascuel 2005). Differences in results were also found between the fishermen's perceptions and the modeling results. Self-predation relationships in cat fishes were expressed by fishers, whereas, the importance of benthos–debris relationship or the contribution of benthos were not identified.

The two sources appeared to give similar levels of knowledge with a certain level of common information, predominance of shrimp as the principal food source in the ecosystem and the diversity of relationships between groups, most of which were identical for both approaches. The indicated differences reflected complementary nature of scientific and fishermen's knowledge and not discrepancies in knowledge.

V. CONCLUSION

From the analysis, fishermen's knowledge could be considered as providing a comprehensive functional description of the local ecosystem exploited in the area. All knowledge systems, both scientific and local, have a characteristic structure that could pose dangers in extracting information from one system, and applying it in another system. Therefore Local Ecological Knowledge could complement scientific studies as it seems to address all the different dimensions (ecology, fish reproduction, trophic relationships) of the ecosystem functioning simultaneously and also as a source of new scientific investigation. It could substitute for scientific surveys in areas where it costs too much to carry out scientific studies (Maurstad, *et. al*. 2007), provided the level of validity is identical (fish diets), or constitute a satisfactory proxy (trophic web). LEK could help to provide answers to questions relating to the identification of sensitive areas in terms of ecosystem productivity (Aswani and Hamilton 2004; Aswani and Lauer 2006) . Apart from addressing specific questions, LEK may therefore be worth considering to guide management actions, (Silvano and Begossi ,2010). It would be possible to implement this approach by intensifying the two-way links between researchers and other actors, involving both mutual information acquisition and bidirectional structures (links) for communicating existing knowledge (Le Fur, *et a*l. 2002).

In developing countries where data collection is difficulty and cost intensive due to lack of funding and resources (Cury, *et al*. 2005; Garcia and Cochrane 2005),some authors have highlighted the importance of LEK for obtaining knowledge (Johannes 1998; Silvano and Begossi 2010).), for which diverse knowledge must be obtained. The experience, continuous activity and wide distribution of small-scale fishers along the creek results in a collective observation force (Williams and Bax 2007).

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Appendix A. Qualitative summary of the comparison between local ecological knowledge (LEK) and scientific knowledge

LEK compared with scientific knowledge	Fish reproduction		Trophic Relationship	
	Nursery Localization	Reproductive cycle	Diet	Trophic network
Overall agreement	–	+	+	–
Overall discrepancy	–	–	–	–
Only tractable by means of LEK	–	–	–	–
Provides complementary insight	–	+	+	+