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The Diffusion of 'Lambreta,' an Artificial Lure, at Búzios Island (Brazil)

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ABSTRACT We studied the adoption process of a special jig used to catch bluefish (*enchova – Pomatomus saltator*) at Búzios Island. Búzios Island is a fishing community of about 44 households located in southeast Brazil (São Paulo State). Data were collected through direct observations and interviews. Observations of fishing trips were done at Porto do Meio harbor. The main hook-and-line techniques used to catch bluefish at Búzios are *lambreta* (jigging), *corrico* (trolling) and deep line. The lambreta has been replacing the corrico. Lambreta allows more yield per hour fishing than corrico. Unlike the corrico, it does not require natural bait (nylon skirts give the lure a life-like motion). Innovator categories were also found: younger and full-time fishermen are most likely to adopt the lambreta in contrast to older and part-time fishermen. Both features of the innovation and adopters are important to understand the process of the diffusion of the lambreta among fisherman categories.

Introduction

Studies on diffusion of innovations and technological change can be very useful in understanding the mechanisms and processes of cultural and social change within communities. Some authors, such as Boserup (1981:3) have stressed that human history can be regarded as a long series of technological changes. Bernard and Pelto (1972:4-5) defined two sets of innovations: the ones which involve large-scale environmental modifications (dams, factories, 'new cities') and the small-scale technology ('microtechnology'), which is usually owned by individuals or families.

Anthropological research on innovation has been focused on the decisions made by individuals concerning the adoption or rejection of innovations. Two main questions are usually asked in these studies. The first concerns the understanding of what kind of individuals tend to adopt innovations and why; the second is concerned with understanding which kind of innovations are adopted in certain circumstances (Acheson 1981).

An 'innovation' can be defined as the use of a new idea or technique when there is certain degree of uncertainty attached to the enterprise (Downs and Mohr 1979). Thus, adopting an innovation involves risk. Rogers and

Shoemaker (1971:27) and Rogers (1983: Ch. 7) reviewed theories, concepts and studies on diffusion of innovations. They defined general features of innovators and of innovations. For example, they classified potential adopters into categories of innovators, early adopters, early majority, late majority and laggards. These categories were correlated with socioeconomic status, personality and communication behavior. Downs and Mohr (1976) suggested that features of the innovations ('primary and secondary attributes') associated with environmental circumstances are critical to the understanding of adoption or rejection of an innovation. However, most studies on innovations have focused mainly on adopter's features rather than attributes of the innovations (Dewees and Hawkes 1988).

Even in modern fishing communities, little is known about the process of technological change (Acheson 1982:279). Some studies on maritime fisheries have compared Rogers and Shoemaker's and Downs and Mohr's theories on diffusion of innovations. Acheson and Reidman (1982) studied four kinds of innovations of fishermen from northern New England. They found that different sets of independent variables could explain fishermen's decision to each innovation. Also, they observed that fishermen from similar geographic and economic environments would tend to adopt similar kinds of innovations. Dewees (1985) and Dewees and Hawkes (1988) studied technical innovations in Pacific Coast trawl fisheries. Their results also indicated that each innovation adopted was explained by different sets of independent variables. They concluded that both features of potential adopters and of innovations are important in the decision to adopt or not an innovation. Also, the match between the innovation and the potential adopter's needs is critical.

Recent theoretical work (Boyd and Richerson 1985:166,245) points out that studies on diffusion of innovations can be used to investigate the relative importance of some cultural and social change processes. Boyd and Richerson's model of cultural transmission offers a valuable approach to understand the main evolutionary forces involved in individual's behavior and in the transmission of an innovation within a population. In particular, three kinds of bias modeled by Boyd and Richerson (1985) might be important: direct bias, which corresponds to Downs and Mohr's hypothesis, and indirect and frequency dependent bias, which correspond to Roger and Shoemaker's approach.

In November, 1986, we observed that a kind of jig, locally called *lambreta* and used to fish bluefish (*Pomatomus saltator*), was adopted by some fishermen from Búzios Island (São Paulo State). The objectives of this study are to understand the process that underlies the adoption and transmission of this kind of innovation among artisanal fishermen. The analysis focuses on features of the innovation as well as on fishermen's cultural and social characteristics. In this study we suggest that the approaches mentioned above are complementary and show relative importance in different stages of the process of diffusion of the lambreta among fishermen. Innovation features

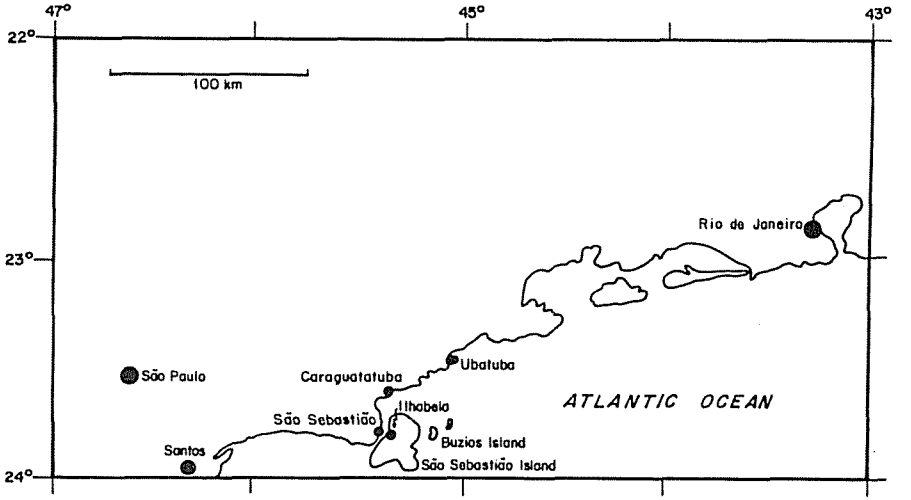
are very important in the transmission of lambreta between fishermen from the coast of São Paulo and innovators from Búzios Island. Adopter's features play an important role in the process of the diffusion of lambreta inside Búzios Island, i.e., among innovators and early adopters.

This research was undertaken on Búzios Island, which is a fishing community located on the coast of São Paulo State, Brazil (see map 1). This island includes 8 small harbors with canoe shelters, and about 44 families. Willems (1952) studied this community in detail. At the time of Willems' study, agriculture was a very important economic activity. Nowadays, fishing is the main source of cash for families from Búzios and is performed mainly with paddled canoes, hooks and lines and gillnets (Begossi 1989).

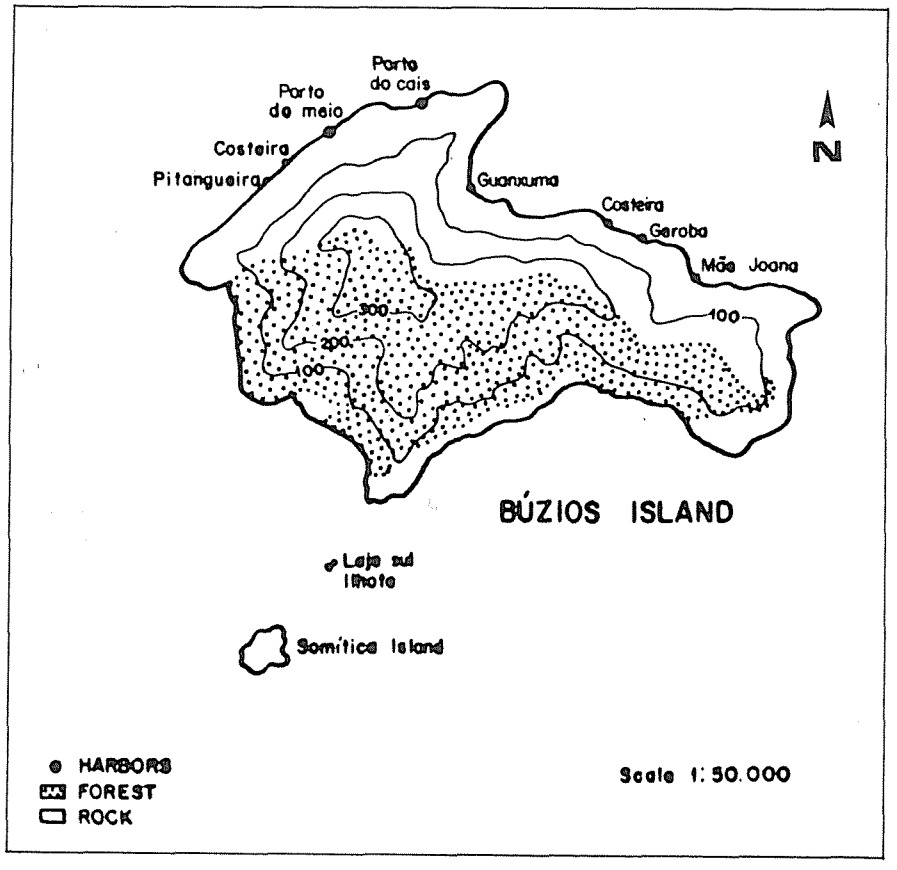
Procedures

At Búzios Island there are 36 part or full time adult fishermen. A preliminary interview was done with 31 fishermen and was followed by seasonal interviews such as in Spring (November 1986, n = 27), Summer (February 1987, n = 21), Autumn (May, n = 27) and Winter (August, n = 21). The sample size varied because fishermen were sometimes absent from their homes, for example being away on a fishing trip or buying supplies on the coast. Interviews were conducted in six harbors of Búzios (39 families), which are Costeira, Guanxuma, Mãe Joana, Pitangueira, Porto do Cais and Porto do Meio. Information about the diffusion of lambreta, cash income, age and educational level of fishermen was obtained in these interviews, which were based on questionnaires.

Fishing activities were sampled at Porto do Meio harbor, the most popu-



Map 1. *Southeast Brazil, including the coasts of São Paulo and Rio de Janeiro States. The island and city of São Sebastião are places with which Búzios' islanders have a regular contact.*



Map 2. *Búzios Island and its harbors.*

lous harbor at Búzios Island (22 resident fishermen 18 years up), for 4-5 days each month, during 14 months, starting in November 1986. The sample included fishermen that fish near the island and use paddled or motor canoes (16 fishermen). Very often fishermen's sons and relatives from the coast participated in fishing trips. This increased the sample to 24 fishermen. Among 4 docks existing at Porto do Meio, 3 are used by canoe fishermen and 1 is used by 6 fishermen that fish by boat near São Sebastião island. The sampling process included the collection of data on fish species catch and weight, time of trips, time spent fishing and fishing gear for all fishing trips occurring from and to a randomly sorted dock. During every sample day, priority was given to the sorted dock. Thus, all trips from and to docks used by canoe fishermen were sampled but,in case of simultaneous trips, the trip recorded was of the priority dock.

Fishermen were divided in four categories: innovators, early adopters, late adopters and non-adopters. These categories were based on the time of

Photo 1. *A typical canoe shelter from a small harbor on Búzios Island (Pitangueira harbor, 4 families).*

adoption of lambreta by fishermen. Direct observation of fishing trips and questionnaires served to determine the time of adoption. For example, innovators are fishermen that were using lambreta since the beginning of the fieldwork; early adopters were using it in the first months of the field work and late adopters used it in later months and/or seldom used it.

Utilization of Hook-and-Line for Bluefish Fishing

Bluefish (*enchova* – *Pomatomus saltator*) is the most important fish at Búzios Island in terms of catch, diet, and cash sales (Begossi 1989). It is caught by hook-and-line and with gillnets. The hook-and-line techniques used by fishermen for bluefish are locally called *corrico*, *lambreta* and *linha de fundo* ('deep line'). Corrico is a common hook-and-line system used in surface waters; it is a kind of trolling, since fishermen pull the bait using a canoe. The deep line is a hook-and-line with a lead weight attached for deep water fishing. The lambreta is a jig with an artificial lure consisting of a lead weight and nylon skirt (Figure 1). According to Búzios fishermen, the artificial lure is supposed to mimic sardines or duskies. Jigging is the fishing method used for lambreta.

As explained by fishermen from Búzios Island, before 1986 they normally used the corrico, deep line or gillnets to catch bluefish. During our study the corrico (trolling) was in the process of being replaced by the lambreta (jigging). As fishermen stress, deep line is not a directly competing technol-

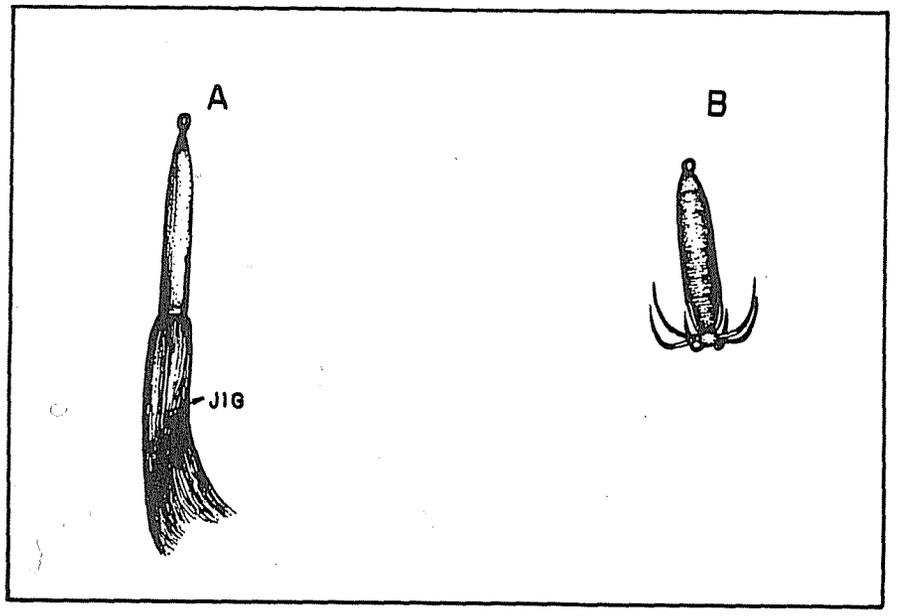


Figure 1. *Examples of gear used at Búzios Island: (A) lambreta, used to catch bluefish. The jig can be seen within the nylon filaments which are an artificial lure; (B) ripper jig (*jangarelho*) used to catch squid. The lines wrapped on the lead shank act as a lure.*

ogy with the other two because it is used in late afternoon and at night. Not all fishermen use this gear as some are afraid of fishing at night. These fishermen own canoes of one-person size and do not feel confortable being alone in the canoe at night. Both corrico and lambreta techniques are used during the day.

In November, interviews showed that 63% of fishermen were using the lambreta to fish bluefish. Lambretas are not easily found in the markets from São Sebastião Island or São Sebastião City. These are the localities at which fishermen and buyers from Búzios go to sell fish and to buy products (see map 1). Fishermen usually buy the necessary materials (hook, lead and nylon) and manufacture the lambreta themselves. The first fishermen who adopted the lambreta have specialized in making and selling them to other fishermen from Búzios. Among the users of lambreta, 88% answered in interviews they know how to make it.

The interview conducted in February showed that 38% of interviewees prefer to use corricos to catch bluefish, 24% prefer lambretas and 38% do not show preferences. Most interviewees who prefer the corrico explained they either do not know how to use the lambreta or do not own one; others explained that lambreta must be pulled quickly out of the water while they are fishing, which is physically tiring. Fishermen who prefer to fish only with the lambreta argued that they catch more fish using it as compared to the corrico,

and that there is no need to paddle their canoe while fishing, making fishing less tiring. Fishermen that use both types of gear explained that the lambreta catches fish in deep waters and the corrico catches fish in surface waters. Other fishermen explained that they first try one kind of gear; if they are not catching any fish, they try the other. It was also argued that lambreta is suitable for motor boat fishing and corrico more suitable for canoe fishing.

In May, interviews showed that 22% of fishermen were using either corricos or lambretas, 11% only deep lines and 37% both corricos and lambretas. The explanations given were the same as those from February, except for one fisherman who emphasized that the advantage of the lambreta is that it does not need a natural bait, which is time consuming to catch.

In August, fishermen were asked to rank their utilization of the corrico and lambreta in bluefish fishing. In this interview, 52% of fishermen ranked the lambreta in first place and only 5% ranked the corrico in first place, 10% ranked both corrico and lambreta in second place and 5% ranked the corrico in third place; 80% said they did not use the corrico any more and 38% said they do not use lambretas. Thus, in about one year, the corrico was largely replaced by the lambreta. In fact, during the fishing sample at Porto do Meio harbor, relatively few fishing trips which included fishing with corricos could be sampled.

The seasonal pattern of hook-and-line usage for bluefish is in Figure 2.

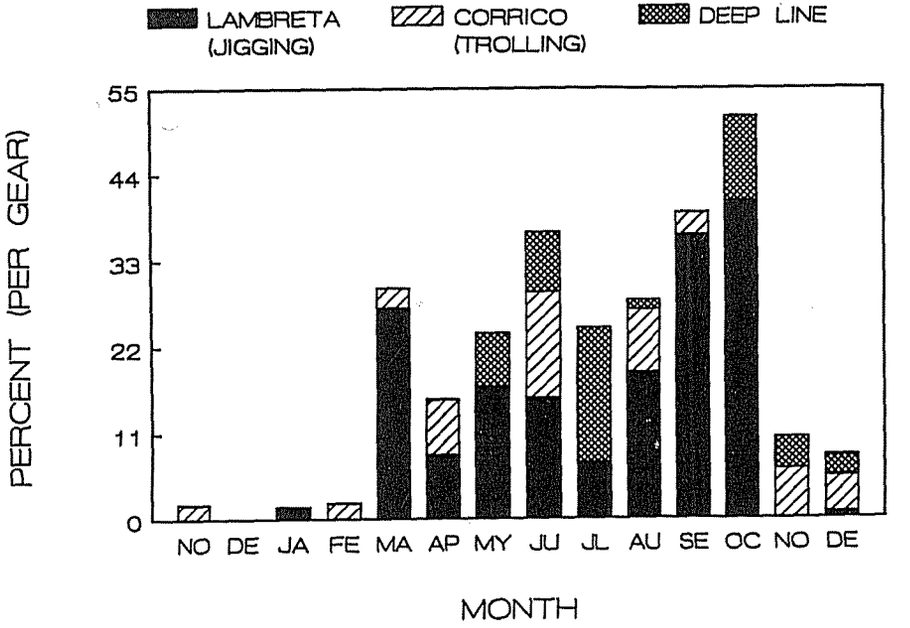


Figure 2. *Monthly utilization of line-fishing gear used to catch bluefish at Porto do Meio harbor. N= 1137: total gear used in 906 fishing trips, 1986-1987.*

Fishing for bluefish is especially important in Spring, but also occurs in Winter and Autumn. Almost no fish of this species are caught in the Summer, when squid (*Loligo sanpaulensis*) is the commonest target of fishing. While the lambreta (jigging) is only used for bluefish, the corrico (trolling) can be used to fish other species, such as bluerunner (*xalerete – Caranx crysos*), yellowtail (*olhete – Seriola lalandi*) and greater amberjack (*olho de boi – Seriola dumerili*). Deep lines are often used to take grouper (*garoupa – Epinephelus* spp.) – called fishing *garoupa de prumo*.

Fishing hours varied according to the gear used. Peak hours of lambreta use are between 12:00-1:00 to 4:00-5:00 p.m. (departures and arrivals, respectively). Corrico is most intensively used from 4:00 to 6:00-7:00 p.m. and deep line from 6:00 to 9:00 p.m. Corrico use overlaps with both lambreta and deep line use (in spite of each one having a different peak hour). Apparently, each of these technologies is suited to specific times of day. However, the fact is that the corrico is being replaced by the lambreta. This suggests that corrico is being neglected by fishermen in part because its hours of use overlap with both other fishing methods.

A major advantage of the lambreta is that it reduces time expenditure. Fishermen usually have to spend considerable time and effort to obtain bait to use corricos and deep lines. For example, halfbeak (*panaguaiú – Hemiramphus balao*) is used for bait and consumption. It is caught by cast net (*picaré*) in late afternoon, before going fishing for bluefish with deep lines. There are also times when bait supply fails.

Efficiency Comparisons Among Hook-and-Line Fishing Gear

In 65 sample days or 498 hours of observation at docks, 906 fishing trips were sampled at Porto do Meio harbor. The lambreta (jigging) was used on 113 fishing trips by 23 different fishermen, the corrico (trolling) on 43 trips by 13 fishermen and deep line on 37 by 17 fishermen. Hook-and-line (not specified), pole and line, ripper jig (to catch squid – *Loligo sanpaulensis*, see Figure 1) and gillnets were used in the other trips sampled. Data on weight of catch obtained by each type of gear could be obtained for 42 fishing trips using lambreta, 8 using corrico and 12 using deep line because as the weight of fish was obtained per trip, it was possible to separate weight per gear for a few trips.

Table 1 shows that the deep line yields the largest returns (Kg) per hour spent fishing and has also the largest variance, followed by lambreta and corrico. Technology choice will depend on what fishermen want to maximize. For example, if they want a secure but small amount of food, they should choose the corrico. However, if they want to maximize food or cash return, in spite of some risk, they should choose the lambreta. Despite the highest returns observed for deep line, it is risky (high variance).

These results are consistent with Búzios fishermen's conscious rationales and choices: many of them are using the lambreta rather than the corrico, and

Table 1. *Mean of Bluefish by Fishing Trip and by Gear; Mean of KG = Kilogram, TH = Total Time Spent in Round Trip, HF = Time Spent Fishing, CREW = Crew Number, TEC = Number of Types of Gear.*

Technology	KG	TH	HF	CREW	TEC	KG/HF	KG/HF/CREW
Corrico (trolling) (n = 8)							
Mean	1.9	3.1	2.6	1.1	1.1	0.9	0.8
Variance	1.5	0.4	0.5	0.1	0.1	0.3	0.3
Deep line (n = 12)							
Mean	27.1	4.3	3.3	1.9	1.9	5.4	3.2
Variance	2436.4	5.0	4.2	0.2	0.2	43.8	15.6
Lambreta (jigging) (n = 42)							
Mean	4.1	3.3	2.5	1.4	1.4	1.8	1.4
Variance	17.3	2.1	1.6	0.6	0.5	2.1	1.3

they argue that they prefer the lambreta because 'it catches more bluefish.' Another advantage of the lambreta is that it does not require natural bait. If the time spent in acquiring bait would have been computed for corrico and deep line fishing, the catch per unit of effort for these gear would decrease.

Fishermen's Attributes

In order to determine if there are individual attributes which characterize 'innovators,' 'early adopters,' 'late adopters' and 'non-adopters,' data on age, educational level, cash income and intensity of dedication to fishing activities were collected. The other harbors on Búzios Island are also included, since they use the same techniques as inhabitants from Porto do Meio harbor. The adopter/non-adopter categories were based on interviews and direct observation on fishing activities (Table 2).

Regression analyses were performed using the categorical variable 'INO' (innovators = 1, early adopters = 2, late adopters = 3 and non-adopters = 4) as the dependent variable. Data were log transformed to minimize possible effects from heteroscedasticity (Gujarati 1978:210). The variable FPT (categories: full and part time fishermen) was excluded from the analysis as it is correlated with NUF = number of fishing trips per fisherman ($r = -0.58$, $p < 0.05$).

Significant results from the regression analyses (Table 3) show that age, education, intensity of fishing activities (number of fishing trips), and income play some role in determining if a fisherman will be a lambreta (jigging)

Table 2. *Fishermen's Attributes: Age, Educational Level (EDU), Part-Full Time Fisherman (FPT), Number of Fishing Trips (NUF), Family Monthly Cash Income and Income per Capita (INC and INPC in US$), and Classification of Adopters/Non-Adopters (INO).*

Fishermen	AGE	EDU	FPT	NUF	INC	INPC	INO
1*	57	0	0	51	4	12	4
2*	40	4	0	23	190	17	2
3*	43	3	1	34	24	3	2
4*	58	0	0	NS	101	25	3
5*	59	1	0	14	60	7	3
6*	22	0	1	86	70	12	1
7*	27	1	1	78	143	71	1
8*	28	1	1	87	100	33	1
9*	28	1	1	58	102	25	1
10*	31	1	1	150	81	14	1
11*	58	0	0	NS	207	69	4
12*	36	0	0	48	55	11	2
13*	32	5	0	17	67	22	3
14*	40	0	1	NS	186	37	3
15*	34	1	0	0	67	21	3
16*	29	0	1	56	112	21	2
17*	46	5	1	NS	95	19	3
18*	37	3	1	NS	101	34	3
19*	20	0	1	59	118	32	2
20	24	5	1	NS	134	45	3
21	45	0	1	NS	65	32	4
22	65	0	1	NS	136	27	4
23*	25	ND	1	NS	518	173	2
24	40	3	1	NS	96	16	2
25	67	0	0	NS	21	7	3
26	53	1	1	NS	395	56	2
27	27	4	1	NS	82	21	2
28	44	5	1	NS	155	22	4
29	36	1	1	NS	85	9	3
30*	22	0	1	48	**	17	2
31*	18	3	1	25	**	17	3

EDUCATION: 0 = illiterate, 1 = functional illiterate, 2 to 5 = years of study.
FPT: 0 = part-time fisherman, 1 = full-time fisherman.
ADOPTER/NON-ADOPTER CLASSIFICATION: 1 = innovator, 2 = early adopters, 3 = late adopters and 4 = non-adopters (based on interviews and on observations on fishing trips).
* = fishermen from Porto do Meio harbor.
** = sons of fisherman 2.
NS = fishermen not included in sample (boat fishermen or fishermen from other harbors).
ND = no data available.

Table 3. *Significant Results of the Regression Analyses Using the Categorical Variable 'I (Innovators = 1, Early Adopters = 2, Late Adopters = 3 and Non-Adopters = 4) as the Depe ent Variable. Data Are in Table 2 and Are Log Transformed. DW = Durbin-Watson d-test.*

Independent variables	Estimator	r^2	Df	p	Dw
Age	0.66	0.29	29	0.01	0.69
Age*	0.86	0.61	28	0.001	2.23
Education	0.35	0.30	16	0.05	1.52
Number of fishing trips	-0.55	0.56	13	0.01	N.A.
Income and number of fishing trips**	-0.25 -0.50	0.78	10	0.01	N.A.

* First difference method used here (Gujarati, 1978: 240) to correct for autocorrelation – observe Dw test.
** $R^2 = 0.74$ and F, $p < 0.001$
N.A. = not applicable in $N < 15$

'innovator.' Education is not very important as r is relatively low. Educ tional level differences are small among fishermen from Búzios Island, sin most of them are illiterate or functionally illiterate. The variable income significant only when the variable NUF is included in the model. Thu 'innovators' tend to be younger and full-time fishermen whereas non-adop ers tend to be older and part-time fishermen. Any fishing gear innovation w be more of interest or will more closely match the needs of an acti fisherman. Moreover, older fishermen are disproportionately involved agricultural activities and less in fishing activities (Begossi 1989).

The Transmission of Lambreta Use Among Fishermen

The most important 'innovators' are five brothers (6 to 10, Table 2) fro Porto do Meio harbor. These brothers live near each other and usually fi together. They were the first to learn and teach other fishermen how to u and manufacture the lambreta. Among 17 fishermen, 12 learned to u lambreta from these brothers. Fishermen 8 and 6 were the most mentioned b interviewees. Nine interviewees explained they had their first contact with th lambreta through fishermen on a boat from Ubatuba City. Ubatuba City a few miles farther from Búzios Island than São Sebastião City (see map 1 Islanders reported that they saw fishermen from Ubatuba catching a lot bluefish using lambretas in front of Búzios Island. They then obtained a

example of this gear (stories differed as to whether they were purchased or a gift from Ubatuba fishermen), tried it and decided to adopt it. In fact, the five brothers (especially fisherman 8) were often observed making and selling lambretas for other fishermen from Búzios. These brothers often tell this story about the Ubatuba boat.

In another interview, all adopters cited the name of at least one of these 'innovator' brothers as the ones responsible for the teaching of lambreta utilization or manufacture in the community. Again, fishermen 8 and 6 were the most quoted.

As pointed out by Rogers (1983:271), opinion leadership is very important in the diffusion of innovations. Downs and Mohr (1976) observed that prestige is commonly attributed to individuals who are among the first to adopt new innovations. Among Búzios's fishermen, the 'best fishermen,' or the ones who usually have good catches, have a high status within the community. Búzios community is constituted essentially by part and full time fishermen. Manioc cultivation is performed in small plots by old men (usually part-time fishermen) and women (Begossi 1989). Thus, we expect that 'innovators' should be among the most prestigious members of the Búzios community.

To assess status and prestige among fishermen, fishermen were interviewed to obtain information regarding who fish the most and best at Búzios Island (November). All fishermen cited the name of at least one of the 'innovator' brothers as the fisherman who fishes most. In particular 14 cited fisherman 8, 11 cited fisherman 9 and 9 cited fisherman 6. Twenty-one fishermen considered fisherman 8 as 'the best fisherman' and 13 mentioned fishermen 6 and 9. The explanations given by islanders include that these men are always fishing, they fish at night, they usually catch many and big fish, and that fishing is their main economic activity.

The high status that these fisherman brothers have among other Búzios fishermen played an important role in the diffusion of the lambreta in this community.

Factors Affecting the Diffusion of Lambreta at Búzios Island

Rogers (1983: Ch. 6) observed that features of the innovation are usually important for its diffusion. He classifies these as 'relative advantage,' or the degree to which an innovation is perceived as better than the technology already in use; 'compatibility,' or the degree to which the innovation is consistent with experiences and values; 'complexity,' or the degree to which the innovation is difficult to understand or use; 'trialability,' or the degree to which the innovation can be experimented, and 'observability,' or the degree to which it is visible to others. Downs and Mohr (1976) classified the attributes of an innovation as 'primary attributes,' or ones that everybody agrees on (cost, communicability, among others) and 'secondary attributes' (those perceived by senses).

The lambreta (jigging) is highly 'trialable' and observable, since it can be easily experimented and fishermen are aware of their own and others results. The 'innovators' helped to reduce the complexity of this gear by teaching other fishermen how to use it. Also, 'trialability' is increased by the innovators, since they either taught fishermen how to make lambretas or how to use them (and also by selling some of this gear, making them available). The lambreta is quite compatible with existing fishing practices, since it is mainly a direct substitute for the corrico and does not require dramatic ancillary changes in behavior. The relative advantage of this innovation is that it allows higher returns per hour, of the most important fish at Búzios (bluefish: *enchova*), than the corrico (trolling) without being risky as the deep line technique.

Adopter features, such as suggested by Rogers (1983), were also found to be important. Young and full-time fishermen are the 'innovator class' in the diffusion of lambreta. Thus, the rapid diffusion of the lambreta at Búzios can be understood in terms of both innovation and fishermen features in an environment in which it is effective and highly compatible. Downs and Mohr (1976) have emphasized that characteristics of both adopters and innovation are important to understand the extent and rate of the adoption. Actually, fishermen from Búzios often ask visitors to bring them fishing gear. The thin nylon used in the manufacture of lambreta is not commonly found at either São Sebastião Island and City. The material made available by visitors is also helping to the speed of the diffusion of lambreta at Búzios.

According to Boyd and Richerson (1985:134-36), biased transmission is a process of cultural evolution in which variants are favored over others. They consider this kind of transmission as a major force directing human evolution. Biased transmission is classified by them in 'direct bias,' 'indirect bias' and 'frequency dependent bias.' In direct bias, an individual's decision is based on trying different objects or behaviors and to choose among the 'best' (as in Downs and Mohr's hypothesis that primary attributes of innovation are important in adoption). In indirect bias, the decision is based upon prestige or some similar attribute which individuals imitate (as in Rogers' concept of opinion leadership). Frequency dependent bias occurs when the most common behavior is imitated, independently of the intrinsic features of the behavior.

The behavior of the adopters of lambreta can be understood through these forces of cultural transmission. Innovators behave mainly through direct bias, since they tried the lambreta and decided to adopt it after evaluating the results. Indirect bias also plays some role, even if secondary, as innovators had the opportunity to observe other fishermen using this gear before using it themselves ('outside people' represent status among islanders). However, indirect bias is a strong force concerning the diffusion of lambreta within Búzios's community: early adopters observe and imitate the gear used by the fishermen considered as the 'best' from the island. Thus, the use of lambreta

gives certain prestige among fishermen, since the best fishermen use it. Frequency dependent bias seems the more important force driving the decision of late adopters.

Boyd and Richerson (1985:167) observed that direct bias is evident in most innovation case studies presented by Rogers and Shoemaker (1971). The authors also observed the importance of indirect bias for small groups of innovators, which is similar to the case described for Búzios Island.

A similar innovation was adopted by Búzios fishermen in the early eighties and gives additional insight into the adoption process on the island. It is a special jig used to fish squid. Squid fishing takes place during the Summer, from November to March (Begossi and Duarte 1988). The squid jig is an 'umbrella hook' or ripper jig (Von Brandt 1984:133), locally called *jangarelho*. One kind of ripper jig which needs natural bait was replaced by another, which uses an artificial bait (lines around it function as bait – see Figure 1).

All Búzios fishermen now use the 'new' ripper jig. As with the lambreta gear, fishermen usually make ripper jigs instead of buying them. Interviews (November) show that 57% know how to manufacture them. When fishermen were asked about how they learned to make ripper jigs, 56% answered that they learned from fishermen 6 to 10, the same five brothers (Table 2) from whom they learned about the lambreta. Twenty-five per cent explained they learned about it from fishermen from a boat from Santa Catarina State (south of Brazil), which was fishing squid near Búzios. There are many Santa Catarina fishermen on the coast of São Paulo State. In recent years, many of these fishermen have migrated to São Paulo coastal areas with their families, and they are called 'Catarina' by local fishermen. As with the lambreta adoption, Búzios fishermen explained they decided to adopt the ripper jig because it does not require natural bait and because they saw the 'Catarina' catching a lot of squid with it.

Conclusions

The approaches by Rogers and Shoemaker (1971) and by Downs and Mohr (1976, 1979) in the study of innovations are complementary with regard to the adoption of lambreta at Búzios Island. The lambreta is an innovation which can be experimented by fishermen with no difficulty and is compatible with existing fishing practices. Its relative advantage includes higher returns per hour fishing and the fact that it does not need natural bait, which are 'primary attributes' in Downs and Mohr's sense. On the other hand, adopters features were also found to be important, as young and full-time fishermen more readily adopted the lambreta than older and part-time fishermen.

Actually, different aspects seem important in different stages of the adoption process. In an initial stage, innovation features were the key in the transmission among fishermen from Ubatuba and Búzios (direct bias). In a second stage, or in the transmission of the lambreta among innovators and early adopters in Búzios, both attributes of the innovation and of adopters were critical. In this stage, indirect bias based on prestige was contributing to the spread of the innovation on the island. The forces of cultural transmission suggested by Boyd and Richerson (1985) allowed the understanding of the different stages of the diffusion of lambreta which was fundamental to perceive the dynamic process of diffusion of an innovation.

The fact that the lambreta and the new ripper jig do not need natural bait (time spent fishing is thus increased) played a key point in the diffusion of both innovations at Búzios Island. The same 'class' of innovators were found for both gear. Dewees (1985) and Dewees and Hawkes (1988) found that different sets of variables explained the adoption of each of the innovations they studied, probably due to specific innovation differences in the match among adopter-innovation. Both innovations studied at Búzios are similar in their primary and secondary attributes. Thus, the finding of a specific class of innovators for this case cannot be generalized for other different innovations. These might be considered as a cluster of innovations that the same people need or see the same relative advantage in adopting.

The question of adoption or rejection of innovations may be confused by our own belief system (Smith 1977). As pointed out by Alexander (1975), peasant villages cannot be considered conservative if they accept new methods that increase their rewards and reject methods that raise risks. Studies by Alexander (1975, 1976) at Sri Lanka, by McCay (1978) at Fogo Island (Newfoundland) and by Forman (1970) in a Brazilian fishing village (Alagoas State) have shown that fishermen tend to adopt innovations if they respond to their needs in specific environments. This is a critical point that should be well understood by government agencies: programs without local participation and evaluation are very likely to fail.

Finally, the importance of the fishing boats that stop at Búzios cannot be neglected. These outside fishermen provide opportunities for islanders to observe new technologies. Rogers (1983) pointed out that a cosmopolite communication behavior is a common feature of innovators. Innovators from Búzios Island have such behavior, since the adoption of both lambreta and ripper jigs depended on relationships developed between fishermen from Búzios Island and other localities.

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