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The Ethnoicthyology of Small-Scale Fishermen of Puntarenas, Costa Rica I: Taxonomy

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<u>INTRODUCTION</u> It is obvious that it is necessary to understand a given system if one wishes to effect desired changes within it. If human beings compose one of the units within the system, and if their actions are necessary to effect the desired changes, then it is essential to understand their perceptions of affected elements within the system. This is desirable for three reasons: first, it provides information which can be used to structure communications regarding proposed changes in terms of the concepts and structural features used by the target group; second, it permits comparison of target group and change agent perceptions of the target system, thereby enabling identification of potential conflict areas which could result in misunderstandings; third, the change agent's credibility is enhanced if he can relate to the system as it is understood by the target group.

With regard to changes in small-scale fisheries, it is important to note that local fishermen have usually been interacting with the sea for a long time. In their attempts to cope with the sea, they have made inferences from their observations and constructed taxonomies and theories concerning the marine environment and its flora and fauna. This folk science, or ethno-oceanography, is as real and important to the local fisherman as theories concerning ocean systems are to the academic oceanographer. Thus, attempts to communicate information concerning the ocean must take these folk scientific systems into account.

The purpose of this paper is to present an account of selected aspects of the knowledge system that the small-scale fishermen of the Gulf of Nicoya, Costa Rica have developed concerning marine fish. The paper examines the local fishermen's system of classifying fish and the criteria used in classification members of important fish classes. This knowledge system will be referred to as the ethnoicthyology (ethno-local people; icthyology science of fish) of the small-scale fishermen (cf. Morrill 1967).

SAMPLE AND METHODS Data for this paper were collected from small-scale fishermen living in Barrio el Carmen, Puntarenas, Costa Rica. Puntarenas is located on a relatively flat, thin finger of land jutting westward into the Gulf of Nicoya on the Pacific Coast of Costa Rica approximately 110 kilometers west of San Jose. Barrio el Carmen is at the extreme western end of Puntarenas and is inhabited primarily by small scale fishermen. Most of the fishermen live and land their catches on the northern, more sheltered shore of Puntarenas. For the most part, the small scale fishermen fish from motorized (primarily inboard) wooden plank or dugout vessels from 15 to 30 foot in length using both longlines and nets. Some still use sail and/or oars. No navigation equipment is used. Desired fishing spots are located through the use of visual triangulation, distance estimated through elapsed sailing time, and visual judgements of distance. Vessels usually carry between 2 and 4 crew members counting the captain.

Data for the taxonomy were elicited by requesting 4 knowledgeable informants to report all the different names of fish they knew. These lists were checked and expanded by 10 additional informants. Four key informants were used to subcategorize the listed fish into taxa at different levels of inclusion (cf. Frake 1964).

Paired comparisons and triadic sorts were used to determine classificatory criteria and the structure of subsets of the domain (cf. Pollnac 1975 a, b). Two knowledgeable small scale fishermen participated in the paired comparison of types of corvina and shark. A sample of 50 small scale fishermen responded to a triadic sort procedure involving a subsample of the most important types of corvina. In this procedure six of the most important types of corvina were arranged into all of the possible triadic combinations (20), and each informant was requested to select from each triad the type of corvina which he considered the most different and tell why it was the most different.

ANALYSIS Folk Taxonomy The named fish types known to the small scale fishermen of Puntarenas along with their folk taxonomic organization can be found in Figure 1. The list includes 122 different categories of named fish which are further subcategorized into eight named categories and a residual large "other" category. The "other" category may be further subcategorizable, but further categories were not evident to the informants, and therefore, probably not very salient among this group of fishermen.

Several observations can be made concerning the folk taxonomy in Figure 1. First, although shark (tiburon) and rays do not have scales, the informants insisted that they were a type of pescado escama (scaled fish).[1] These same fishermen did not claim that a shark or ray has scales; thus, pescado escama is simply a name for the domain we are dealing with, not a descriptive name. Second, it will be noted that there are a relatively large number of different types of corvina, pargo (snapper), and tiburon (shark). These are important groups of fish among the fishermen in Puntarenas. Third, as can be seen in Figure 1, two different types of fish are referred to as corvina coliamarilla.

One is the commonly caught large, yellow-tailed corvina (Cynoscion stolzmanni) and the other only grows up to one pound and has a big spine in the anal fin (tentatively identified as Bairdiella sp.). It is also interesting to note that one variety of corvina (Cynoscion albus) can be referred to by two different names--reina or chola--depending on the stage in the growth cycle. Chola is a large reina.

Dyadic Comparisons Dyadic comparisons were conducted for two important categories of fish: corvina and shark. They were also conducted for three superordinate categories: corvina, pargo, and cuminate. Eleven of the fifteen named varieties of fish locally categorized as corvina were arranged into all possible dyadic combinations and the informants were asked how each member of each pair was different from the other member of the pair. The responses of the 55 possible dyadic combinations of the 11 types of corvina are summarized in Table 1.

Although the characteristics listed in Table 1 may not be used by biologists to classify the corvina, they are derived from responses made by Puntarenas small-scale fishermen and probably represent the key they use in identifying the various types of corvina. In other words, the characteristics are those which are salient to the local fishermen.

Size is rank ordered in Table 1. Scale thickness approached a rank ordering, but there was some disagreement. Thick scales, however, was noted by all as a salient characteristic of agria. In a true componential analysis, "large eyes" and "small eyes" would have been one component probably labeled "large eyes" with ojona (ojo = eye) given a "plus" and guavina a "minus" (cf. Tyler 1969). The same principle would probably apply to the "round head"

PESCADO ESCAMA

CORVINA
- reina (chola)
- coliamarilla[1]
- china
- cholesca
- cinchada
- zorra
- guavina
- agria
- aguada
- aguada ojona
- picuda
- rayada
- nata
- trompilla
- coliamarilla[2]

PARGO
- rojo
- roquero
- salmonete
- estrella
- seda
- de la mancha
- negro
- blanco
- jilguero
- guacamayo
- palmito

TIBURON
- torpedo
- espada
- gata
- aleta negra
- picudo
- barroso
- cornuda
- martillo
- bahia
- mamon
- tigre
- sardo
- paleta
- amarilla

RAYA
- guitarra
- raya
- zopilota
- gavilina
- tembladera
- manta

CUMINATE
- blanco
- negro
- volador
- alguacil
- colorado
- bagre
- gallina

LISA
- hedionda
- real
- palmera

ANGUILA
- anguila
- cobra
- morena

JURELES
- pampano
- sierra
- palometa
- palometa de pluma
- jurel
- jurel ojon
- bonito
- bananito
- platanillo
- hojaran
- come tierra
- pinuelero
- chopa

O T H E R S
- mano de piedra
- gualaje
- robalo
- lulo
- roncador
- vieja
- catecismo
- salema
- frijolillo
- pez bandera
- pez cotongo
- pez chancho
- pez hoja
- pez lenguado
- pez perro
- congrio
- gorrion
- timburil
- erizo
- timburil chayote
- hojarasa
- dorado
- skipjack (barrilete)
- macabi
- sabalo
- loro
- mero
- cabrilla
- cabrilla profundidad
- menta
- cabro
- merluza
- palmito
- macarela
- berrugate
- aguja
- aguja palmera

O T H E R S (Contd.)
- gallo
- guaju
- pez estrella
- remora
- caite
- pez jabon
- chupa piedra
- yorotel
- garrobo
- cinta
- machete
- vela
- merlin

Table 1. Defining characteristics of eleven varities of corvina abstracted from dyadic comparisons.

	TYPE OF CORVINA										
CHARACTERISTIC	REINA	COLI AMARILLA	CHOLESCA	CINCHADA	ZORRA	GUAVINA	AGRIA	AGUADA	PICUDA	RAYADA	OJONA
SIZE*	8	7	1	3	3	3	6	5	4	3	2
THICK SCALES							x				
YELLOWISH	x			x		x		x			
SILVER								x	x	x	x
GOLDEN							x				
BLACK			x		x						
3 BLACK STRIPES ACROSS				x							
STRIPES ALONG BODY										x	
YELLOW TAIL		x									
CHATA** MOUTH			x								
SMALL DOWNTURNED MOUTH					x						
POINTED JAW									x		
ENLONGATED JAWS								x			
LARGE EYES											x
SMALL EYES						x					
FLAT HEAD					x						
ROUND HEAD						x					
WRINKLED HEAD						x					
ROUND									x		
TWO BARBS					x						
SOFT								x			
FROM THE DEEP										x	

*Rank order ** "bonnet shaped"

Table 2. Defining characteristics of eleven varities of <u>tiburon</u> (shark) abstracted from dyadic comparisons.

TYPE OF SHARK

CHARACTERISTIC	GATA	ESPADA	TORPEDO	ALETA NEGRA	TIGRE	MAMÓN	BAHÍA	MARTILLO	BARROSA	PICUDO	CORNUDA
DARK GREY				X				X			
GREY					X				X	X	X
VERY LIGHT GREY			X								
ASH COLORED CENIZO							X				
YELLOWISH BROWN		X				X					
CAFE CLARO (LIGHT COFFEE)	X										
BLACK STRIPES					X						
BLACK FIN TIPS				X							
BLACK SPOT ON NOSE			X								
YELLOW-BROWN TAIL	X										
DARK MEAT								X			
WHITE MEAT											X
ROUNDED HAMMERHEAD											X
RECTANGULAR HAMMERHEAD								X			
ROUND HEAD							X				
POINTED NOSE			X			X				X	
BONNET NOSE (ÑATO)					X		X		X		
COMB (PEINE) SAWFISH BILL		X									
SMALL EYES	X							X			
LARGE EYES		X									X
SMALL MOUTH				X							
NO TEETH						X					
FINE TEETH IN MOUTH	X	X		X							
FLATTENED BODY (APLASTADO)								X			X
ENLONGATED BODY					X	X					
THICK SKIN	X										
FROM THE DEEP						X					
SIZE*	3	7	2	2	8	1	4	6	4	2	5

* Rank order

and "flat head" characteristics. The characteristics were kept separate in this analysis, however, for clarity of presentation. The same type of comments apply to Table 2 which lists the defining characteristics of eleven types of shark. As in the previous discussion, these characteristics were derived from the responses to the 55 dyadic combinations of the elevan shark types.

The analysis of the dyadic comparisons between the superordinate categories corvina, pargo (snapper) and cuminate (catfish) indicate that in terms of maximum size of largest varieties caught out of Puntarenas and scale size, pargo is the largest, cuminate second, and corvina third. Comparing pargo and corvina, the informants note that the flavor is "different", pargo has harder meat, larger more open ribs, and a larger but thinner head. Concerning the pair corvina and cuminate, the meat of cuminate is reported as having less flavor. Cuminate are also reported as having harder and flatter heads, three big spines, and are very slippery. The responses to the cuminate-pargo dyad resulted, once again, in cuminate being ranked as less flavorful and more slippery. Pargo are noted as having a larger head and eyes than cuminate.

Triadic Sort The triadic sort technique is used only on corvina. Basically the triadic sort is a technique used to determine the relative similarity in meaning among the members of a set of terms. All possible triadic combinations of the set of terms are formed and the respondent is requested to select from each triad the term most different in meaning. The two remaining terms are the most similar in the triad. The total number of times each possible pair of terms is classified as the most alike is calculated, resulting in a measure of the relative similarity of the terms.

In this study, all possible triads were formed of six locally recognized *corvina* types, resulting in 20 triads. *Corvina* type similarity matrices were calculated for each individual, and reasons for the various sorts were content analysed. The mean similarity matrix for the entire sample can be found in Table 3.

Table 3. Mean similarity matrix (scaled) for *corvina* types.

	CHOLA	COLIAMARILLA	AGUADA	AGRIA	PICUDA	ZORRA
CHOLA	1.00					
COLIAMARILLA	.23	1.00				
AGUADA	.25	.42	1.00			
AGRIA	.34	.27	.48	1.00		
PICUDA	.19	.44	.97	.62	1.00	
ZORRA	.17	.36	.61	.57	.54	1.00

N = 50

The similarity coefficients presented in Table 3 were scaled by dividing by a constant resulting in a figure which varies between zero and one, with one indicating a maximum similarity (equivalence) and zero a maximum distance. According to the results of the triadic sort technique, the local fishermen, on the average, perceive *chola* and *zorra* as the most unlike and *agria* and *picuda* as the most similar pairs within the set of six *corvina* types. An average link cluster analysis of the values in Table 2 provides a clearer representation of the perceived relationships between the six *corvina* types (see Figure 2).

Turning to rationales for the triadic sorts, the distribution of the various reasons provided for the 20 sorts can be found in Table 4.

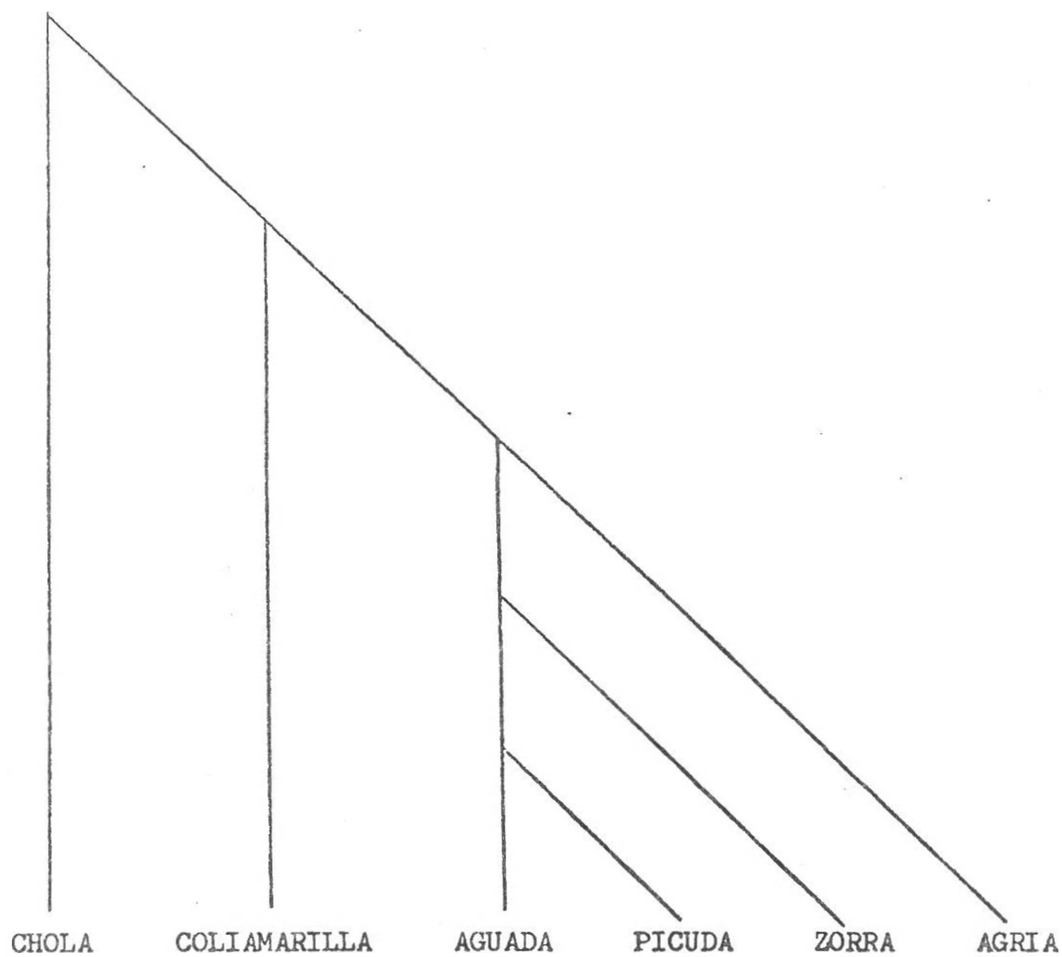

Figure 2. Average link cluster analysis of corvina type similarity matrix.

Table 4. Distribution of rationales for triadic sorts on <u>corvina</u> types.

CATEGORIZED RATIONALE	MEAN NUMBER OF TIMES USED	STANDARD DEVIATION	MAXIMUM	MINIMUM
weight/size	9.1	5.4	19	0
color	8.2	5.6	19	0
form	1.7	2.5	12	0
width/thickness	0.4	0.7	3	0
taste	1.9	4.5	20	0
scale size	1.4	2.8	11	0
class	0.4	1.4	8	0
value	1.8	3.7	19	0

N = 50

The values presented in Table 4 indicate that weight/size and color are the most frequently mentioned rationales provided for the triadic sorts. There is a large gap between these two categories and taste, value, form, and scale size, the categories which come in next most frequently. The width/thickness and class (marketing categories, first, second class, etc.) manifest relatively low frequencies. Categories mentioned but not entered in the table (e.g. soft, noise made, rot resistance) manifest very low frequencies and were used by only one individual each.

One thing that is evident in Table 4 is that there is a fair amount of variability with respect to the rationales used in the sorts. This type of variability in reasons for selecting the most different member of a triad can also result in variability in similarity matrices resulting from triad sorts. An examination of the standard deviations and maximum/minimum values for the cells in the corvina similarity matrix indicates that there is a fair amount of variability in individual similarity matrices also. It would be interesting and informative to determine the interrelationships between the variance in the similarity coefficients and the frequency of use of the various rationals for sorting. These two variable sets were intercorrelated using canonical correlation, and the results of the analysis can be found in Table 5.

TAble 5. Canonical analysis of relationship between triad sort rationales and similarity coefficients

VARIABLES	CANONICAL VARIATES I	CANONICAL VARIATES II
weight/size	-0.12	0.89
color	-0.64	-0.52
form	-0.15	-0.18
width/thickness	-0.14	0.19
taste	0.72	-0.17
scale size	-0.26	-0.08
class	0.20	-0.33
value	0.48	-0.07
Percent of trace	16.5	16.0
chola-coliamarilla	-0.16	-0.29
chola-aguada	-0.16	-0.46
chola-agria	-0.08	-0.51
chola-picuda	-0.21	-0.44
chola-zorra	0.48	-0.37
coliamarilla-aguada	-0.32	-0.20
coliamarilla-agria	0.14	-0.01
coliamarilla-picuda	-0.22	-0.09
coliamarilla-zorra	0.35	-0.36
aguada-agria	0.17	0.52
aguada-picuda	-0.60	0.60
aguada-zorra	-0.01	0.47
agria-picuda	0.08	0.12
agria-zorra	0.70	0.24
picuda-zorra	-0.09	0.36
Percent of trace	10.1	14.1
Redundancy coefficient	.087	.099
R_c	0.33	0.84
p	$<.001$	.03

N = 50

In the analysis presented in Table 5, the triad sort rationale variable set (e.g. weight/size, color, etc.) is conceptualized as the independent variable, and the traid sort derived similarity coefficients as the dependent. The analysis indicates that there is a statistically significant relationship between the two variable sets. The first canonical variate is significant at better than the .001 level and the second at 0.03. The canonical correlations are .93 and .84 respectively.

The canonical variable loadings in Table 5 (the columns) can be interpreted as correlations with the canonical variate (Levine 1977). For example, within the independent variable set, taste has the highest correlation with the first canonical variate. In turn, the canonical variates can be viewed as factors of the variable sets. Percent of trace for a given variable set is the sum of the squared elements of a column of canonical variable loadings divided by the number of variables in the set, and is therefore the proportion of a set's variance associated with each canonical variate (Levine 1977). The redundancy coefficient is not symmetrical and is interpreted as the amount of variance in the dependent variable set trace accounted for by the independent variable set canonical variate (Levine 1977). Thus, in the analysis presented here, 8.7 percent of the variance in the dependent variable set trace (the similarity coefficients) can be accounted for by the independent variables' first canonical variate, and 9.9 percent by the second, for a total of 18.6 percent. This modest but respectable sum indicates that the criteria used in the sorts do, in fact, influence the similarity matrix derived from the sorts.

The two highest loading independent variables on the first canonical variate are color and taste, but one is high positive and the other high negative. This indicates that those who use color as criteria are less likely to use taste. Turning to the dependent variables (the similarity coefficients) we find that those who use taste as criteria (high positive on the first variate) and tend not to use color (high negative) make sorts that result in higher similarity coefficients for the chola-zorra and agria-zorra dyads. Those who use color, however, tend to make sorts that result in higher similarity coefficients for aguada-picuda (see Table 1; both are "silver"). The zero-order correlations bear out this analysis: the correlations between frequency of use of taste as criteria and the similarity coefficients for the chola-zorra, agria-zorra, and aguada-zorra dyads are 0.60, 0.36, and -0.52 respectively ($p < .01$). Frequency of use of color has a high negative correlation (-0.49; $p < .01$) with the agria-zorra similarity coefficient.

The highest loading independent variables on the second canonical variate are weight/size and color. Once again, the signs of the loadings are opposite indicating that those who use weight/size tend not to use color. Here we find that those who tend to use weight/size and not color make sorts that result in similarity coefficients which are lower for the chola-aguada, chola-agria, and chola-picuda dyads and higher for the aguada-agria, aguada-picuda, and aguada-zorra dyads. The zero-order correlations also bear out this interpretation of the second canonical variate. Use of weight/size as criteria is negatively correlated with the similarity coefficients between the chola-aguada, chola-agria, and chola-picuda dyads ($r = -0.33$ ($p < .05$), -0.46 ($p < .01$), and -0.39 ($p < .01$) respectively) and positively correlated with the aguada-agria, aguada-picuda, and aguada-zorra dyads ($r = 0.44$, 0.55, and 0.38 respectively; $p < .01$).

The variance in triad sort data suggests that certain experiential variables may be influencing the perception of the various corvina types (cf. Pollnac 1975a, b). At this exploratory stage it might be revealing to examine the potential influence of age, education, and years fishing experience on the fishermen's perceptions of corvina. The intercorrelations between age, years of formal education, and years fishing experience and the triad sort variables can be found in Table 6.

Table 6. Correlations between triad sort variables and background variables.

	BACKGROUND VARIABLES		
TRIAD SORT VARIABLES	AGE	EDUCATION	FISHING EXPERIENCE
SIMILARITY COEFFICIENTS			
chola-coliamarilla	-.20	.12	-.09
chola-aguada	.00	.23	.00
chola-agria	-.23	.01	-.15
chola-picuda	.18	.09	-.22
chola-zorra	-.06	.05	-.12
coliamarilla-aguada	-.17	.08	-.15
coliamarilla-agria	-.09	.08	-.33*
coliamarilla-picuda	-.12	.27*	-.03
coliamarilla-zorra	.24	-.26	.14
aguada-agria	-.13	.03	-.03
aguada-picuda	-.09	.22	-.02
aguada-zorra	.33*	-.35*	.23
agria-picuda	.03	-.06	.04
agria-zorra	.23	-.09	.14
picuda-zorra	.30*	-.29*	.36*
CATEGORIZED RATIONALE			
weight/size	.08	.10	.00
color	-.38*	.29*	-.14
form	-.21	.15	-.10
width/thickness	.09	.05	.18
taste	.07	-.15	-.06
scale size	.25	-.27*	.16
class	.22	-.15	.25
value	.13	-.08	.07

N = 50 *$p < .05$

The background variables used in the analysis presented in Table 6 are not strongly related to the triad sort variables. In brief, the analysis indicates that those with more fishing experience tend to perceive coliamarilla and agria as less similar and picuda and zorra as more similar. Individuals with more education perceive coliamarilla and picuda as more similar and see less of a similarity between zorra and both aguada and picuda. Finally, older fishermen perceive zorra as being more similar to both aguada and picuda than do younger fishermen. With respect to the categorized rationales for the triad sorts, Table 6 indicates that younger individuals and those with more education are more likely to use color as a rationale. Finally, those with less education manifest a tendency to use scale size as a triad sort criteria.

SUMMARY AND CONCLUSIONS The various techniques used were successful in both developing a taxonomy of the fish known by the small-scale fishermen in Puntarenas and in determining the criteria used for classifying several important categories of fish. The triad sort technique was used to determine the relative importance of the various classificatory criteria along with the sociocultural correlates of this usage.

Overall, the analysis gives us some data pertinent to understanding what fish are significant to the small-scale fishermen of Puntarenas and how they organize these fish in their minds. One of the basic propositions underlying cognitive anthropology is that naming is one of the most important methods of ordering perception (Tyler 1969); therefore, the analysis presented here should help us understand how the small-scale fishermen in the Gulf of Nicoya think about the fish in their environment. As pointed out in more detail in the introduction to this paper, such as understanding is important in designing information systems and enhancing the interaction between the fishermen and others, such as fishery biologists and extension agents, who either interact with or are planning to interact with the small-scale fishermen. For example, if the full complexity and potential ambiguity (e.g. two different fish with the same name or one fish with two different names at different sizes) of the local classification system is not understood, then information systems could produce erroneous data. In brief, the symbol systems used by both those who gather and use information and those who provide the information must be the same. The equivalence of such systems is an empirical question which can only be answered by research such as that presented above.

NOTES

1. Technically, sharks do have scales (referred to as placoids), but they are quite different from what the non-biologist and the small scale fisherman from Puntarenas would refer to as a scale (D. Stevenson, Personal Communication).

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