

Volume II, Issue II — January-June 2015

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**Journal - Ecuador**

ISSN-On line: 1390-9959

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ECORFAN Journal-Ecuador, Volume 2, Issue 2, January-June -2015, is a journal edited four- monthly by ECORFAN. 18 Marcial Romero avenue, Postcode: 241550. Salinas 1 – Santa Elena WEB: [www.ecorfan.org/ecuador](http://www.ecorfan.org/ecuador), [journal@ecorfan.org](mailto:journal@ecorfan.org). Editor in Chief: RAMOS-ESCAMILLA, María. PhD, ISSN- On line: 1390-9959. Responsible for the latest update of this number ECORFAN Computer Unit. ESCAMILLA-BOUCHÁN, Imelda. PhD, LUNA-SOTO, Vladimir. PhD, 18 Marcial Romero avenue, Postcode: 241550. Salinas 1 – Santa Elena, last updated June 30, 2015.

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## Presentation

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In this number is presented in Section of Experimental design Antimicrobial susceptibility of strains isolated Enterobacteriaceae in urine samples in patients with urinary tract infections. Period January 2013 – January 2016 by SUÁREZ, Patricia, JARRÍN, Carlos, LASCANO, Carmen, SANTOS, Sonia, in Section of Commerce an article Strategies of Mexican pork producers in the Japanese market by GÓMEZ, Alma and PÉREZ, Francisco with adscription in the Universidad Autónoma Chapingo, in Section of Options an article Materials and resources in the teaching and learning process of mathematics by CARRERA, Alfredo, LAÍNEZ, Amarilis, TUMBACO, Mónica, LASCANO, Carmen, in Section of Rural an article The impact of agriculture and tourism on Mexican GDP. By FIGUEROA-HERNÁNDEZ, Esther, PÉREZ-SOTO, Francisco y GODÍNEZ-MONTOYA, Lucila., with adscription in the Universidad Autónoma del Estado de México in Section of Flora and fauna an article Patterns of diurnal behavior of the species *Himantopus mexicanus* belonging to the Family Recurvirostridae, in the Estuary of Saint Paul - Santa Elena by GONZÁLEZ, Tanya, OÑATE, by GONZÁLEZ, Tanya and GONZÁLEZ, Crithian. with adscription in the Universidad de Guadalajara, in Section of Agronomy an article Incidence of Salmonella and *E. coli* in Mango exporting company in the State of Nayarit, Mexico by IBARRA, L., ALVARADO, S., CASTILLO, A. and ALANÍS, R with adscription in the Universidad Autónoma de Nayarit, in Section of Natural an article Composition, abundance and diversity of larval and juvenile fish associated to the roots of the Mangrove trees, in the estuary of the Commune Palmar - Province of Santa Elena, by GONZÁLEZ, Tanya and GONZÁLEZ, Crithian with adscription in the Universidad Estatal Península de Santa Elena

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## Antimicrobial susceptibility of strains isolated *Enterobacteriaceae* in urine samples in patients with urinary tract infections. Period January 2013 – January 2016

SUÁREZ, Patricia †, JARRÍN, Carlos, LASCANO, Carmen, SANTOS, Sonia

Received January 16, 2015; Accepted May 22, 2015

### Abstract

The urinary tract infections (UTI) are one of the main reasons for consultation in the field both outpatient and Hospital. This study aims to establish the susceptible antimicrobial stability of *Enterobacteriaceae* strains isolated from urine samples in patients with urinary tract infections Hospital General "Dr. Liborio Panchana Sotomayor". Treat diseases directly with the appropriate drug benefits the community in providing faster recovery and better living conditions. A retrospective observational study. The universe are patients of all ages and both sexes, urinary tract infections They are attending the Hospital General "Dr. Liborio Panchana Sotomayor" Santa Elena, period from January 2013 to January 2016. To determine the antimicrobial susceptibility, it was used the method Kirby Bauer disk diffusion. *Escherichia coli*, it was found in a high percentage of cases, the most common etiologic agent. The infection rate was much higher in women than in men. With respect to patterns of antimicrobial susceptibility commonly used for treatment the UTI, it was found in strains of *Enterobacteriaceae*. It was sensitive to nitrofurantoin, gentamicin, Amox. + Ac.Clavulánico. Low sensitivity to antibiotics such as aminopenicillins, first generation cephalosporins and ciprofloxacin showed. In hospitalized patients a high percentage of multiresistant strains was obtained

### Antimicrobial susceptibility, *Enterobacteriaceae*, urinary tract infections

**Citation:** SUAREZ, P, JARRÍN, Carlos, LASCANO, Carmen, SANTOS, Sonia. Antimicrobial susceptibility of strains isolated *Enterobacteriaceae* in urine samples in patients with urinary tract infections ECORFAN Journal-Ecuador 2015, 2-2: 93-97

† Researcher contributing first author.

## Introduction

In the province of Santa Elena no data are available to assess what the real situation in this respect, on the behavior of bacteria against different antibiotics.

These conditions are aggravated by the fact that an accurate diagnosis requires both clinically and positive urine culture, which implies an empirical antibiotic treatment. (Foxman, 2002)

Through this research project aims to show the reality in relation to this problem, because in the town there is a network of surveillance to track the effectiveness of antibacterial therapy and make visible microbial resistance levels. (Johnson, 2002)

The purpose of this research is to recover and identify strains of *Enterobacteriaceae* urine cultures between the months of January to December 2014 in patients with urinary tract infections (UTI) are found in General Hospital "Dr. Liborio Panchana Sotomayor "Santa Elena, since the study area is a site occur frequently urinary infections of different natures and therefore it is important to do this work.

Considering the need to provide support for specialized committee of prevention and infection control for the sound management of antibiotics and increase the therapeutic efficacy of established protocols, information obtained during the conduct of this study is of great importance in the health area, because it will reveal the susceptibility of strains of *Enterobacteriaceae* to antibiotics of first choice and alternative drugs. Thus significant improvements occur in the therapeutic treatment and the economics of antibiotics.

Treat diseases directly with the appropriate drug benefits the community in providing faster recovery and better living conditions. (Hellestein ,2006)

Type of study is retrospective, observational.

Universe: It will consist of urine samples of patients of all ages and both sexes who come to the Hospital General "Dr. Liborio Panchana Sotomayor "Santa Elena, with urinary tract infections in the period from January to December 2014.

Sample size: It is equal to considering inclusion and exclusion criteria universe.

Criteria and exclusion inclusion: Samples to consider are those that meet the following criteria:

1. Samples of patients of both sexes and all ages and what are being treated at the Hospital General" Dr. Liborio Panchana Sotomayor "in the period between January to december 2014.
2. Samples of patients who meet the acceptance criteria of the laboratory.
3. Urine samples in which *Enterobacteriaceae* recovers.

Well as samples with exclusion criteria are:

1. Those who do not meet the inclusion criteria.

## Materials and methods

Of the approximately 13,050 urine cultures are performed annually in the Hospital "Dr. Liborio Panchana Sotomayor "between the period January 2013 to December 2015, 1,800 were positivos.

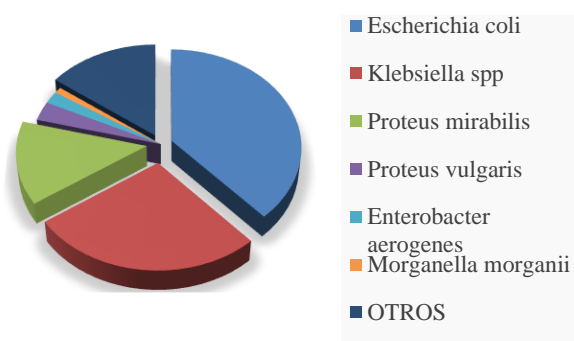
## EXPERIMENTAL DESIGN

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Of these, it was excluded 650 corresponding to hospitalized patients.

The highest percentage of UTI is caused by *Escherichia coli*, with 38% of cases, 27% are caused by *Klebsiella spp*, then lower percentages are: *Proteus mirabilis* with 14%. (Ronld, 2002)

They have also been found, other etiologic agents but less frequently, among them are: *Staphylococcus* negative coagulase, *Enterobacter spp*. *Streptococcus agalactiae* among others. (Ria, 2009)



**Figure 1** Distribution causative agen of urinary tract infections

The study found that between the ages of 26-64 years are more susceptible to UTI, 38.6% of cases. Ages between 13 to 25 years with 28.4% ranked second, the third was for ages 50 to 64 with 5.7%, those aged under 5 years, 65 years and over had low percentages. Also we can see that correspond to a lower percentage, they are male, while a higher percentage of patients are female. (Frimod, 2002)

The age groups of 13 to 25 years and 26 to 64 were selected by a high rate of urinary tract infections. In this age group we will evaluate the antimicrobial susceptibility against drugs of first choice. (Ochoa, 2005)

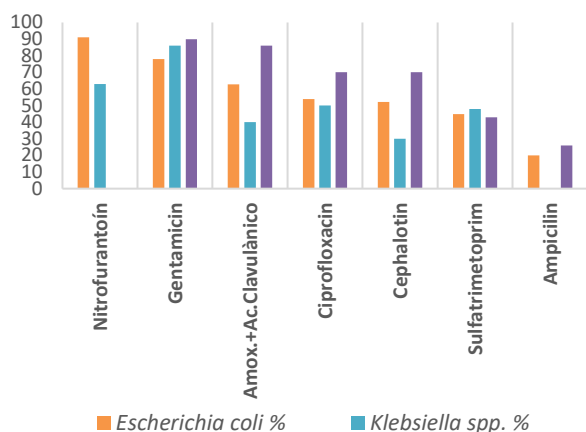
A tab data collection will be designed, built a database in Microsoft Excel 2007. Results are expressed as percentages and shown in tables. To determine the antibiotic sensitivity diffusion method Disk, which provides two groups of antibiotics= Group 1 ant ibióticos first choice will be used.

*Escherichia coli*, found in 38% of cases, the most common etiologic agent. Other germs most frequently associated with this pathology are caused by *Klebsiella spp*. 27%, then lower percentages are: *Proteus mirabilis*, *Staphylococcus cogulasa* negative, *Enterobacter aerogenes*, *Streptococcus agalactiae* among others.

On the other hand aged 26-64 years are more susceptible to UTI in 38.6% of cases, followed by the range of 13-25 years (28.4%). The infection rate was much higher in women than in men.

## Results

With respect to patterns of antimicrobial susceptibility commonly used to treat the UTI found that *Escherichia coli* was sensitive to nitrofurantoin (91,1%), gentamicin (77,9%), Amox. + Ac. Clavulanate (62,8%) and ciprofloxacin (54%), and showed low sensitivity to ampicillin (20%), trimethoprim sulfamethoxazole (44,9%) and cephalothin (52,2%). This is consistent with those reported in the literature. (Tablet #2)



**Figure 2** Distribution and frequency of antimicrobit susceptibility of Enterbacteriaceae strains against drugs of first choice

When referring susceptibility profile of *Escherichia coli* isolated, as it was observed that there was low frequency of resistance to most antibiotics tested; however, the maximum levels of resistance were found in the antibiotics administered orally and often indicated for uncomplicated urinary tract infections.

### Acknowledgements

Hospital General "Dr. Liborio Panchana Sotomayor" Santa Elena.

Conflict of interest: No conflict of interest to declare.

### Conclusion and recommendations

This result reflects the widespread use of fluoroquinolones and beta-lactam antibiotics as empirical therapy of UTI. The intensive use of these and other antimicrobials, exerts selective pressure on microorganisms, which could explain the patterns of antimicrobial resistance found in this investigation.

Gentamicin could be ideal for empirical treatment of uncomplicated community UTI. Likewise, the information sensitivity profiles will be distributed to all health personnel especially prescribers for good rational use of antibiotics. Besides antibiotics with high percentage of sensitivity will be presented to drug area committee to be analyzed and thus considerable improvements will occur in the therapeutic treatment and the economics of antibiotics. Treat diseases directly with the appropriate drug benefits the community by providing more speed your recovery and better living condition.

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## **Strategies of mexican pork producers in the japanese market**

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Received January 5, 2015; Accepted June 1, 2015

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### **Abstract**

Mexico and Japan signed an Economic Complementarity Agreement that came into force in 2005. Japan is a major consumer of pork and pays excellent prices for it. This paper attempts to determine the production and business strategies that have enabled major Mexican pork companies to penetrate the Japanese market in order to recommend them to other pork producers. A survey was drawn up and applied to pork producers in the states of Jalisco and Sonora. It was found that pork production is intended for both the domestic (80%) and international (20%) market, that extensive and intensive production is used, and that the PIC Genetic Line breed is preferred because it reduces costs. Farmers produce their own feed, taking care to ensure that quality control and nutritional requirements are met. The main pork export destinations are the United States and Japan, taking care of disease control, type of feed, vaccines and medicines.

### **Economic complementarity agreement, production strategies, business strategies, Japan, pork production**

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**Citation:** GÓMEZ, Alma and PÉREZ, Francisco. Strategies of mexican pork producers in the japanese market. ECORFAN Journal-Ecuador 2015, 2-2:98-108

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† Researcher contributing first author.



## Introduction

Mexico's entry into GATT in 1986 marked the beginning of the country's trade liberalization policy and therefore the reduction of barriers to the import and export of products. Within the negotiations of tariff fraction groups, those of the primary sector received most-favored-nation treatment, i.e. they pay preferential tariffs. Continuing this trade liberalization, Mexico and Japan signed an Economic Complementarity Agreement (ECA) which came into effect in 2005. Japan is a major consumer of pork (Dyck and Nelson, 2007) and is known for paying excellent prices for it. The pig carcass price in Japan is \$209 per 100 pounds, while in South Korea it is \$189, in China \$160, in Russia \$139, in Spain \$123, in the US \$94 and in Canada 91 (Stuart, 2013). It is noteworthy that even though Mexico is not very competitive in the production of animal feed, in recent years it has managed to increase its livestock exports to Japan.

Moreover, Mexican pork is very popular in Asian markets. This year has also seen Mexican pork producers make additional inroads into the Asian market, such as the incorporation of Jalisco into the group of states authorized to sell their products to Japan after providing proof that it is free of classical swine fever, and the authorization granted by Chinese authorities to four Mexican pork processing plants. It should be pointed out that Japan suffered outbreaks of foot and mouth disease in 2010 (Anonymous (b), 2010) and was forced to move livestock (Anonymous (a), 2010) and sacrifice a considerable number of head of pigs and cattle (Anonymous (c) 2010). Therefore, the demand for meat products will increase in the coming years.

In this context we set ourselves the goal of determining the production and business strategies that have enabled the major Mexican pork companies to penetrate the Japanese market in order to suggest them to other producers of pork and other livestock products. Our two-fold working hypothesis was as follows: 1) Mexican pork is popular in Asian markets for its quality and freshness and 2) The effectiveness of animal health programs has enabled the development of Mexican pork exports.

## Justification

Pork is a very important product for Japan. The access achieved by Mexico includes an export quota within which Japan provides preferential treatment to Mexican exports, which mainly consists of a reduction in the integrated import price (IIP) of 11 yen/kg for fresh refrigerated or frozen pork cuts, and a reduction of 37 yen/kg for processed pork cuts (mainly hams).

Year	Quota	Volume exported
2005	38,000	35188
2006	53,000	40358
2007	65,000	48345
2008	74,000	56550
2009	80,000	43681

**Table 1** Quota negotiated in the Economic Complementarity Agreement for Mexican pork exported to Japan. (Metric tons)

As can be seen in Table 1, from 2006 Mexico's pork exports were substantially less than the quotas set out in the Economic Complementarity Agreement. Therefore, there is a significant window of opportunity for Mexican pig producers that has not yet been fully exploited.

Pork is currently the most consumed meat worldwide; its demand, in recent decades, has seen a sharp increase. This is due to changes in consumption patterns in developing countries. Pig farming is the fastest growing livestock subsector, with the number of animals reaching one billion by 2015, double that of the 1970s. Pork production is distributed worldwide, with the exception of some regions that maintain certain cultural and religious reservations regarding the consumption of pork (FAO, 2014).

The nutritional, economic and social importance of this meat is undeniable. In Mexico, in 2010, pork was the second most consumed meat only after chicken. The pig is now among the most efficient animals in terms of meat production; its particular characteristics, such as great precocity and prolificacy, short reproductive cycle and high nutrient processing capacity, make it particularly attractive as a food source (FIRA, 2012).

For many years pork was considered as a food of very little nutritious value, and associated with diseases and parasites. However, in recent years, nutritional qualities have been found that are comparable with those of red and white meat. Moreover, during this same period, fat content has been reduced by 31%, calories by 14% and cholesterol by 10%, thanks to technological advances in pig production in the world.

In addition to Mexico's previous economic model that maintained a closed economy, the country also suffered several epidemics of cysticerci in 1920, 1954 and 1980-1981 (De Aluja, accessed 16 March 2014). With regard to classical swine fever (CSF), the first outbreak was recorded in 1883 in the Bajío area.

By 1980 the first campaign for CSF control and eradication was established through various actions that allowed declaring the area CSF-free by 1983. Also in the period 1983-1991 in the central-western area of Mexico with immunization coverage from 45-55% of pigs, outbreaks occurred cyclically with greater than 50% morbidity and mortality. Immunization coverage reached 93% in 1992 and 97% in 1993, which enabled reducing the number of cases to zero (Morilla and Carvajal, 2002). In 1998 there were again CSF outbreaks in the area under eradication, spreading the disease. By 2003 the country was divided into two zones, one CSF-free in Sonora and the northern states of the Yucatan Peninsula, and the rest of the country where the disease was present and vaccination was needed. From the second half of 2007 the disease was only found asymptotically in some regions of the country, and by January 2009 it was announced that CSF had been eradicated after several years of efforts (Ferrer et al, 2010). The fact that these animal health problems have been successfully controlled currently allows this product to be exported.

Pork carcass production is largely concentrated in two Mexican states: Jalisco and Sonora, which account for 18.9% and 18.2%, respectively, of domestic production. Jalisco supplies the domestic market, while Sonora's production is mainly export-oriented. Other notable pork-producing states include Guanajuato (9.4%), Puebla (9.3%) and Yucatan (8.4%). The remaining 35.8% of production is accounted for by all the other Mexican states combined (Financiera Rural, 2012). Table 2 shows the evolution of the volume in metric tons that Japan has imported from NAFTA countries for four-year periods. It should be noted that in the analyzed period, the United States and Canada doubled their export volumes, while Mexico increased its export volume at a lower rate.

On average, in this period the US accounted for 57% of total Japanese pork imports from these three countries, compared to 34% for Canada and only 9% for Mexico.

	1997-2000	2001-2004	2005-2008	2009-2012
Canada	315231	682708	686929	697470
United States	654053	987982	1147751	1224600
Mexico	132225	149974	180441	171440

**Table 2** Amounts of pork imported by Japan (metric tons)

(Source: Author-made based on data from Japan's Ministry of Finance. [www.customs.go.jp/toukei/srch/indexe.htm](http://www.customs.go.jp/toukei/srch/indexe.htm) (accessed 18 Dec. 2012))

On the other hand, in Table 3 we see the value of these imports in millions of yen. During the period of analysis both the US and Canada obtained on average 553,000 yen per metric ton, while Mexico obtained 576,000 yen per metric ton. The fact that it pays a better price for Mexican pork shows the value that the Japanese market places on the high quality of Mexican meat.

	1997-2000	2001-2004	2005-2008	2009-2012
Canada	177554	406454	367289	365791
United States	384359	594597	613969	627463
Mexico	73659	98177	102688	90380

**Table 3** Value of pork imported by Japan (thousands of yen)

### Theoretical Framework

The formation of the global livestock market began after the Second World War. Thereafter different processes began that resulted in a new economic order. Production of some food products was also reorganized on a commercial basis that has a global exchange. In various developing countries agricultural production for domestic consumption has been switched to an export focus, benefitting global capitalism.

The basis of the new international division of labor is the direct employment of a large number of workers with low production costs in foreign territories to perform standard production tasks.

The global system has been able to develop thanks to a global system of suppliers, consumers and circulation that emerged in recent years instead of bilateral trade arrangements that are now economic blocs. The global economy is also an information economy; that is, an economy in which productivity growth is not dependent on a quantitative increase in the factors of production (capital, labor, natural resources), but the application of knowledge and information to management, production and distribution both in processes and products (Foray and Freeman, 1992; cited by Borja and Castells, 1997: 25). The generation and strategic processing of information have become essential factors in productivity and competitiveness in the new economy (Dosi, 1988; cited by Borja and Castells, 1997: 25).

### The importance of location in the food supply

Supply analysis departs from the macroregional, regional and subregional environment, taking into account the identification of production areas and demand centers and the behavior of the various linkages involved in the chain; from there the functionality of this national food system is established. The information economy is also characterized by a flexible production model, built around the increasingly widespread practice of the company-network. By this term we do not mean a network of companies, but a new form of organization.

What we are seeing in the economy (and to a large extent in society as a whole) is the decentralization of large enterprises, creating semi-autonomous management units: the proliferation of small and medium-sized enterprises, and the formation of cooperation networks between small and medium-sized enterprises, between small ones and between large ones, thereby forming networks of networks (IHMAI, 1990 cited by Borja and Castells, 1997: 25). Since strategic alliances between large companies vary according to product lines, technology, market or country, we can consider that the new structure of the economic system consists of specific, ever-changing networks in a variable geometry system (Borja and Castells, 1997: 25).

### **Competitive strategy**

Competitive strategy is largely based on a deep understanding of industrial sectors and competitors. Competitive strategy is a combination of the goals that the company seeks and the means (policies) by which it tries to achieve them. The formulation of a competitive strategy essentially consists of linking a company with its environment (Porter, 2004). Three general strategies for achieving a competitive advantage are: cost leadership, differentiation and focus. The decisive factor when profitability is calculated is to know whether companies can get the value they generate for customers or whether they will lose them to the competition (Porter, 2009).

The basic criterion of an above-average performance over the long-term is the sustainable competitive advantage. Although a company may have many strengths and weaknesses compared to its rivals, there are two basic types of competitive advantage within its reach: low costs and differentiation.

Ultimately, the importance of a strong or weak point depends on the impact it has on the relative cost or differentiation. Both variables come from, in turn, the industry structure. They originate from the ability to better deal with the 5 factors than its rivals (Porter, 2009). The two basic types of competitive advantage, combined with the scope of activities for which companies seek to achieve them, give rise to three generic strategies to achieve above-average industry performance: cost leadership, cost focus and differentiation focus. The focus strategy has two variants: cost focus and differentiation focus (Porter, 2009).

### **Cost leadership**

This kind of leadership is perhaps the clearest generic strategy. In it, an organization sets out to become the low-cost producer in its industry. It has a broad scope, serves many industry segments and may even operate in related industries; its breadth is often important to its cost advantage. The sources of this advantage are varied and depend on the structure of the industry. They may include the pursuit of economies of scale, proprietary technology, preferential access to raw materials and other factors (Porter, 2009). A cost leader must reach parity or proximity in differentiation against the competition to be a leading participant, although its competitive advantage is founded on cost leadership. Differentiation-based parity allows it to translate its advantage directly into higher profits than its rivals. Differentiation-based proximity means that the price discount necessary to achieve an acceptable share in the market does not offset the cost advantage and hence the leader earns above-average returns (Porter, 2009).

### **Differentiation**

It is the second generic strategy.

In it, the firm seeks to be unique in its industry in some aspects widely valued by buyers. It selects one or more attributes that it considers important and uniquely positions itself to meet those needs. Its uniqueness is rewarded with a higher price (Porter, 2009).

Every industry has its own means for differentiation. It can be based on the product itself, the delivery system by which it is sold, the marketing approach and many other factors (Porter, 2009). The logic of the differentiation strategy requires that the company select attributes that are different from those of its rivals. If it wants to set a high price, it must be truly unique in something or be perceived as such. But unlike cost leadership, there may be more than one successful strategy in an industry if there are several attributes valued by many customers (Porter, 2009).

### **Focus**

The third generic strategy differs radically from the previous two because it is based on the choice of a narrow competitive scope within an industry. The company selects a segment or group of segments in it and tailors its strategy to serving them to the exclusion of others. By focusing on them, it seeks to achieve a competitive advantage despite not possessing a competitive advantage overall (Porter, 2009).

The focus strategy has two variants. In the cost-based focus, the company seeks an advantage of this type in the target segment, while in the differentiation-based focus it seeks to distinguish itself in it. Both variants are based on the differences between target segments and other segments in the industry. The former must have customers with unique needs, because otherwise the production and delivery system that best serves them must differ from that of other segments.

The cost focus exploits differences in cost behavior in some segments, whereas the differentiation focus exploits the special needs of the members of certain segments. It is assumed that the segments are poorly served by competitors that also have other customers. Thus, the firm can achieve a competitive advantage by exclusively devoting itself to the segments. Without a doubt the target segment has a varied breadth, but the focus essentially consists of exploiting the small differences in the segment compared to the industry as a whole. A rigorous focus in no way guarantees outstanding performance (Porter, 2009). If cost leadership and differentiation are obtained simultaneously, huge rewards will be achieved because the benefits are additive; differentiation causes high prices and cost leadership means lower costs (Porter, 2009).

### **The Value Chain**

The value chain contains total value and consists of value activities and margin. It involves physically and technologically specific activities that are carried out. They are the structures by which a product useful for buyers is created. Margin is the difference between total value and the actual cost of making them. It can be measured in various ways. Also, the supplier and channel value chains introduce a margin that should be isolated to understand the causes of a firm's cost position, since the margin of each one is part of the total cost charged to the customer (Porter, 2009).

### **Focus or concentration**

The focus is aimed at a buyer group, product line segment or geographic market; like differentiation, it adopts a multitude of modalities.

This seeks above all to give excellent service to a particular market. It is based on the assumption that the company may provide better service to its segment than companies competing in larger markets, by doing it at a lower price to accomplish both goals (Porter, 2004). Competitive strategy involves positioning a company to take maximum advantage of the value of the capabilities that distinguish it from its rivals. From this we can deduce that a central aspect of the formulation of strategies is to analyze the competition thoroughly (Porter, 2004).

### The business strategy

The business strategy is the plan to bring products to market and survive over time; such a strategy is a combination of tools that allow the company to reach its intended market.

### Methodology

Deductive and comparative methods were used. For the methodological development of this research, a qualitative survey was drawn up and applied to pig producers (production units) in the states of Jalisco and Sonora.

The aim of the survey was to carry out an analysis of the strategies used by pig producers to enter and remain in the Japanese market, as well as to meet the country's animal health and presentation requirements.

The survey consists of 3 sections: questions about some features of the production units (type of farming, breeds with which they work, feed), international market (exporting states, export destinations, intermediaries) and the Japanese market (demands of the Japanese market, strategies to remain in the Japanese market).

It was determined that a total of 37 direct surveys would be applied to 37 production units, which are considered a representative sample of the population under study. This sample was defined based on the size of the population.

A sample size of 37 production units was determined, taking as a reference a population of 42 production units located in the states of Jalisco and Sonora, which are the states that export to Japan. The database was obtained from the Association of Pork Producers. By applying the following equation (1), we were able to determine the sample size by the proportions mentioned:

$$n = \frac{pqNZ^2}{E^2(N-1)+Z^2pq} \quad (1)$$

Where:

N: is the population size. (N=42)

Z= is a constant that depends on the confidence level assigned; 90% confidence level (Z=1.65).

E: is the desired sampling error. (E=5%)

p: is the proportion of individuals in the population that possess the study characteristic. (It is assumed that p=q=0.5, which is the safest option).

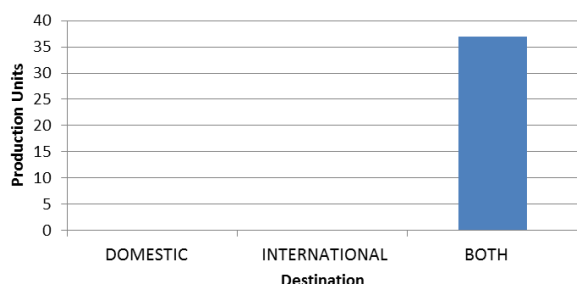
q: is the proportion of individuals that do not possess that feature, i.e., it is -p. (q=0.5)

n: is the sample size. (n=37)

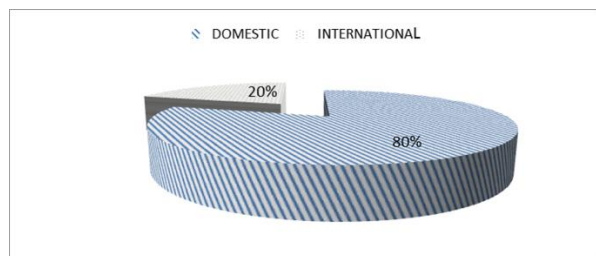
The results of the surveys applied were systematized in the Excel software package for further analysis. A literature review of sources such as Japan's Ministry of Finance, FAO, USTDA, SAGARPA and SIAP was performed in order to present an analysis of the international and domestic pork market.

**Results and Discussion**

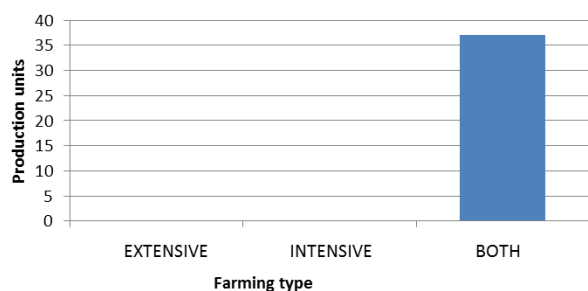
It was found in the fieldwork that the meat produced in the production units surveyed is intended for both the domestic and international market, as can be seen in Figure 1. Of the production obtained, it is estimated that 80% is to meet domestic demand and the rest is for export (Figure 2).



**Figure 1 Product Destinations**



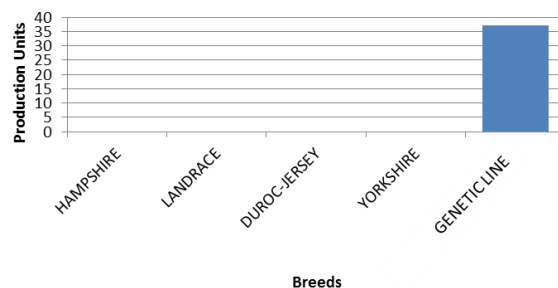
**Figure 2 Product Destinations (Percentage)**



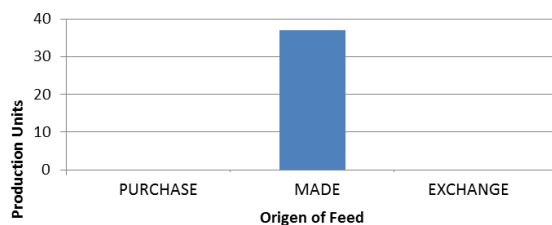
**Figure 3 Farming Type**

Figure 3 shows that both extensive and intensive production methods are used in all the production units where the surveys were conducted; this is because piglets are treated differently after weaning compared to those animals which are old enough to be fattened.

In Mexico the most commonly used pig breeds are Hampshire, Landrace, Duroc-Jersey, Yorkshire and PIC (Genetic Line) and we found that the production units prefer the PIC Genetic Line, because they consider this breed as ideal due to the rapid growth of these animals which helps to reduce costs and obtain excellent quality meat (Figure 4).



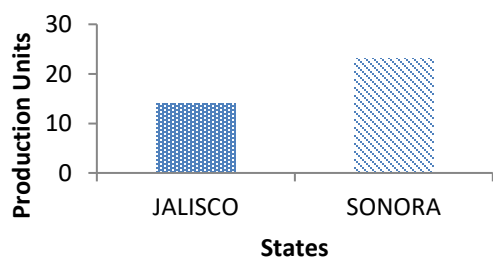
**Figure 4 Breeds Used for Production**



**Figure 5 Origin of Feed**

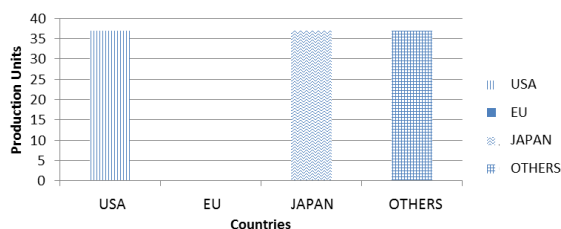
In Figure 5, we see that the surveyed production units prepare their own feed for fattening their pigs, because they have better control over quality and nutritional requirements to achieve efficient growth of animals and excellent meat quality, as well as taking care to ensure that ingredients banned in Japan are not added. However, the usual custom in Mexican pork production is to buy, produce or exchange for the feed given to their pigs.

Of the states selected for applying the survey, Sonora stands out because it is the leading pork-exporting state, followed by Jalisco which is just now making inroads into the Japanese market (Figure 6).



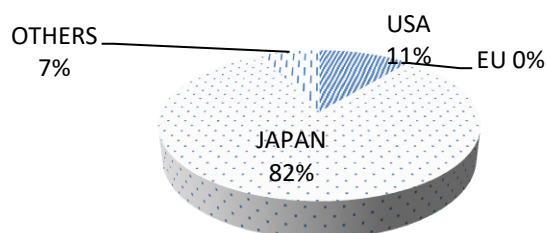
**Figure 6** Pork-exporting states

Figure 7 shows that the main export destinations for Mexican pork are the United States and Japan. The European Union does not import Mexican pork, and while there are other markets, their export volumes are of minor significance so they were grouped together.



**Figure 7** Export Destinations

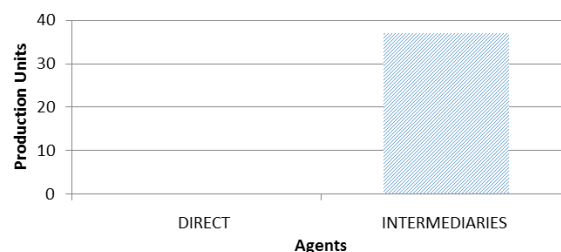
More than 80% of Mexican pork exports are sent to the Japanese market, which is the largest consumer of Mexican meat. The US is the second largest consumer of Mexican pork, accounting for about 11% of the export total; the rest of the countries are South Korea, China and Russia, among others (Figure 8).



**Figure 8** Export Market

Source: Author-made with survey data

From Figure 9 we conclude that the most important intermediary agent between the Japanese market and Mexican pig producers is the broker, who is in charge of drawing up purchase and sale contracts for 100% of the production units.



**Figure 9** Marketing Agents

Mexican pork producers over the years have modified their production system to meet the requirements of the Japanese market. Among the most important actions taken in this context are the following:

- Implementation of a protocol for the use, handling and storage of chemicals on farms.
- Implementation of protocols for controlling needles on farms to have control over infections, prevent the transmission of pathogens, etc.
- Purchase of equipment to detect chemical residues.
- Purchase of metal and X ray detectors (to detect physical contaminants in the meat).



- Certification of a quality system audited by third parties.

Likewise, changes have been made in the presentation, such as in the product specification and specifications on the packaging for each new customer.

Pork produced in these production units is characterized by being fresh, having a good taste, and being one hundred percent safe. This has been achieved through sophisticated production systems and continuous improvement in health and hygiene conditions. Pigs in these production units are healthy and, therefore, the resulting meat is also lean and of high quality.

Advertising and gastronomic sampling are the main strategies used by Mexican producers to remain in the Japanese market. Tastings take place in self-service stores, and advertisements are placed on public transport, in the media, and on noticeboards, etc. Another activity is participation in trade fairs and exhibitions.

Other actions that are performed but in our country include fulfilling the commitment to deliver orders in a timely and proper manner (volume and mix), being price competitive, abiding by quality and safety standards and promoting the development of pork and raw material suppliers to achieve greater supply and continued growth in the Japanese market.

## Conclusions

The Japanese market is important for Mexican pig producers due to the good price it pays for pork and its reliability in honoring its agreements. Moreover, Japan is the leading pork importer in the world so it has high demand for this product.

The most important production and business strategies in the pork market include: the exporting country or region is classified as free of cysticerci, classical swine fever, and the H1N1 virus (although, according to scientists, it is not transmitted by eating pork products); the type of feed consumed by the livestock, and vaccinations and medicines. Within the commercial aspects, we have product presentation, quality and frequency with which deliveries are made.

Mexican pork is prized by the Asian market. Countries like South Korea and Singapore are interested in signing trade agreements with Mexico and one of the products they are most interested in is pork. An agreement has already been signed with China under which some pig farms in Mexico can export to China. Therefore, it is necessary for our country to produce this product in sufficient quality and quantity to meet the needs of these markets.

## Recommendations

It is important for the government to promote the production of livestock feed, because this input, when imported, increases production costs and reduces the competitiveness of our meat in the world.

It also needs to promote pork production in the country and the installation of Mexican Federal Inspection Type (TIF) slaughterhouses to meet international demand, as well as control the entry of pork into the country so that our producers do not have unfair competition from meat smuggled across the border or sold at prices below the cost of production.

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## **Materials and resources in the teaching and learning process of mathematics**

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Received January 7, 2015; Accepted June 9, 2015

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### **Abstract**

The objective of this research is to improve academic performance in the mathematics of students in La Libertad Educational School by implementing materials and resources in the development of the educational process. With this strategy teachers shall further methodology applied, making the young students increase their level of motivation to learn mathematics. This research applies a quantitative, descriptive and transversal methodology. the technique of the survey, with questions drawn up with the Likert scale was used for data collection, the same as found that most teachers in the area of mathematics of the institution, do not use materials and resources at the time to give their classes, it made the teaching process very monotonous, causing a lack of students motivation and academic underachievement. In the development of research, teaching materials and resources applied to impart their math classes during the second quimestre, the expected results were obtained, the level of student motivation increased, and improved their academic performance.

**Mathematics, Materials, Resources, Motivation.**

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**Citation:** CARRERA, Alfredo, LAÍNEZ, Amarilis, TUMBACO, Mónica, LASCANO, Carmen, Materials and resources in the teaching and learning process of mathematics. ECORFAN Journal-Ecuador 2015, 2-2: 109-117

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† Researcher contributing as first autor.

**Introduction**

Share experiences with professional mathematics teacher was the beginning for this research project. The traditional teaching process using blackboard and markers has made the signature like something difficult and boring to understand.

We live in an age where everything change and develop quickly, so now it is an obligation find new strategies to teach and learn. The bad grades in Mathematics is a real and enough indicator to show that exist a lack of motivation to learn the signature.

The teacher must have a complete vision of their students like a learning community and not only a group of students. Mathematical reasoning should prevail rather than simple memorization processes, so students may have the connection of mathematical ideas and their applications in solving problems.

The use of resources and materials for teaching and learning of mathematics constitute a strategy that teachers should use in their classes for students to experience a new learning environment, which is very motivating and will allow significant learning generated.

**Teaching and learning of Mathematics**

The mathematics learning is to build the sense knowledge is an essential both problem solving and reflection around them (Diaz, 2015) activity.

The process of learning of the mathematics is vitally important for students to have the ability to build their knowledge.

Teachers should seek and implement methods and strategies to arouse interest and taste for this important science; therefore the training of teachers is essential to provide knowledge, vision, methods, resources, attitudes and skills to students.

The goal of teaching mathematics is not just memorize a series of skills but students learn and are able to apply the knowledge acquired in solving problems. According to the authors (Flores, Lupiáñez, Berenguer, Marin, & Molina, 2011) to reach it, the student must come to create a chain of behavior: Make, Internalizing, organize, Hold, identify the conditions and recover.

According to (Piaget, 1972, pp. 47-46) "It's amazing how everyone is convinced that there is enough to know to teach mathematics, without having to worry about how the concepts are actually built into the thinking subject."

Over time we have established two main approaches to teaching and learning of mathematics, behavioral and constructivist approach.

Conductive method is learning theory that believes learning is to change behavior, measuring learning by objective observable behaviors, regardless of the mental processes that occur in the development of certain activities. For example learn addition and multiplication tables. (Broadus Watson, 1974)

Constructivism is a pedagogical theory that aims to provide students with the necessary tools to build through its application to the processes to solve problematic situations that arise which will make their ideas are changed and continue to learn.

According to (Carter M., 1993) is the idea that the individual holds both cognitive behavioral and social aspects, is not a product of the environment, but their own construction that was produced every day as a result of interactions between the two factors.

Example when student has already learned algorithms to perform multiplications, problems which apply different strategies to reach solutions thus create new mental structures that will allow for significant learning arise.

Today is conceivable mathematical learning with a cognitive-constructivist approach since it is made from concrete experiences which become a significant situation for students through which they can perform processes of abstraction and generalization. Discovery learning is an accurate way to obtain meaningful learning in students.

### **Math teacher education**

The Constitution of the Republic of Ecuador establishes in Article 349 that the state shall guarantee to teachers at all levels and modalities stability, update, continuous training and educational improvement according to their needs and those of the national education system.

Teacher training in mathematics in recent years has evolved according to current educational laws proposed by the government for the purpose of improving educational quality in Ecuador. Currently there are training courses proposed by the Ministry of Education, ensuring that compliance with the provisions of Article 10, paragraph a, of the LOEI (Organic Law of Intercultural Education) concerning the rights and obligations of the teachers.

Math teacher should possess professional skills that consist of a set of knowledge, skills and abilities so that it can carry out its work in an effective manner, in this sense the authors (Larios Osorio, Font Moll, Spíndola Yanez, & Sosa Garza, 2012) state "that should be emphasized that the professionalization should not come solely from institutional recognition, but also personal development of teachers".

These competences are gotten with constant training, updated activities and researches of methods and techniques to learn, skills and instruments to improve more the learning teaching process.

It is also necessary that teachers must be identified like actors with responsibility about their training process, their skills, inside and outside knowledge, to show a effective and efficient labor, according the context. (Larios Osorio, Font Moll, Spíndola Yáñez, & Sosa Garza, 2012).

The continuous training process of math teachers allow to improve not only professional competence, the management inside the classroom, pedagogical and psychological aspects, to improve the learning students processes, by personal contact, it is so important the interaction between teacher and student.

The actual situation of math teaching and learning process show the training and update necessity in teachers, for this reason the government authorities offer on line services, with international universities, promoting the use of ITC in the teaching process. But it is more important the motivation of teachers to change and do different things using technological advances resources.

These formative activities on line are developed at the web, this facilitates the interchange of experiences, elaboration and share of information and communication, to be used in the classroom.

### **Materials and resources for teaching and learning Mathematics**

Through research and educational innovation in the subject of mathematics, it has been determined how important is the active participation of students in their learning process. This view is enhanced by the use of materials and resources in the classroom, as with manipulation, exploration and questioning of alternative solutions, students will have meaningful experiences for their learning process.

Although the resources and materials used in the classroom have the same purpose and can be used interchangeably, it is necessary to differentiate according to the purpose for which they were created. A resource is any means, that has not been designed specifically for the learning of any mathematical notion, the teacher can incorporate into their teaching examples: calculators, multi-base blocks, some websites, games, etc. The materials are means that initially designed and created with an educational purpose, even if that is not their only field of application examples: worksheets prepared by teachers, handy resources, magazines, coins, banknotes, etc. (Carretero, Coriat, & Nieto, 1995). Resource materials and also they can be classified into two groups: those that can be manipulated in physical form and those who are about technology, like an additional support is. Meanwhile the author (Cascallana, 1988) called structured materials to materials, and unstructured to resources.

The material and resources will allow to teachers to send different activities to students to learn mathematics concepts. The selection of them has a real important part in the teaching learning process, the teacher must choose the specific materials that help students understand the signature and develop their skills. The Mathematic context are divided in four blocks: numeric, geometric, algebra and functions, statistics and probability. The teacher must consider the materials to be used for this proposal.

#### To the first block

For first block numbers are materials developed to address the first numerical concepts such as multi-base Cuisenaire rods or blocks, which serve to build the decimal numbering system and its properties.

To study geometry a useful material is garboard, is a proposed Gattegno and distributed in Spain by Puig Adam (Cascallana, 1988) structured material, which consists of a square board with nails in the scheduled vertices, on which you can build polygons, a grid for analysis. There are also puzzles and Pentominoes to construct geometric figures. Technological materials like Graphmatica and geogebra are very helpful when making graphs with complete accuracy.

The use of materials and technological resources has great potential for education, such as tablets, calculators and computers allow the properties and algebraic relationships and the different representations of functions. For that you need to plan in detail that we want to use that competence is to be developed, which tasks should be designed and the evaluation system should be implemented for its development. (Lupiáñez & Codina, 2004).

For the study block statistics where analysis and interpretation of data collected on different types of phenomena are made, have available spreadsheets are a very useful technological resource that organize, explore and graphically display large amounts of data. The use of dice, playing cards and gambling allow students to address problems and random probability calculus.

There are other materials and resources that are very versatile, such as tangram is a puzzle consisting of seven geometric figures with which content can be treated as perimeters and areas, fractional relationships, irrational numbers, equivalences and similarities among others. Origami or paper folding part of traditional games in family life, yields similar to those drawn with a ruler and compass, symmetries, translations and construction of polygons, polyhedral and fractal geometric figures; with these activities facilitates understanding of geometric concepts. (Ledesma, 1996).

When the teacher includes within its planning the use of any material or unusual resource it is likely to be a change in behavior regarding students' attention, because it is not something they are used to, so it's being done more frequently to assimilate that is part of the process and give the importance for learning in the classroom, which will become a math lab in which students significantly increase their participation.

### **Troubleshooting**

One of the most important components in the teaching and learning of mathematics is the approach and problem solving; they must occur continuously during the process and not leave them to work in isolation.

Problem solving is closely related to creativity and is defined as the ability to generate new ideas and solve all kinds of problems and challenges. (Said Nieto, 2004) is a competition that students should acquire during their learning of mathematics, often used this ability throughout their lives.

Through problem solving students can raise questions, make mistakes and research, as well as enjoy their learning process as they will be immersed in the construction of their own knowledge acquiring a greater understanding of the subject.

The teacher can promote the development of mathematical thinking in students through problem solving, it is necessary to analyze their competencies, to determine if they are ready to venture into the process and to obtain the expected results. The following aspects will determine whether students are ready to solve problems:

- It must have basic knowledge about concepts, formulas and algorithms on specific issues that are involved in the proposed problems.
- Apply cognitive strategies or heuristics to explore and understand the problems through graphical representations decompose into simpler analyze situations or through another similar problem.
- Metacognitive strategies that allow students to know their limitations, determine what you need or use knowledge. By this the student will control and monitor their own cognitive process.
- Trust and affective components by controlling their emotional states that allow you to feel able and willing to engage in mathematical activities.

To start solving problems with students, teachers suggested considering the following activities:

- Have advance preparation, read articles and books on problem solving.
- Take into account that work to solve problems with students are slow and sometimes very slow, the fruits of this process are not seen immediately.
- Dedicate one or several working sessions with students about the advantages and disadvantages that arise in solving problems, and the importance and the objectives pursued.
- Solve problems with student models, taking into account the degree of difficulty and using various processes and a method, for example Polya is highly recommended. In this way students are helped to develop a number of strategies to solve problems.
- Present problems that increase the interest of students in order that it can foster a good working environment and to deepen the basic strategies and most relevant content.

Also it is necessary that the teacher shows an adequate treatment, analyzing strategies and solution techniques, “acting” the thinking and contrasting with other people. (Echenique Urdiain, 2006).

The adequate use of ITC skills in problem resolution helps to use strategies dynamic mathematics objects, measuring long, areas and superficies, geometric places and algebra operations, it helps to understand concepts and inference of results.

## **Objectives**

### **General Objective**

Apply materials and resources in the teaching learning process of Mathematics to improve the students’ academic performance

### **Specific Objectives**

To encourage the teachers in the use of materials and resources in the classroom to stronger the teaching and learning of math.

Foster teamwork in students, through the use of materials and resources in the subject of mathematics to improve their academic level

## **2. Materials and methods**

For the development of research a mixed methodology based on qualitative and quantitative model was used because it is considered that with the integration of both approaches will be achieved correctly apply resources and materials in the teaching and learning of mathematics, which will students, acquire math skills.

Inductive and deductive methods help to draw conclusions from the analysis of particular situations to reach the general and vice versa. The inductive method was used so central to the analysis of the problem of learning mathematics through student surveys to determine the degree of motivation that exists in this important subject and to make recommendations to teachers in the area over the use of materials and resources used in the classroom. The deductive method was used for the analysis of resources and materials that can be used in math classes, know its features, applications and limitations, to link them with the essential contents of the subject and select those that are appropriate for achieving the general objectives of the area.

The research was conducted in a population of 185 people, made up of 175 Freshmen General Unified Baccalaureate, and 10 teachers in the area of Mathematics Education “La Libertad School”



Population	N°	%
Students	175	94,6
Teachers	10	5,4
Total	185	100

**Table 1** Population**Instrument: Survey****3. Results**

To meet the objectives, instruments for collecting information with which data used for the determination of levels of motivation in students regarding the subject of mathematics was obtained, and the degree of implementation of resources were developed and materials by teachers at the time of teaching their classes. Surveys were conducted in two stages, at the end of the first five months to analyze the problem and at the end of the second five months, after application of resources and classroom materials. These results are summarized in the following tables:

Survey to 1<sup>st</sup> High school level Students

Indicator	Result	Percentage
Always	0	0 %
Sometimes	20	11,43 %
Never	155	88,57 %
Total	175	100 %

**Table 2** Does the math teacher use material and resources to teach?**Instrument: Survey**

The results show that 88, 57% of students tell that their teachers don't use materials and resources to teach math, and can infer the teaching process is monotonous, causing lack of motivation to students to learn the signature. Survey to 1<sup>st</sup> high school level Teacher

Indicator	Result	Percentage
Always	0	0 %
Sometimes	2	20 %
Never	8	80 %
Total	10	100 %

**Table 3** Do you use material and resources to teach math?**Instrument: Survey**

At the end of the first five months the teachers answer they include in their class plans the use of materials and resources, 20 % do that sometimes, and the 80% never.

It is important the use of these material and resources, in order students learn and understand math in a better way.

## Survey to First High School Level Students

Indicator	Result	Percentage
Always	153	87,43 %
Sometimes	22	12,57 %
Never	0	%
Total	175	100 %

**Table 4** When the teacher uses material and resources to teach math, do you feel motivated to learn?**Instrument: Survey**

After teachers used materials and resources to teach math, the students answer 87,43% increase their motivation for study math. The motivation and skills have an important role in the teaching learning process, a motivated student increases her confidence and can break the idea that mathematics are difficult.

## Survey to 1st High School teachers

Indicator	Result	Percentage
Always	7	70 %
Sometimes	3	30 %
Never	0	0 %
Total	10	100 %

**Table 5** Using materials and resources in your math class increase the students' performance?

### Instrument: Survey

70% of teachers said the performance of their students improved using materials and resources to teach their classes. When a student is motivated, increase his interest and attention for signature and desire to learn the signature, likes to understand it and feel satisfied because can resolve the homework, increasing their academic performance.

### Conclusions

The purpose of this research is break with the idea that math is difficult and antisocial, using strategies that include materials and resources in the classroom, changing this signature funny and easy going for students.

The results show the increasing of academic performance in the students after the use of new strategies by their teachers. This strategy is not new but teachers didn't know about it or don't have enough time to use them.

The use of resources and materials in the teaching learning process of Math, increase the motivation in students, add ITC in pedagogical process, and the teachers will improve their methodology develop interactive classes, doing active and collaborative learning in students.

At social level with collaborative groups, the students improve their interpersonal relations, sharing experiences and encourage the practice of values like solidarity, friendship, respect and tolerance.

### Recommendations

Materials and resources selected by the teacher must be according to the content of classes' plans.

The math teacher will select the material and resource from the web, they must be easy to get and elaborate, attractive to students, to motivate and wake up the interest for studying Math.

Not all mathematic contents could be taught by material and resources. They can't be too used because can cause the opposite reaction in students.

It is necessary to continue researching about this topic inside the classroom, with the objective of improve the teaching learning Math process in the basic level.

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**The impact of agriculture and tourism on mexican GDP**

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Received January 22, 2015; Accepted May 29, 2015

**Abstract**

Economic growth is a central element of economic development. In this regard, the role played by agriculture in poverty alleviation and economic growth in the least developed countries is crucial. Agriculture is still the main source of income for 70.0% of the world's poor living in rural areas. However, agricultural production for domestic and export markets has lagged behind in such countries, due to the poor performance of agriculture (low productivity and rudimentary infrastructure, among other factors). Low-income rural groups are mostly small landholders engaged in producing traditional cash crops, raising livestock and performing low-profit, non-farm tasks. Because the Mexican agricultural sector is not generating enough income for them, rural families are increasingly turning to non-farm income sources, including tourism, to supplement their income. Based on the above, the objective of this study was to analyze the importance of agriculture and tourism in the Mexican economy, from 1980-2013. To this end, we developed a multiple linear regression model in which the Gross Domestic Product (GDP) of Mexico is a function of agricultural GDP and tourism revenues, the unemployment rate, inflation, the minimum wage and the real exchange rate. The main results indicated that the variables that most significantly affected economic growth in Mexico in the period under review were agricultural GDP and tourism revenues.

**Economic growth (GDP), agriculture, tourism revenues**

**Citation:** FIGUEROA-HERNÁNDEZ, Esther , PÉREZ-SOTO, Francisco y GODÍNEZ-MONTOYA, Lucila. The impact of agriculture and tourism on mexican GDP. ECORFAN Journal-Ecuador 2015, 2-2: 118-131

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**Introduction**

Economic growth is a central element of economic development (FAO, 2013). From 1997 to 2002 the international context was marked by economic instability. While the world's overall economic growth rate was satisfactory (3.5%), there were significant fluctuations around this average. First, the growth rate of Gross World Product (GWP) in 1998 fell due to the crisis in Southeast Asia and then Russia. Secondly, it was affected again in 2001 as a result of the recession in the United States (LAIA, 2004).

After a period of significant economic growth in the early 21<sup>st</sup> century, the world economy contracted in 2009 as a result of the global financial and economic crisis (ILO, 2013). In this regard, in the period 2003-2007 the growth of emerging market economies accelerated, while that of advanced economies was weak, and although in 2009 more than half of the former experienced negative growth, they soon recovered and in 2010 grew at rates equal to or higher than those recorded before the crisis (FMI, 2012), reaching a growth rate of 5.2%, which seemed to signal a definitive end to the 2008 crisis, and 2011 saw a slowdown in overall activity as the growth rate fell to 3.8%, according to estimates by the International Monetary Fund (IMF) (Banco de la República de Colombia, 2012).

Global economic growth further weakened in 2012, so that the prospects for the next few years will be characterized by uncertainty and risk of further slowdown. The economic problems of developed countries (particularly those in the euro area and the U.S.) continue to affect developing countries and economies in transition through reduced demand for their exports and greater volatility in capital flows and commodity prices (Claridades, 2013).

The role played by agriculture in poverty alleviation and sustainable economic growth and development of the least developed countries (LDCs) is crucial. Therefore, agriculture, by consolidating food security, export earnings and rural development, is the foundation of the economies of these countries. However, agricultural production for domestic and export markets has lagged, as their growth in per-capita GDP slowed in the nineties. Slow growth and sharp annual fluctuations in production continued to be chronic problems in such countries, and were the main causes of increased poverty and food insecurity. In regard to trade, the LDCs continued to occupy a marginal place in world agricultural markets, and their contribution to global agricultural exports was only 5.0% in the early seventies, and barely 1.0% in the late nineties (FAO, 2001).

The poor performance of agriculture in the LDCs is related to many internal and external difficulties that hinder their attempts to promote agriculture and achieve the objectives of improving food security and export earnings. Internal problems include low productivity, lack of flexibility in production and trade structures, a shortage of specialized skills, low life expectancy and educational levels, the rudimentary nature of the infrastructure and deficiencies in the institutional and policy frameworks. At the same time, with the increasing integration of markets resulting from globalization and trade liberalization, the economies of those countries face an increasingly competitive external trading environment. They continue to export a limited range of primary products highly vulnerable to volatile demand and deteriorating terms of trade. In addition, their external debt remains high.

The inability of these countries to compete in global markets and even their own domestic markets is also reflected in the increased total cost of their food imports (FAO, 2001).

In spite of this situation, it is estimated that agriculture is the main source of income and employment for 86.0% of the world's rural population (World Development Report, 2008), representing 47.0% of the world's total population (FAO, 2013), and for 70.0% of the world's poor living in these areas. Low-income rural groups are wage earners, most of whom are casual and seasonal workers, while others are small landholders engaged in producing traditional cash crops, raising livestock, or performing low-profit, non-farm tasks, and they often combine two or more of these activities. Therefore, crop production will remain essential for reducing poverty and generating rural employment and income (FAO-ILO, 2013). However, the depletion and degradation of land and water seriously affect the ability to grow food and other products needed to sustain livelihoods in these areas and meet the needs of the urban population (FAO, 2013).

In this regard, it is estimated that worldwide there are 450 million wage earners in the agricultural sector, representing 40.0% of the world's agricultural workforce. These workers and their families are among the groups most affected by poverty and food insecurity; in many countries, more than 60.0% live in poverty conditions.

Because the agricultural sector in Mexico and the world as a whole is not generating enough income for rural families, many of them are increasingly turning to non-farm income sources to supplement their income, one of which is tourism.

### **Tourism at the global level**

According to the World Travel and Tourism Council, tourism is the world's largest industry, surpassing the automobile, steel, electronics and agricultural sectors (Castro, 2013), which means it is one of the fastest-growing sectors of the world economy. Tourism development can promote economic growth, both directly and indirectly, by stimulating the growth of other sectors and by increasing household income. This dynamism has led to tourism becoming the key to socio-economic progress. Therefore, tourism's ability to reduce poverty in developing countries has recently been demonstrated and recognized. The economic potential of tourism implies the creation of jobs, which are especially important in rural and remote areas, where according to data from the World Tourism Organization (UNWTO), three-quarters of the two billion people who live under conditions of extreme poverty are found (Ruiz, 2008).

### **Tourism: an economic and social phenomenon**

In view of the increase in household incomes in emerging economies, tourism stimulates leisure activities and the growth of international trade, with the consequent expansion of business travel; demand, moreover, is not expected to wane. Given its size, the sector has considerable potential for economic growth, diversification and structural transformation of economies (UNCTAD, 2013). Today, the business volume of tourism equals or even surpasses that of oil exports, food products or automobiles. This sector has become one of the major players in international trade, and also represents one of the main sources of income for many developing countries. This growth goes hand in hand with increasing diversification and competition among destinations (WTO, 2014).

The general expansion of the industrialized and developed countries has been beneficial in economic and employment terms for many related sectors, from construction to agriculture and telecommunications. Tourism's contribution to economic welfare depends on the quality of visitor services offered and the resulting income that can be asked for or expected. The World Tourism Organization (WTO) helps destinations to position themselves, in a sustainable way, in increasingly complex domestic and international markets. As the United Nations agency dedicated to tourism, UNWTO stresses that developing countries will especially benefit from sustainable tourism and acts to do so (WTO, 2014).

Tourism is one of the growing sectors, generating more jobs, more exports, and more revenue for the benefit of the countries involved. Despite the crisis, the number of international travelers continues to increase. It is therefore clear that the positive effects of tourism on the economy, both direct and indirect, are important (WTO, 2014).



**Figure 1** Tourism revenues and international tourist arrivals by region, 2012

Source: WTO, 2013.

International tourist arrivals grew by 5.0% in 2013 to reach 1.087 billion, according to the latest UNWTO World Tourism Barometer. Despite the economic difficulties experienced by the world, international tourism results were well above expectations, and in 2013 about 52 million more international tourists travelled over the previous year. For 2014, UNWTO forecasts growth of between 4.0 and 4.5%, again surpassing existing long-term projections. International tourism demand was higher for destinations in Asia and the Pacific (+ 6.0%), Africa (+ 6.0%) and Europe (+ 5.0%). The most-visited subregions were Southeast Asia (+ 10.0%), Central and Eastern Europe (+ 7.0%), Southern and Mediterranean Europe (+ 6.0%) and North Africa (+ 6.0%). (Figure 1).



**Figure 2** Distribution of the effects of tourism on global economy

Source: WTO, 2014.

The importance of tourism in the world can be seen in Figure 2. On the one hand, as can be seen, it represents 9.0% of GWP and 1 in 11 jobs (adding up for both figures the direct, indirect and induced effects). It also accounts for 6.0% of world trade and 6.0% (1.3 billion dollars) of exports from the LCDs (WTO, 2014).

Stakeholders in the tourism sector are aware of its economic importance, which lies in generating not only financial but also social mobility, which is necessary for the development of any country. The goal of tourism, approached from different angles, is to meet the needs of travelers who, far from home, require food services, lodging, transportation, fun, possibly suitable working conditions, and, above all else, courteous treatment. The tourism sector is not a passing trend or fashion in modern economies, but has grown into an important activity with global significance. In several countries, it is the most important element in their international trade activities (Castro, 2013).

### **Importance of tourism in Mexico**

In the past 60 years, tourism has been identified as a major driving force behind national development, mainly as a generator of foreign exchange and employment and as a catalyst for regional progress. In regards to tourism as an income generator, we can distinguish three stages: the first one lasted until 1971, when continued growth in that sector resulted in it accounting for 45.0% of current account revenue in that year; a second phase ran from 1972-1982, when its relative contribution to overall revenues began to decline in percentage terms mainly due to surging oil revenues. The third stage was from 1982 to 1992, when tourism's contribution to overall revenues remained almost constant, accounting for about 10.0%, mainly as a result of the contribution of the manufacturing industry. In 1999, tourism revenues accounted for only about 5.0% of current account revenues. Today, tourism in our country faces a number of problems mainly characterized by a strong dependence on visitors from the United States and on the so-called sun and beach segment.

Other problems include: inadequate or unequal promotion of domestic tourism to make better use of the capacity installed during periods of low demand; tourism development that is limited to sun and sand destinations; oversupply in the main destinations that results in negative environmental impacts and urban growth in the surrounding areas that lacks proper public services; and inadequate tourist or customer service levels, among others (Mercado and Palmerín, 2012).

Ministry of Tourism figures show that the industry, as a driving force behind development, contributed 9.0% of GDP in the first quarter of 2013, generating 7.5 million jobs, including 2.5 million direct ones. Ministry figures also show that tourism provides the third largest source of foreign exchange earnings and has over 43,000 companies involved in it. Tourism, then, is an essential activity which helps propel national development, especially in terms of income redistribution, balance of payments, employment, GDP and regional economies. In Mexico and other countries, tourism is an industry of paramount importance both for the foreign exchange earnings it brings in, and for the considerable amount of direct and indirect employment it generates (Castro, 2013).

Rural tourism emerged in Europe as a complementary strategy for rural development. In Mexico, the planning of this activity started in the seventies; however, data show that rural tourism in the country is still in its infancy and therefore has only a marginal status, as evidenced by the fact that it receives little financial support compared with the main tourism segment promoted in Integrally Planned Centers (known by the acronym CIPs in Mexico).



Rural tourism can be developed based on biodiversity, the variety of ecosystems, endemic flora and fauna, and the culture of indigenous ethnic groups. Mexico has 57 ethnic groups and 127 officially-declared Protected Natural Areas (PNA), where it is feasible to develop ecotourism, adventure tourism, ethnotourism, rural tourism, hunting, and water sports, attached to management and conservation programs (Juárez and Ramírez, 2007).

### The agricultural sector and economic growth in Mexico

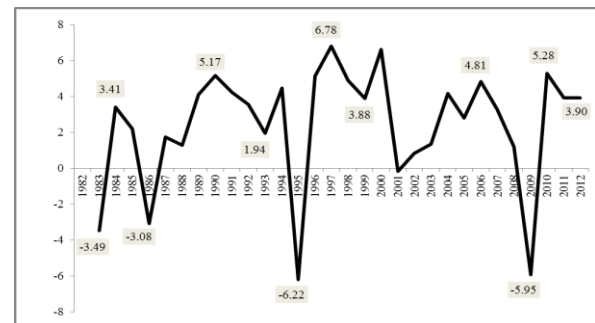
Today, Mexico is in a globalized world where the supply and demand for products, goods or services are in constant motion. For this reason, it is necessary to know what resources are absent, abundant, scarce and available in appropriate amounts.

Globally, Mexico is one of the countries that has signed the most free trade agreements, from the North American Free Trade Agreement (NAFTA) signed in 1994, the Treaty with the European Union (EU) to the agreements it has with Central and South American countries; therefore, the buying and selling of items plays a very important role in the economy. A large proportion of the population earns a livelihood from agricultural production and contributes in a very important way to the country's GDP. In addition, food has an intrinsic value for any nation in terms of food autonomy and self-sufficiency. Mexico is a country with great export opportunities, as it is located next to the American economy, which has the largest number of high-income consumers (Guajardo, 2012).

In the last fifteen years the Mexican agricultural sector has experienced a decline in its production levels, which has not been sufficient to meet domestic market demand.

Moreover, variations in agricultural production show greater volatility than those in other sectors of the economy. This indicates the presence of high risk and uncertainty, leading producers to exhibit defensive behaviors such as resistance to change their harvested products or to maintain a certain degree of diversification that may not seem optimal from the point of profitability, but that is explained as a way of diversifying risk, all of which significantly affects the profitability conditions of the Mexican agricultural sector (Escalante and Catalán, 2008).

This situation is related to the agricultural sector's low share of real GDP in Mexico.



**Figure 3** Growth rate of real GDP in Mexico (%)

In its modern economic history, the country has gone through various phases of high and low growth. By plotting the growth rates of Mexico's real GDP, an average annual growth rate of 0.09% for the period 1982-1987 is observed. From 1988-1993, it grew at an average annual rate of 3.1%; for 1994-2000, it grew at 2.9% and finally for 2000-2010 its growth was 1.3% per annum. For the entire period, 1982-2010, the economy managed to grow just 2.1% annually against 6.3% growth achieved between 1940 and 1970 (see Figure 3).

As for the evolution of sectorial economic growth, the data reveal that during the period 1982-2009 the agricultural sector had a diminishing share in total GDP, falling from 6.3% in 1982 to 5.4% in 2009; meanwhile the industrial sector (including manufacturing, construction and electricity, gas and water) went from 24.9% to 23.2%, thus contracting by almost two percentage points; manufacturing accounted for 17.0% of GDP in 1982 and 16.0% in 2009; the services sector increased its share, rising from 62.7% to 65.9% (Calderon and Sánchez, 2012).

Based on the above reasons, the aim of this study was to analyze the importance of agriculture and tourism in the Mexican economy during the period from 1980-2013.

### Materials and Methods

To carry out this research, various information sources were consulted. These included, among others, the following: the Latin American Integration Association (LAIA), the World Bank (WB), the United Nations Food and Agriculture Organization (FAO), the United Nations International Labour Organization (ILO), the United Nations World Tourism Organization (UNWTO), the United Nations Conference on Trade and Development (UNCTAD), Mexico's National Institute of Statistics and Geography (INEGI), the Bank of Mexico (B of M or BANXICO), the Ministry of Tourism (SECTUR), the Ministry of Finance and Public Credit (SHCP), the Center for the Study of Public Finance of the Chamber of Deputies (CEFP), and the Statistics Division of FAO (FAOSTAT).

From these sources, data was obtained on total GDP, tourism and the agricultural sector's share of GDP, which were deflated based on 2008, the unemployment rate, the inflation rate, the minimum wage and the exchange rate.

With this information a database for the period 1980-2013 was generated for each of the variables.

Based on the theoretical elements a multiple linear regression model was developed with variations in the number of independent variables, establishing functional relationships in linear terms and structural form, using the following notation system.

$$GDP_t = \alpha_0 + \alpha_1 GDP_{agrop} + \alpha_2 Tur_t + \alpha_3 \pi_t + \alpha_4 E_t + \alpha_5 W_t + \alpha_6 U_t + \varepsilon_t \quad (1)$$

$$GDP_t = \beta_0 + \beta_1 GDP_{agrop} + \beta_2 Tur_t + \beta_3 \pi_t + \beta_4 E_t + \beta_5 U_t + v_t \quad (2)$$

$$GDP_t = \gamma_0 + \gamma_1 GDP_{agrop} + \gamma_2 Tur_t + \gamma_3 \pi_t + \gamma_4 E_t + u_t \quad (3)$$

Where:  $\alpha_0, \dots, \alpha_n, \beta_0, \dots, \beta_n$  and  $\gamma_0, \dots, \gamma_n$  = Are the parameters to be estimated for each of the variables;  $\varepsilon_t, v_t$  and  $u_t$  = Are the terms of the error that are introduced in the models and independently and identically distributed with zero mean and constant variance;  $GDP_t$  = Gross Domestic Product (millions of pesos, base= 2003);  $GDP_{agrop}$  = Agricultural sector's share of Gross Domestic Product (millions of 2008 pesos),  $Tur_t$  = Tourism revenues (Millions of dollars);  $U$  = Unemployment rate (%),  $\pi$  = Inflation rate (%),  $W$  = Minimum wage (\$/day),  $E$  = Real exchange rate (\$/Dollar).

The equations were estimated by the ordinary least squares (OLS) method using the Statistical Analysis System (SAS) package, and the elasticities of the model were calculated and analyzed. Conclusions based on this work were also drawn.

**Results and Discussion**

The results obtained from the proposed model allowed us to statistically and economically analyze the parameters obtained.

**Statistical analysis of GDP<sub>t</sub>**

The statistical analysis was based on the following parameters: the coefficient of determination ( $R^2$ ), the value of calculated F ( $F_c$ ), the mean squared error, the value of partial t's for each of the estimators from analysis of variance for each given equation. Finally, to test the statistical significance of the fitted regression equation, we considered the hypothesis  $H_0: \beta_1 = \beta_2 = \dots = \beta_n = 0$  against  $H_a: \beta_i \neq 0$  for  $i \geq 1$ .

The results in Table 1 indicate, for the three models considered, but especially for equation 1, that at a significance level of 0.01,  $F_c = 238.02$  is greater than  $F_{t,0.1} (6, 27) = 2.0$ , so  $H_0$  is rejected in favor of  $H_a$ .

Dependent variable	Independent variables				
<b>Equation 1</b>					
<b>GDP<sub>t</sub></b>	<b>GDPagrop</b>	<b>Tur<sub>t</sub></b>	<b><math>\pi</math></b>	<b>E</b>	<b>U<sub>t</sub></b>
Coefficient	19.11311	194.53082	3822.25782	-165469	32751
t <sub>c</sub>	4.28	3.21	0.90	-1.33	0.53
P	0.0002	0.0034	0.3747	0.1937	0.6005
R <sup>2</sup> = 0.9814					
F-value = 238.02					
Prob>F=<.0001					
Durbin-Watson D	0.936				
Number of observations	34				
1st autocorrelation order	0.401				
<b>EQUATION 2</b>					
<b>GDP<sub>t</sub></b>	<b>GDPagrop</b>	<b>Tur<sub>t</sub></b>	<b><math>\pi</math></b>	<b>E</b>	<b>U<sub>t</sub></b>
Coefficient	19.81793	193.46893	2617.13708	-127291	15162
t <sub>c</sub>	4.94	3.25	0.94	-1.75	0.37
P	<.0001	0.003	0.3563	0.0915	0.7124
R <sup>2</sup> = 0.9813					
F-value= 294.57					
Prob>F=<.0001					
Durbin-Watson D	0.944				
Number of observations	34				
1st autocorrelation order	0.394				
<b>EQUATION 3</b>					
<b>GDP<sub>t</sub></b>	<b>GDPagrop</b>	<b>Tur<sub>t</sub></b>	<b><math>\pi</math></b>	<b>E</b>	
Coefficient	19.94253	192.57009	2701.72664	-123231	
t <sub>c</sub>	5.07	3.29	0.99	-1.74	
P	<.0001	0.0027	0.3322	0.093	
R <sup>2</sup> = 0.9813					
F-value=379.45					
Prob>F=<.0001					
Durbin Watson D	0.924				
Number of observations	34				
1st autocorrelation order	0.398				
t <sub>c</sub> : t observed value					
P: significance of t observed value					

Indicating that at least one parameter is different from zero, that is, the regression equations are highly significant, implying a high explanatory power of the estimated models.

On the other hand, the variation in GDP<sub>t</sub> based on the coefficient of determination ( $R^2$ ) is 98.14% explained by the variables included in the three equations. Regarding the GDP<sub>t</sub> model, the variables that were highly significant were: agricultural GDP ( $GDP_{agrop}$ ), tourism revenues ( $Tur_t$ ) and the real exchange rate (E), which had reliability values of 0.0002, 0.0034 and 0.1937 respectively and t values of  $4.28 > 1$ ,  $3.21 > 1$  and  $-1.33 > 1$  for each variable, which are significant values indicating that these variables explain GDP. On the other hand, inflation ( $\pi$ ), wage ( $W_t$ ) and unemployment ( $U_t$ ) were not significant.

The results in Table 1 indicate that, for equation 2, at a significance level of 0.1,  $F_c = 294.57$  is greater than  $F_{t, 0.1 (5, 28)} = 2.06$ , so  $H_0$  is rejected in favor of  $H_a$ , indicating that at least one parameter is different from zero, that is, the regression is highly significant, implying a high explanatory power of the estimated model. In the case of GDP variation based on the coefficient of determination ( $R^2$ ), it is 98.13% explained by agricultural GDP ( $GDP_{agrop}$ ), tourism revenues ( $Tur_t$ ), the inflation rate ( $\pi$ ), the real exchange rate (E) and the unemployment rate ( $U_t$ ). For the GDP<sub>t</sub> model, the variables that were highly significant were:  $GDP_{agrop}$ ,  $Tur_t$  and E, which had reliability values of 0.0001, 0.0030 and 0.0915 respectively and t values of  $.94 > 1$ ,  $3.25 > 1$  and  $-1.75 > 1$  for each of these variables, which are significant values indicating that these variables explain GDP. As in the previous model, inflation ( $\pi$ ) and the unemployment rate ( $U_t$ ), were not significant.

The results in Table 1, relating to equation 3, show that by removing the variables wage and unemployment rate at a significance level of 0.1,  $F_c = 379.45$  is greater than  $F_{t, 0.1 (5, 28)} = 2.06$ .

So  $H_0$  is rejected in favor of  $H_a$ , indicating that at least one parameter is different from zero, that is, the regression is highly significant, implying a high explanatory power of the estimated model. Moreover, the coefficient of determination ( $R^2$ ) indicates that economic growth is 98.13% explained by agricultural GDP ( $GDP_{agrop}$ ), tourism revenues ( $Tur_t$ ), the inflation rate ( $\pi$ ), and the real exchange rate (E). The variables that were highly significant were:  $GDP_{agrop}$ ,  $Tur_t$  and E, which had reliability values of 0.0001, 0.0027 and 0.0930 respectively and with t values of  $5.07 > 1$ ,  $3.29 > 1$  and  $-1.74 > 1$  for each variable respectively, which are significant values indicating that these variables explain GDP. The only variable that was not significant was ( $\pi$ ), as was the case in the results of the first two models.

### Economic Analysis

In this section the economic analysis of the coefficients, based on economic theory, is presented.

### Economic interpretation of the equations in their structural form

At this point, it is important to analyze the coefficients of the parameters in their structural form, since they allowed us to recognize the consistency of some of the estimates in relation to the established precepts of economic theory.

The estimated model for Gross Domestic Product (GDP<sub>t</sub>) was:

$$GDP_t = 38034 + 19.113 GDP_{agrop} + 194.53 Tur_t + 3822.2 \pi_t - 165469 E_t - 1937.2 W_t + 32751 U_t + \varepsilon_t \quad (1)$$

From Equation 1, by increasing agricultural GDP and tourism revenues, the economy would grow; according to the available information, and the period analyzed in this particular study, the variables  $\pi$ ,  $E$ ,  $U_t$  and  $W_t$  did not show the expected correlations, based on the established precepts of economic theory.

$$\begin{aligned}
 GDP_t = & -447652 + 19.8 GDP_{agrop} \\
 & + 193.4 Tur_t + 2617 \pi_t - 127291 E_t \quad (2) \\
 & + 15162 U_t + u_t
 \end{aligned}$$

For equation 2, estimated for the  $GDP_t$  model without considering wage ( $W_t$ ), similar results to those of equation 1 were obtained in terms of the expected correlations based on economic theory, since only in the case of agricultural GDP and tourism revenues were the expected correlations obtained.

$$\begin{aligned}
 \widehat{PIB}_t = & -453458 + 19.94253 PIB_{agrop} + \\
 & 192.57009 Tur_t + 2701.72664 \pi_t - 123231 E + \\
 & \varepsilon_t \\
 GDP_t = & -453458 + 19.9 GDP_{agrop} \quad (3) \\
 & + 192.6 Tur_t + 2701.7 \pi_t + 123231 E_t + v_t
 \end{aligned}$$

Equation 3 estimated for the  $GDP_t$  model without considering  $W_t$  and  $U_t$  indicates that by increasing agricultural GDP and tourism revenues, the economy would grow. As in the above equations,  $\pi$ ,  $E$ ,  $U_t$  and  $W_t$  did not fulfill expectations.

**Economic interpretation of the elasticities of structural form**

The economic results of the elasticities of structural form for each of the equations are shown in the following table:

Equation 1		Equation 2		Equation 3
$\mathcal{E}_{GDP_{agrop}}^{GDP}$	$\mathcal{E}_E^{GDP} =$	$\mathcal{E}_{GDP_{agrop}}^{GDP}$	$\mathcal{E}_E^{GDP} =$	$\mathcal{E}_{GDP_{agrop}}^{GDP}$
$\mathcal{E}_{Tur}^{GDP}$	$\mathcal{E}_W^{GDP} =$	$\mathcal{E}_{Tur}^{GDP} = 0$		$\mathcal{E}_{Tur}^{GDP}$
$\mathcal{E}_\pi^{GDP}$		$\mathcal{E}_\pi^{GDP} = 0$		$\mathcal{E}_\pi^{GDP}$
$\mathcal{E}_u^{GDP}$		$\mathcal{E}_U^{GDP} = 0$		$\mathcal{E}_E^{GDP}$

**Table 2** Elasticities of structural form  
Source: Author calculations based on the output of the Statistical Analysis System (SAS) package.

**Gross Domestic Product (GDPt)**

The GDP elasticities of equation 1, with respect to agricultural GDP ( $GDP_{agrop}$ ) and tourism revenues ( $Tur_t$ ), were 0.92263729 and 0.219489284, respectively, which means that with a 10.0% increase in these variables the economy would grow by an average of 9.22 and 2.19%, respectively. GDP elasticity with respect to inflation, the real exchange rate, the unemployment rate and wage did not show the correlations expected by economic theory (see Table 2).

**Gross Domestic Product (GDPT) without  $W_t$**

The GDP elasticities of equation 2, with respect to agricultural GDP ( $GDP_{agrop}$ ) and tourism revenues ( $Tur_t$ ), were 0.956660701 and 0.218291152, respectively, which means that with a 10.0% increase in these variables the economy would grow by an average of 9.56 and 2.18%, respectively. As with Equation 1, GDP elasticity with respect to inflation ( $\pi$ ), the real exchange rate ( $E$ ), the unemployment rate ( $U_t$ ) and wage ( $W_t$ ) did not show the expected correlations (See Table 2).

**Gross Domestic Product (GDPT) without  $W_t$  and  $U_t$**

The GDP elasticities of equation 3, with respect to agricultural GDP ( $GDP_{agrop}$ ) and tourism revenues ( $Tur_t$ ), were 0.962675453 and 0.217276991, respectively, which means that with a 10.0% increase in these variables the economy would increase by an average of 9.62 and 2.17%, respectively. On the other hand, GDP elasticity with respect to inflation ( $\pi$ ), the real exchange rate ( $E$ ), the unemployment rate ( $U_t$ ) and wage ( $W_t$ ) did not show the expected correlations, as shown in Table 2.

### Conclusions

Based on the model results, we conclude the following: For the Gross Domestic Product equation, if agricultural GDP and tourism revenues were increased, the economy would grow.

According to Nadal (2001), if the rates provided for in the corn tariff quota system were charged today, and if a mechanism to ensure higher prices to domestic producers were restored, the price to the end consumer of corn flour (tortillas) would probably retain the increases that have occurred in recent years, but not necessarily skyrocket. There are forces on the supply side that would help keep tortilla prices stable. Productivity and yield increases achieved by domestic corn producers would be associated with an increase in the supply of the grain and help maintain a stable final price. Although there are no reliable studies that measure the price elasticity of the corn supply, shortages of this grain would be less severe in many regions and, as a result, its price would fall.

In the event a policy was implemented to support the agricultural sector as a whole, with emphasis on crop diversification, the fall in per-capita GDP of the agricultural sector and the impact on the food supply in Mexico would be reversed, resulting in a positive effect on price stability.

In Mexico the agricultural sector plays a very important role in generating foreign exchange, employment and income. Despite this fact and the need to meet the population's food needs and generate raw materials for other industries, the agricultural sector is barely competitive because it has had to face numerous adverse situations, including natural disasters such as droughts, hail, torrential rains, atypical frost, floods and cyclones. Droughts, up until November 2011, had had a significant impact on agricultural, livestock and forestry activities, causing the loss of 963,000 hectares (ha) corresponding to 4.0% of the 22 million arable hectares, the death of 450,000 head of cattle equivalent to 1.4% of the cattle herd, extensive forest fire damage and a 60-70% decrease in water availability in dams (SAGARPA, 2011).

In addition to the above, the sector has been beset by other problems, including: low levels of physical and human capitalization; inefficiency in post-production processes that increases costs and contributes to higher prices for consumers; large regional differences in production, productivity and income; high poverty levels in the sector; and overexploitation of aquifers (Fadi, 2011). As a result of all this, Mexico is highly dependent on food imports.

We concur with one of the underlying themes of the United Nations Conference on Trade and Development (2013), as do several developing countries, that tourism is important for achieving economic progress and poverty reduction. However, it is also clear that the relationship between tourism and economic growth and poverty reduction is not automatic, but depends on tourism to generate employment opportunities, create linkages (particularly with agriculture and the service provider sectors) and encourage the development of basic infrastructure such as roads and airport and port facilities, and the provision of financial services that benefit the economy as a whole. It also depends on tourism development to be guided by a national strategy that provides general policies and regulatory and institutional frameworks with sufficient incentives to stimulate the development of supply capacity in domestic markets. Equally important is the extent to which the national strategy limits financial losses that hurt the economy, which is the eternal problem of many developing countries, and minimizes the negative effects of tourism on the environment and cultural heritage. While the contribution of tourism to structural economic progress and sustainable development is not a new topic on the international agenda, ensuring that tourism is more sustainable and contributes to the achievement of sustainable development objectives in developing countries remains a challenge that requires urgent attention.

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## Patterns of diurnal behavior of the species *Himantopus mexicanus* belonging to the Family Recurvirostridae, in the Estuary of Saint Paul - Santa Elena

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Received January 7, 2015; Accepted April 30, 2015

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### Abstract

This study aimed to analyze the diurnal behavior of the Cigueñuela cuellinegra, *Himantopus mexicanus* in the area of the estuary of the Rio Grande in San Pablo, we rely on the determination of behavioral patterns as Protocol Blumstein (2006). 16 samples were taken, resulting in a total of 7 hours of continuous observation, in which 28 behaviors, grouped in 9 categories, it was found that individuals maintain their locomotion for 48% of their daily daytime activity, sound signals were recorded with 16 %, power 13%, 10% rest, social agonistic 4%, 3.5% alert, grooming 3%, not 1.5% and finally agonistic defecation less than 0.1%, at the beginning of the observation 28 individuals were counted and the end of sampling about 40 individuals, we found that the population is growing, also considering the nests are located nine habitat as spawning area, locomotion behavior is linked with the sound signals and feed mechanisms more frequently peck and insert is made because the area facilitates such activity.

**Estuary, patterns of behavior, habitat, *Himantopus mexicanus*, breeding area.**

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**Citation:** GONZÁLEZ-Tanya, OÑATE-David and VITERI-Ermel. Patterns of diurnal behavior of the species *Himantopus mexicanus* belonging to the Family Recurvirostridae, in the Estuary of Saint Paul - Santa Elena. ECORFAN Journal-Ecuador 2015, 2-2: 132-137

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## Introduction

Scot and Carbonell in 1986, defines two types of habitat in the approximately 2500 km of coastline belonging to the Equator; the same which is represented by a dry zone (produced by the flow of Humboldt) and a wet zone characterized by a line of coast of mangrove, both being home to a large number of aquatic birds and marine, intimately related to wetlands freshwater or coastal-marine, particularly the species under study is located in any type of wetland, both in fresh water and salt.

The species is diurnal, but has also been seen in activity for the night, is sociable and congregatoria with other shorebirds in mixed groups. It feeds on the shores of the wetlands collecting insects with its peak fine and long, thanks to the long legs that possession can forage in greater depth than other shorebirds, frequently recorded swimming being its most common behavior the walk. Sometimes looking for food by moving the head and the peak horizontally or from one side to another within the water, in a similar way to the American Avoceta (American *Recurvirostrata*) [4, 5, 6, 7]. with a wide range of types of foraging the species found in the area of Rio Grande easy access to small crustaceans, arthropods, and even small fish that are caught during the changes of high tide and low tide [1].

The present study proposed to analyze the diurnal behavior of the Cigüeñuela cuellinegra (*Himantopus mexicanus*), because there are no specific projects on the ethology of this species in the area of the estuary of the Rio Grande River in San Pablo, observing a high anthropogenic impact, on the basis of the little existing information allowed us to obtain data relevant to the natural life cycle.

Which will serve as a basis for information for future conservation projects or reducing the impact that could lead to its habitat to intervene the human being, hence the importance of the study is reflected in set the behavior of the animal to external factors. To be a potential site for shrimp culture, has been modified its geography by excavation and construction of aquaculture pools. In the methodological aspect we rely on the determination of behavior patterns according to protocol (Blumstein, 2006). Referred to in (Iannacone, 2012), which we change by adapting it to previous observations 9 patterns of behavior that are categorized in 28 different activities. Figure 1.



**Figure 2** Interactions in pairs of *Himantopus mexicanus*.

Is reproduced at the age of two years between April and July (Cramp and Simmons 1977). The reproductive success is different every year depending on the environmental conditions, which is a reference to make profound studies on their behavior and relationship with their environment for their conservation.

This work has as main objective to study the patterns of the diurnal behavior of this species in habitats that have been modified by man. Because there are no specific data on the ethology of *H. mexicanus* in this sector of San Pablo.

The present study allows us to obtain relevant data of the natural life cycle of the crank handle cuellinegra, which will serve as a basis for information for future conservation projects or reducing the impact, which could lead to their natural habitat by the intervention of the human being, hence the importance of the study is reflected in evaluating the conduct of the day before animal external factors.

## Methodology

### Study area

The study area is located in the Province of Santa Elena, in the commune of San Pablo with around 0.095km<sup>2</sup> meters of expansion, limiting with structures of shrimp pools whose geographical coordinates are:

North: 2° 8'41.20"S, 80°46'52.45" or South: 2° 8'51.10"S, 80°46'32.07"O

this: 2° 8'48.44"S, 80°46'29.81" or West: 2° 8'44.78"S, 80°46'54.92"E



### Observation

We sampling twice per week in the mornings and in the evenings, each observation is made by stealth, no less than 30 meters because that couples are put alerts and then cannot observe its behavior in a natural way, recorded every one of its movements during 3 minutes minimum, in a period of 2 hours per day. We recorded the amount of individuals of the species *H. mexicanus*, to estimate its current population in the study area.

### Determination of behavior patterns according to protocol (Blumstein, 2006). Referred to in (Iannacone, 2012)

*Grooming*: Cleaning of the back feathers, the ave flips the head toward the back; cleaning of the feathers of the chest, the individual is standing and tilt your head in the direction of the chest and left his saliva on the feathers and accommodated his pen with the peak; cleaning the pens in the internal part of the fins, with one of the wings raised, the individual flips the head in the direction of the axilla, cleaning with peak; accommodation of wings, the ave gives a small jolt of your body to be able to accommodate the feathers of your wing; shakes the body, the bird gives a strong jolt of his body; stretches the wings, spreads its wings to be possibly An airy armpits or to the ventral part of your body; stretches the Pata, the ave stretches the pata sometimes together with the wing or independently, the fully extended, this occurs after a break.

*Locomotion*: Jump, the ave gives short hops near the edge of the Estero; run, travels tranches running sometimes with the wing glued to his body other with the separate wing of the same; walk, the ave performs walks in search of food; short flight, performs short flights in the form of flows landing near the initial point of flight.

*Food*: Eat, the ave da pecks to the ground, immerses its peak near the water in search of food.

*Rest*: pata raised, is a type of relaxation where the bird is resting with one leg raised, remaining a time well; sitting, another form of rest is when the bird sits and takes a break staying a considerable amount of time.

*Alert:* lifting of the head, when eating, lounging or walking lift the head and makes movements to toward different addresses semicircular; runs and flies. When notes something abnormal quickly agilita its steps and flies.

*Sonora:* screams long, birds emit loud sounds at the beginning and during the short flights; screams short, while walking or fed; cries warning, were observed in couple and breeding, when noticed our presence advised the chick with shouts short making the chick was hidden near clusters of earth.

*Defecation:* pause for a moment and excrete the stool.

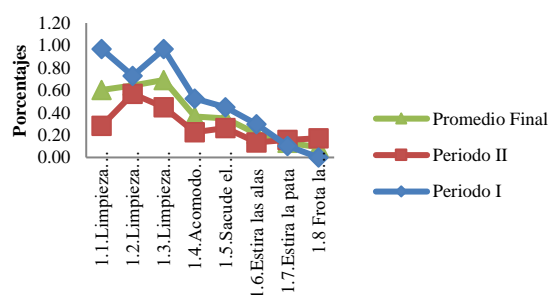
*Social competition:* persecution or attack from one individual to another, while walking near the shore attempt to attack an individual of another species after this performs a short flight and returns near the site.

No social competition: grouping approximation. While feeding are usually 2 or 3 individuals near the site of foraging.

## Results

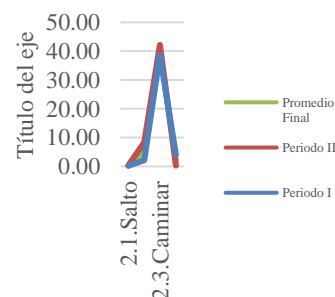
Were made 16 samplings, with a total of 7 hours of continuous observation, in which there were 28 behaviors, grouped in 9 categories (Table 3). With regard to the nine categories grouped it was noted that the individuals maintain their locomotion during the 48 per cent of its daily daytime activity, sound signals with 16%, supply 13%, rest 10%, social competition 4%, 3.5%, alert grooming 3%, no competition 1.5% and finally defecation less than 0.1%. To develop the etograma from (table 3) took into account the observation hours between 07h30 to 10h00 and 16h30 to 19h00.

Reviewing each of the categories of behaviors we have the first types of grooming in both sampling periods we determine that the cleaning of back feathers, chest and inner part of the wings but only in the first period with a percentage of 0.97, 0.73 and 0.97, respectively; while in the second half was 0.28, 0.57 and 0.45 in the same way, being these subcategories most representative of this type of behavior, (Figure 2).



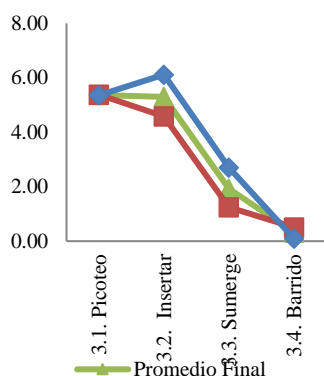
**Table 2** Frequency by categories of behavior - types of grooming.

In the case of mechanisms of locomotion we obtained the highest percentage for the subcategory walk with an average in the two periods which was of 40.55 %, followed by run with an average 5.41 % and lower values are those of jump and short flight below 2.5 %, in general in Ambo periods the dynamics was the same, (Chart 3).



**Table 3** Frequency by categories of behavior during the two sampling periods for types of locomotion.

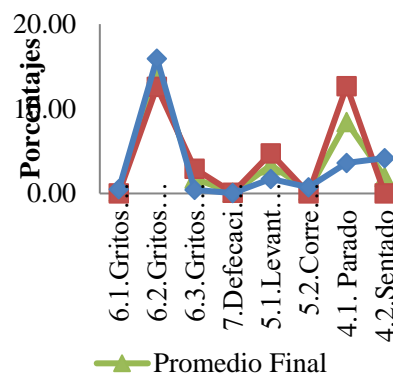
With regard to types of forrajeos (Chart 4), the first period presents a higher percentage with respect to the first, but without significant differences; in regard to those who were presented with higher activities were pecking and insert with an average of 5.30% both



**Table 4** Frequency by categories of foraging behavior (types of) in sample periods.

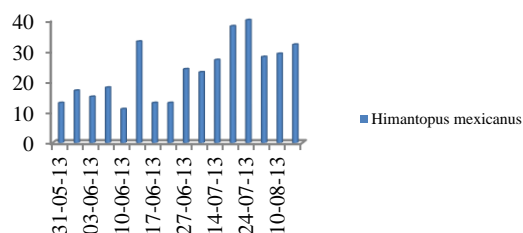
In the social behavior predominates the subcategory persecution or to attack another individual 7.44% in the first period, whereas in the second drops dramatically to a 0.64% This is due to the fact that the first cycle around 7 couples were in reproductive behavior according to the monitoring done. The other categories were not very representative with the exception of grouping and approximation with an average of 1.43% of the cycle muestral.

With regard to the categories of behavior several we have the greatest between the periods was shouting short constants with an average of 12.59%, the second of more incidence of activities behavior of rest stopped with 8.43% between cycles followed by lifting of head (3.32%), sitting (1.96%) and cries of viso (1.77%) were minimal in relation to the previous averages we mainly because they exceeded the 1 per cent of the total activities. (Figure 5).

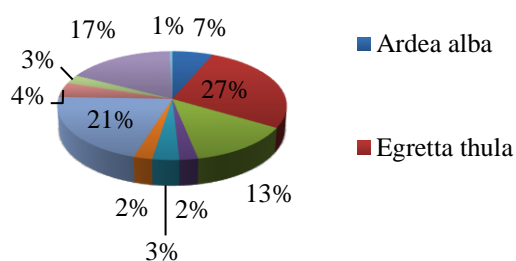


**Table 5** Frequency by categories of behavior (Miscellaneous) during the two periods of sampling.

The number of individuals at the beginning was 28 and at the end of the sampling was recorded 40 individuals, also identified 9 nests which gives us ensures that the habitat is an area of reproduction (Chart 6), in regard to the avifauna companion existed two species that predominated in the sector: Egretta thula (Garza nívea) 185 individuals that represents 27 per cent of the total population, Nyctanassa violacea (Night Heron) with 142 individuals coroniamarilla that reflect the 21% and Pelecanus sp. (Table 1 and Graph 8).



**Table 6** Abundance of individuals of Himantopus mexicanus recorded during all samplings in the area of the estuary of Rio Grande, San Pablo-Santa Elena.



**Table 8** Percentages of avifauna companion during the months of sampling.

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## Incidence of Salmonella and E. coli in Mango exporting company in the State of Nayarit, Mexico

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Received January 5, 2015; Accepted May 20, 2015

### Abstract

The following investigation analyzed conditions of hygiene on that operate in mango fruit packer companies in Nayarit, for it we were in contact with someone in the Mpio de Santiago Ixcuintla, main exporter of mango, according to production statistics in 2010. Samples of 11 places took: 1) the conveyor belts, 2) hands of wokers who place mangos in plastic boxes, 3) packers hands, 4) walls of boxes of plastic, 5) walls of cartons where mango is packaged, 6) wash water, 7) hidrotermic treatment of water and 8) hidrofrezzed water, 9) field mango, 10) handle previous to the treatment hidrotérmico and 11) packaged mango. The methodology used to detect Salmonella was by means of rapid Tecra UNIQUE TM test by means of which it allows the Salmonella detection in 16 -18 hours, sufficient time to stop handle shipments before the arrival to the commercial destination. For E.coli detection and coliformes it was realized by means of Badges of inventories of Petrifilm

We found presence of Salmonella in 10/11 sampling places, being the hands of the workpeople the point of major incidence, E. coli was detected in major percentage in classifiers hands, at the beginning of the flow aswell as the packers' hands at the end of the handling, with values of more than 105 Log. The target of the investigation was to detect the main sources and contamination indexes of pathogenics like Salmonella and E. Coli on the epicarpio mango, in hands of workers and surfaces inside an exporting company of handle.

**Citation:** IBARRA, L., ALVARADO, S., CASTILLO, A. and ALANÍS, R Incidence of Salmonella and E. coli in Mango exporting company in the State of Nayarit, Mexico. ECORFAN Journal-Ecuador 2015, 2-2: 138-147

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**Introduction**

The United States is the main importer of handle (Indian *Mangifera L.*) in the world, and Mexico is its main provider. Nevertheless, the participation of Mexico in the imports of handle in the American market has diminished, at the time that Peru, Brazil and Ecuador have increased its participation. (Hernández-Soto et al., 2009).

Nevertheless, in the last years the segment of major growth inside the food industry is that of fruits and vegetable fresh cut (FVFC) what has increased the investigation of this title substantially. As well as between the tropical fruits major potential on the market of (FVFC) there meets the handle due to its high world production as well as for the preference of the consumer to the high nutritional value (González-Aguilar et al., 2008).

Also, the handle is one of the fruits of major consumption in Mexico., being provided with an approximate surface of 146 000 There is and an approximate production of 1.34 million tons of which only there is exported of 12 15 % of the whole of the production (Wong et al., 1997).

The varieties of major exportation are “Ataulfo“, “Tommy Atkins“, “Haden“, “Kent“ and “Keitt“ (SAGARPA, 2010).

The quality is a key factor in the commercialization of the handle since the consumers demand every time higher standards, so much in the parameters físicoquímicos related to the ripeness, as well as in its external appearance (Lady's man, 1992).

The mango fruit, as all other fruits and vegetables, continues its biochemical and physiological processes after still being harvested, on having induced the fruit's maturity and later the aging. Some of these processes include changes in the color, increase in the sugar content, pH and the relation sugar / acid, as well as the reduction in the steadfastness, acidity and weight. Several of these characteristics are used like indicators of the state of ripeness and of the quality of poscosecha of a fruit (Hulme, 1971; Seymour et al., 1990; Baez, et al., 1998).

Many studies were based on the indicated variables put together with the temperatures of storage of the fruits only on the effect that they induce in the quality of the fruit of handle, and its life of shelf (Thomson, 1971; Thomas, 1975; Seymour et al., 1990); without considering the harmlessness of the product. By what it tries to be contributed which are the places of major danger where the mango could be contaminated during its handling in the packing, already being contaminated by the physical ambience or for contact with food manipulators. In addition to that, this fruit presents a hidrotermic treatment to an established temperature of 46.1°C during 75 to 90 minutes of exhibition, depending on the variety of the mango. In case of less fruits of 500g he is given a time of 75 minutes (as in the handle Ataulfo) and in fruits bigger than 500 g (I marry handle Kent and Keitt) it is exhibited for 90 minutes.

These exhibition times to major temperatures of the temperature average of the fruit, (25 °C), alter the physiological and biochemical properties of the handle, bearing to the increase of weight, of temperature, change of color, of steadfastness, and of processes enzimáticos (Osuna, et to the, 2005; Osuna et to the, 2007; Chaidez, et to the, 2002; Ibarra, 2006).

All these factors can favor the contamination microbiana, to its adhesion and its internalization (Ibarra, 2006).

The target of the present study was to detect the main sources and contamination indexes of pathogenic like Salmonella and E. Coli on the handle epicarpio, in hands of workpeople and surfaces inside an exporting company of mango.

### **Materials and methods**

Tracking of the sources of contamination with Salmonella and E.coli that operate in the facilities of a baler of mango in the Edo. of Nayarit, Mexico.

It made a trace of Salmonella and E. coli that was carried out during a harvest season of the handle in the state of Nayarit (May-August), in a company baler located in the MPIO. Of Santiago Ixcuintla.

Samples were taken of 11 points within the company baler , among which are: 1) the conveyor belts, 2) hands of workers that placed the handles in the plastic crates, 3) hands of packers, 4) walls of the plastic boxes, 5) walls of the cardboard boxes where is packed the mango, 6) the washing water,

7) Water of the hydrothermal treatment and 8) the water of the hidrofriado, 9) field handle, 10) mango before of the hydrothermal treatment and 11) mango baling. Samples 1 to 5 and 9 to 11 were taken with a sponge sterile (brand Bio Pro Sampling System) which were previously moistened with water peptonada sterile 0.1% Vigorously rubbing surfaces of interest.

The samples of water (6 to 8) were taken by a Moore swab (Sepulveda, 2002) which consisted in a portion of gauze of 30 X 30cm, rolled up on itself to form a cylindrical strip approximately 10X4, is sewed at both ends with a thick thread, and on a shore left a piece of wire, with which was later joined by a piece of raffia for secure in a shore tank of the hydrothermal treatment. The swabs were sterilized previously wrapped in paper dextrasa, and once placed the swabs were left in the respective vats of washing, of hydrothermal and hidrofriado by approximately 5 hours and then withdrew and were placed in a sterile pouch, adding pre-enrichment broth, to be transported to the laboratory, like the other samples, within a cooler with refrigerants.

The sampling of the hands of the workers was to rub the hands of 5 workers with the sponge moistened in the broth of preenriquecimiento and in this way, with each sponge is took a pool of 5 samples which counted as a single.

For the sampling of the mango, of each sample was prepared a pool by sampling the surface of 10 handles in the different stages:

Handles newly received from the field, another of mangos before hydrothermal treatment and hidrofriado and finally of mangoes packaged.

The 11 points of sampling were studied in 25 different occasions, which meant that it took a total of 275 samples that were obtained during the whole season of mango production (May-August), becoming daily sampling until completing the sample size. To distribute the sampling in 25 occasions, broadened the possibility of finding Salmonella in those sites, as the conditions of work could vary from one day to another.

Once taken all samples, were kept in a cooler with coolant to be retained until processing. The same day of sampling were transferred to the laboratory and began with the detection of Salmonella and E. coli. The detection of Salmonella was carried out by the test of Tecra UNIQUE TM and the detection of E. coli and coliforms was carried out using rapid tests of Petrifilm (plates of E. coli count and coliforms) 3M.

The technique for detecting Salmonella for this stage of the work was carried out by the test Tecra UNIQUE TM, this method is equivalent to the method of reference of US FDA BAM.

### **Detection of Salmonella with the Tecra UNIQUE TM Test**

Each 25 ml of the sample was added 225 ml water peptonada damped (Tecra, MBPMED500).

As a means of pre-enrichment and were incubated at 35°C for 18 to 24 h. After that time of incubation, proceeded to remove the cap from the pipes 1 to 3 of the test of Tecra UNIQUE TM and transferred 1 ml of enrichment broth to tube 1 test, putting the paddle on the inside of the tube 1 with the numbered part toward the pipe 2. Mixed 2 times and incubated for 20 to 40 minutes at 35°C. During this time are captured some Salmonella present using the purified antibodies highly specific present on the surface of the palette. Subsequently, was transferred the palette to the tube 2 by washing 4 times and was passed to the pipe 3 and incubated again during 4 h, at a temperature of 35°C where it happened replication of Salmonella, which multiplied on the surface of the palette and produced a sufficient number to achieve the detection. Removed the pipe cover 4 to 6 and the palette is change to the tube 4 and was incubated for 30 minutes at 35°C. In this step is presented a conjugate, since the tube 4 contained enzymes linked to specific antibodies for Salmonella (conjugate). The Palette is transferred to the tube 5 where they washed 5 times; then change to the tube 6 and incubated at a temperature of 20-25°C (ambient temperature) for 10 minutes. The tube 6 contained a substrate for the enzyme. If Salmonella was present, was developing a violet color on the bottom of the palette. Finally, they took the results by placing the lever in the front of the support of the test and the color is compared with the color chart included in the test.

In the case of the positive samples, took a roasted pipe 3, which contained broth M and was planted in agar plates agar Hektoen sulphite bismuth, and XLD agar and incubated at 35°C during 24 to 48 h. The colonies that were suspected in these media, they practiced biochemical tests (agar triple sugar iron (IST), Hagar lysine iron (LIA) and urea incubating at 35°C during 18 to 24 h. The tests that were positive for Salmonella were confirmed with evidence of agglutination with polyvalent antiserum.

It should be noted that the technique for detecting Salmonella used in this paragraph by the quick test of Salmonella Unique TM allows only make a qualitative assessment of the bacteria detected

### **Identification of E. coli**

Of the samples taken for Salmonella, took 1 ml and was placed in Petrifilm plates for E. coli and Coliforms, previously labeled for each one of the samples, planting 3 plates; the first was a direct planting, the second a dilution 10-1 and the third a dilution 10-2 incubating at 35° for 24 h, at the end they were practiced counts of blue colonies with gas and coliforms.

### **Results and Discussion**

**Detection of sources of contamination with Salmonella and E.coli that operate in the facilities of a baler of mango in the Edo. of Nayarit**

**Detection of Salmonella in packaging of mango**

The presentation of the results of the frequency of Salmonella has the order of workflow within the company baler, since mangos arrive at the packaging until this is packaged for your shipment.

The percentages of salmonella found in the 11 sites sampled within a company baler mango (Graph 1) were the following, being the hands of workers who are manipulating the handle before treatment of washing presented the highest percentage of contamination (32%), followed by the gangs that transported to handle after being washed and treated hidrotermicamente, (20%). The rinse water from the company owns 16% of frequency of contamination with Salmonella, like mangoes which come from field (16%). The handle in the stage prior to the hydrothermal treatment like the cardboard boxes where is packed the handle have a (12%) of contamination percentage of the total sampled, the hands of the packers that are at the end of the line of hydrothermal treatment and hidroenfriado sampled along with the handle baling presented 4% of contamination with Salmonella.

### **Detection of E. coli in sites sampled in mango packaging**

The Graph 2 shows the data obtained in the detection of E. coli in the 11 sites sampled presenting great variation of the populations in each one of them, fluctuating between 101 and 105 CFU/ml. It should be noted that the order presented in graphs 3, 4 and 5 is the same that exists in the flow of the processing of the handle in companies balers.

The highest counts of *E. coli* are presented in the hands of workers who handle the handle before washing and from the hands of the packers, that is the last step in the process of the packaging of the fruit, with populations of 105 CFU/ml. The conveyor belts represent the second site of greater presence with *E. coli* with counts of 103 CFU/ml. The rest of the sampled sites are in a range of populations of this bacteria of 101 and 102 CFU/ml.

### **Detection of coliforms in sites sampled in mango packaging**

The Graph No. 3 reveals the high concentrations of coliforms in the majority of the sampling points, with populations of 106 CFU/ml and the water that is used in the hydrothermal treatment is the one that contains a lower level of coliforms (103CFU/ml).

The hands of the workers who represented the first place of contamination with *Salmonella*, it may be because they are the first to have contact with the fruit that comes from field, there is a high probability that the handle that they play is contaminated with this pathogenic bacteria in addition to contaminate the objects that have contact as the plastic crates, cartons, or other.

There is the possibility that workers are asymptomatic carriers of *Salmonella*, or that only due to poor hygiene practices and do not have a correct washing hands before start the day and after going to the bathroom or when removed from their activities, causing the return have dirty hands and carriers of *salmonella*.

This situation is in accordance with the studies of (Cruickshank, 1990), who asserts that a proper handwashing decreases the risk of foodborne diseases by asymptomatic handlers.

In some studies reveal that the infected food handlers arrive to cause in the United Kingdom an average of 7 per cent of outbreaks of foodborne diseases (Bryan, 1978) and (Brayan, 1998).

In addition, the Center for Disease Control of the United States, (FDA, 2000) estimated that 20% of events of foodborne diseases caused by bacterial agents are a result of transmission from infected workers.

Certain authors as (Bean & Griffin, 1990; Bean et al, 1996; Olsen et al, 2000) indicate that there is data in the United States that from 1973 to 1997, the poor personal hygiene of workers of foodstuffs has been the second factor frequently cited that contributes in outbreaks of ETAs.

The Conveyor Belts represent the second place of pollution in the company baler, perhaps due to contact with the workers, who can contaminate it, and also by the constant friction that have with handles that are happening throughout the working day, which can present contamination with *Salmonella*.

Because *E. coli* has been widely used as an indicator of faecal contamination (Geildrech, 1966), this microorganism was monitored within the company baler mango, with the object of check in an indirect way the presence of *Salmonella*.

And when considering to *E. coli* as an indicator organism, when analyzing the results is that the hands of the workers, both of which receive the handle from the field for a preselection and washing and from the hands of the packers are the main sources of fecal contamination that may contaminate the existing equipment and the boxes that are used to position the handles washed and the boxes where they are packaged.

The large numbers of *E. coli* in the hands of the packers can arise due to the workers of the company in its most women, avoid washing hands during the working day, even when removed from their activities because they concern that this causes them reumas to wash your hands. This can lead to a serious problem of safety for the fruit. In addition, workers do not have a training to make a correct washing hands, and there is no adequate monitoring so that there is always soap and role of drying in the laver. Michaels et al, (2004) notes that factors such as a poor personal hygiene, bad hand washing and drying inappropriate coupled with inadequate facilities have been documented that contribute to cause foodborne diseases.

With regard to the water used in the company although the numbers of *E. coli* are low in concentrations of 101 and 102 CFU/ml, represent a potential risk of contamination in the epicarp of mango, since the fruit is kept in contact with the water, may become contaminated. The rinsing water, but these are only 15 to 20 sec of exposure, are sufficient for some bacteria can remain on the surface to pass through the rolls of washing, or even could infiltrate (Ibarra et al, 2004).

The waters of hydrothermal and hidroenfriado although present lower concentrations of *E. coli* of 101 CFU/ml, represents a greater risk due to the exposure time of the fruits of mango in the tanks of the hydrothermal water are 46.1°C during 75 to 90 minutes depending on the variety of fruit and in tanks of hidroenfriado at ambient temperature are 20 minutes, time enough to provoke an infiltration of water to the inside of the handle, in the area of the stalk, as it was found in the study of Ibarra et al (2006) in which there was infiltration of water during the hydrothermal and when applied both treatments, presented a higher percentage of infiltration due to the temperature differential Between the hidrotermico e hidroenfriado, 21°C, and mangoes hot (46°C) to be immersed in water at ambient temperature (25°C), there is a contraction of gases from the interior of the fruit, causing a suction to the interior. And here is the problem that if the water is contaminated with bacteria, these not only can contaminate the surface, but infiltration to the pulp of the mango (Ibarra, 2006), (Ibarra et al, 2004)

### **Conclusions**

It is necessary to know the events that occur during the cultivation of mango, harvest and transport of mango, before this arrive to packaging, which favor the contamination of fruit with pathogenic bacteria, as in the present study there was evidence of contamination of Salmonella, *E. coli* and coliforms in the entire surface of the handle when this comes from the field to the company baler.

The current systems for washing and disinfection of fruit and vegetables in the exporting companies of fruit and vegetable products, are insufficient to ensure the safety of the fruit. These technologies were designed to remove the debris from the products, not the microorganisms. And even with new knowledge of disinfectants as well as techniques, it is preferable to avoid microbial contamination through Good Agricultural Practices and Good Management Practices rather than relying on decontamination technologies.

It is known that depending on the time interval between the contamination of the surface of the fruit and vegetables with pathogens, varies the efficiency of the decontamination treatments applied and the greater the interval time, there is a greater probability of smaller reductions logarithmic and possibility of adherence and bacterial internalization within the products. In addition, the cleaning equipment used in the exporting companies do not allow a sufficient contact between the adhered bacteria on the surface of the fruit and vegetable products and agents of washing and sanitizantes with the wash brushes. In addition, brushing during washing can cause injury to the entire surface of the handle, imperceptible to the view, which can promote the internalization of pathogens.

In addition to the above, sanitizantes as hypochlorite, commonly used in the water for processing fruit and vegetables to decrease the bacteriological population, are inefficient, as this item is quite unstable.

Especially in the presence of organic matter and when this is applied to high temperatures such as is the case of the hydrothermal treatment (46.1°C) evaporates with ease and in less than one hour after being applied is reduced fully its concentration. And although there are some alternative sanitizantes to eliminate pathogenic bacteria on the surface of fruits and vegetables, have not yet been adopted by the majority of the companies from the orchard.

To achieve an assurance of the safety of fresh fruits and vegetables is necessary a management system that integrates all aspects of production, processing and distribution, and more training to workers who work both in the field and in the food plants in terms of hygiene and safety. The facilities should be suitable to avoid the entry of birds, rodents, domestic animals and wildlife as iguanas, among others, which represent a potential source of contamination with Salmonella.

### **Acknowledgments**

The authors thank the facilities provided for the realization of the present investigation to an exporter of mango in the state of Nayarit, Mexico, in the MPIO in Santiago Ixcuintla, that allowed access to the facilities for the taking of samples and that for reasons of secrecy is ignored its registry.

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## **Composition, abundance and diversity of larval and juvenile fish associated to the roots of the Mangrove trees, in the estuary of the Commune Palmar - Province of Santa Elena.**

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Received February 4, 2015; Accepted April 27, 2015

### **Abstract**

In the estuary of the Commune Palmar, the study of the composition and abundance of fish larvae and juveniles associated with the roots of the mangroves is done through systematic analysis in three seasons, during December 2014 - April 2015, using cast nets and trammel with mesh opening of 2.5 cm and 0.5 cm respectively for juveniles and larvae. Of the total of 2,414 fish collected, 3 orders and 5 families in 8 species were identified. The highest value of abundance is reflected in April with 900 ind., E3 station being population-average abundance of 39 individuals ( $44.81 \pm \text{stdev}$ ), and in February, with the lowest value of 109 ind. Monthly absolute abundance of each species recorded for statistical index (ANOVA) is considered, the significance of Kolmogorov-Smirnov ( $0.13 > 0.05 \alpha$ ); indicating that the variances of the population means for sampling follow a normal distribution, the ANOVA analysis indicates that between population abundances significant differences. The values of diversity index Mg. ( $1.46 / 1.54 / 1.61$ ) demonstrated homogeneity and low diversity of species in the three stations. According to environmental parameters high salinity correlation ( $0.004 < 0.05$ ) is recorded with respect to abundance ( $r = 0.87839$ ), observed in February with the high value of  $9.6 \text{ mg / L } (\pm 2.15 \text{ desvt.})$ , and April to  $38.6 \text{ mg / L } (\pm 0.95 \text{ desvt.})$ ; oxygen with a high correlation ( $0.04 < 0.05$ ) relative to the abundance ( $r = 0.71776$ ), being March high value of  $4.7 \text{ mg / L } (\pm 0.86 \text{ desvt.})$  and February with a value below  $3.1 \text{ mg / L } (\pm 0.45 \text{ desvt.})$ , considered these environmental parameters which determine the variation of fish communities in each of the research stations.

### **Diversity, abundance, correlation, fish communities, Commune Palmar**

**Citation:** GONZÁLEZ, Tanya and GONZÁLEZ, Cristhian Composition, abundance and diversity of larval and juvenile fish associated to the roots of the Mangrove trees, in the estuary of the Commune Palmar - Province of Santa Elena. ECORFAN Journal-Ecuador 2015, 2-2: 148-159

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## Introduction

Mangrove ecosystems are some of the most productive, as they provide a large amount of nutrients to the east, provide environmental services and host a high diversity of life (CONABIO, 2008); within this ecosystem are estimated that host Parties of the youth populations and fish larvae, and of which we have identified some of the species of commercial importance (Gutierrez, O. and Chinchia, J., 2001), as part of fishing activity, exists in virtue of that certain species that take advantage, have in the roots of the mangrove a place of growth and aging since the early stages of life, since they protect and nourish the larvae and juvenile fish (Have et al 2003), these roots, At the same time serve as energy regulators through complex biological interactions among them and the different habitats of the ecosystem (Diaz-Ruiz et al., 2006).

At present it is to recognize the importance of mangrove ecosystems for the fish communities and their associations in the commune of Palmar, those that have become a place of interest of many investigations by having a great diversity of species.

Therefore, the present study aims to establish the composition, abundance and diversity of larval and juvenile fish associated with the roots of the mangrove and its relationship with the physical parameters in three different stations

## Materials and methods

### Area of study

The mangrove ecosystem is located to one side of the Ecuadorian coast, in the Commune Palmar del Santa Elena county, province of Santa Elena - Ecuador.

Limited by the following points: North Cerro Angahuel and shrimp farms (02° 00' 868" S and 80° 44' 240" W); to the south the neighborhoods, estuaries and Shell (02° 01' 232" S and 80° 44' 179" W); to the east the "Chila," shrimp (02° 01' 22" S and 80° 44' 46" W); to the west is the mouth of the Rio Grande (02° 00' 989" S and 80° 44' 451" W), (CIPS-IMSE, 2005). The topography is flat, taking this area a polygonal shape of 43.85 has of mangrove alive (IMSE - DGAM - 2005). Before the devastation of the ecosystem by the shrimp industry, mangrove forest was much more extensive, surpassing the 200 ha (C-CONDEM, 2006).

## Monitoring Stations

The stations were selected considering the accessibility of the area, mainly in those areas with the highest number of species, due to a prior monitoring. Three stations were selected using a GPS (Garmin), for the identification of the reference points of observation. Photo 1 and Table 1.



**Figure 1** mangroves of Palmar Province of Santa Elena. Source: Google Earth, 2015.

Stations	Coordinates	
	South Latitud	West Longitud
Station #1	02° 00' 998"	80° 43' 762"
Station #2	02° 01' 183"	80° 43' 900"
Station #3	02° 01' 22	80° 44' 46"

**Table 1** Coordinates of the sampling stations.

### Systematic monitoring

After the bibliographic analysis and selection of the stations, it comes to the implementation of the systemic approach, the same that is directed to the study of the mangrove ecosystem, determining their components and the relationships between them, these relationships determine on the one hand the structure of the object and on the other hand its dynamics. To do this we rely on the analysis muestral, in the three stations of study, this type of sampling to detect spatial variations in the community, proposed by Quintana in 2007. The sampling frequency bimonthly was conducted in sites with abundant mangrove roots during the months of study with a duration of 24 hours for each station, with intervals of collection of sample of 4 hours. The area on which it proceeded to place the trammel was 100m<sup>2</sup>, for each station, and also used the nets for species of smaller size.

### Records of abundance

the collection of species is carried out every 4 hours, was to review the trammel nets and launch the, then proceeded to count each one of the agencies for their subsequent identification and classification. Photo 2 and 3.



**Figure 2**

Decision-parameters are made using special equipment such as the YSI (EXO 1 Multiparameter Areat) for temperature and dissolved oxygen, Refractometer (Brixco) to salinity, and a pH meter., for its application in situ.

For the identification of the species was used taxonomic keys of Massay, S. and J. Massay. 1999; marine fishes of Ecuador.

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For the ecological attributes: composition, abundance and distribution used the IBM SPSS statistical 19, for the analysis of ANOVA and the monthly absolute abundance was used first-E6 with ecological formulas; for the incorporated alpha diversity program was implemented Diverse, it should be mentioned that for the beta diversity of absolute abundance data had to be transformed to fourth root; in order to be able to perform the analysis of conglomerates cluster and for correlation of variables the program Basic Statistics (2 array variables) of the statistical package Statistics 8.

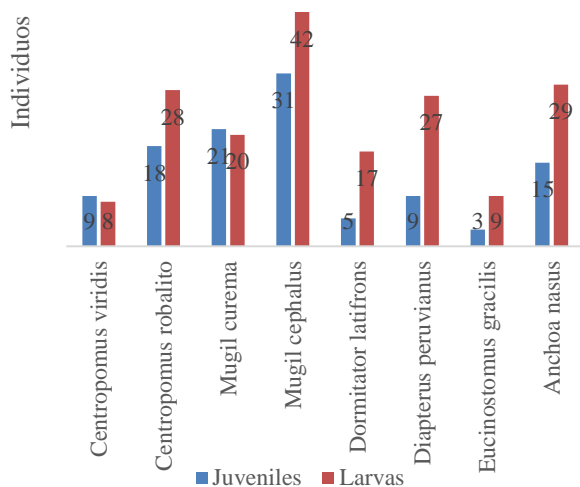
### Analysis and interpretation of results.

#### Composition or biological variety.

The biological composition of fish associated to the roots of the mangrove forests on the Commune Palmar, was composed of 3 Orders (Perciformes, Cupleiformes and Mugiliformes), 5 families (Centropomidae, Elotridae, Gerridae, mullets (Mugilidae) and Engraulidae) and distributed in 8 species (Centropomus viridis, Centropomus robalito, Dormitator latifron, Diapterus peruvianus, Eucinostomus gracilis).

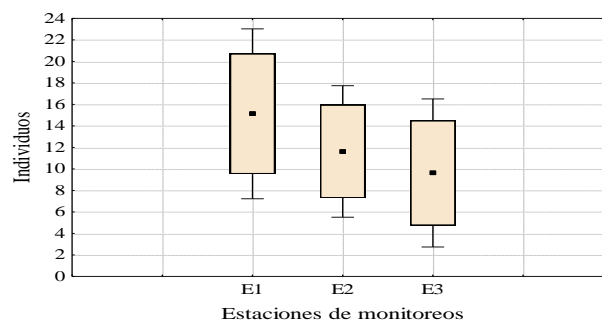
### Population abundance in December

The absolute abundance total, was of 291 individuals collected. *Mugil cephalus* (42 larv., and 31 juv.), presented the highest value in absolute abundance population; follow him Anchovy nasus (29 larv., 15 juv.), *Centropomus robalito* (28 larv., 18 juv.), *Mugil curema* (20 larv., 21 juv.), *Diapterus peruvianus* (27 larv., 9 juv.); in lower population abundance of the species *Dormitator latifrons* (17 larv., 5 juv.), *Centropomus viridis* (9 larv., 8 juv.), and *Eucinostomus gracilis* (9 larv., 3 juv.). Graphic 1.



**Table 1** Absolute abundance of fish in the roots of the mangrove of the Commune Palmar.

The station E1, was the area with the highest population average value in abundance of fish, with 15 individuals ( $\pm 7.90$  STDEV.), the station E2 with 12 individuals ( $\pm 6.12$  STDEV.), and the station E3 with 10 individuals ( $\pm 6.89$  STDEV.). Chart 2.



**Table 2** Fish abundance by monitoring stations in the mangroves of Palmar.

In the three stations, records of population abundance of fish indicate that the stage with high levels in abundance is the larval phase, followed by the juvenile stage. Chart 3.



**Table 3** Abundance of fish per stage in the monitoring stations in the mangroves of Palmar.

### Population abundance in January

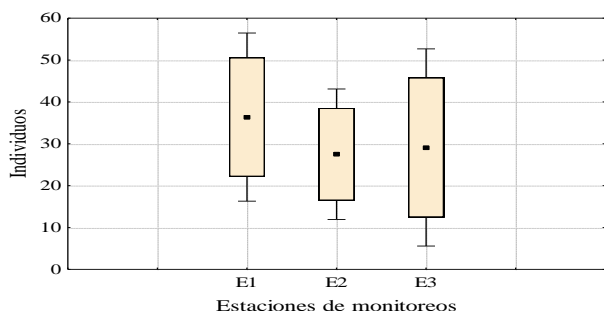
The total absolute abundance in the month, was of 738 individuals. The species *Mugil cephalus* was recorded with a value of 193 individuals (104 larvae and 89 juveniles), this being the highest log in absolute abundance population, followed the species *Mugil curema* with 146 individuals (83 larv., 63 juv.), anchovy nasus with 127 individuals (71 larv., 56 juv.), *Centropomus robalito* with 80 individuals (49 larv., 31 juv.), *Diapterus peruvianus* with 74 individuals (47 larv., 27 juv.).

Dormitator latifrons with 73 individuals (44 larv., 29 juv.); in lower population abundance of the species Eucinostomus gracilis with 22 individuals (14 larv., 8 juv.) And Centropomus viridis with 23 individuals (11 larv., 12 juv.). Chart 4.



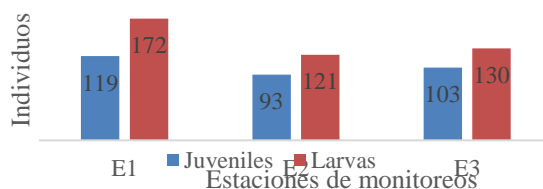
**Table 4** Absolute abundance of fish per stage (youth-larva) in the mangroves of Palmar.

The station E1, with the highest population average value in abundance of fish, with 36 individuals ( $\pm 20.08$  STDEV.), followed by the station E2 with 27 individuals ( $\pm 16.51$  STDEV.), and the station E3 with 29 individuals ( $\pm 23.55$  STDEV.). Chart 5.



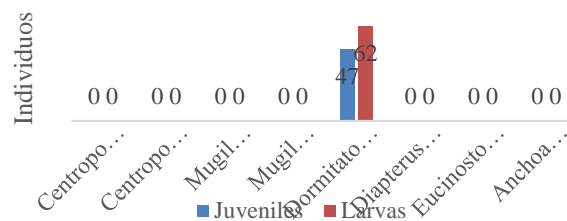
**Table 5** Fish abundance by monitoring stations in the mangroves of Palmar.

In the three stations the records of population abundance of fish indicate that the stage with high levels in abundance is in the larval phase; followed by the juvenile stage. Chart 6.



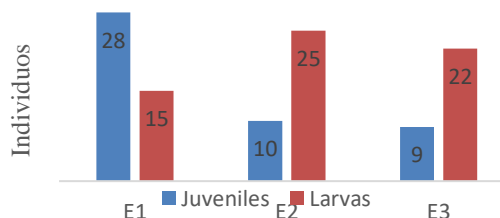
**Table 6** Fish abundance by stage in the monitoring stations in the mangroves of Palmar population abundance in February.

The absolute abundance total was 109 individuals. The only species recorded in this month of monitoring was Dormitator latifrons with 109 individuals (62 larvae and 47 juveniles). Chart 7.



**Table 7** Absolute abundance of fish per stage (youth-larva) in the mangroves of Palmar.

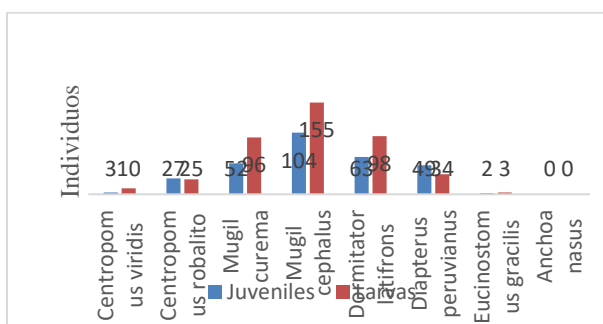
In the three stations the records of population abundance of Dormitator latifrons indicate that the stage with high levels in abundance, is the larval phase; followed by the juvenile stage. Chart 8.



**Table 8** Abundance of fish per stage in the monitoring stations in the mangroves of Palmar.

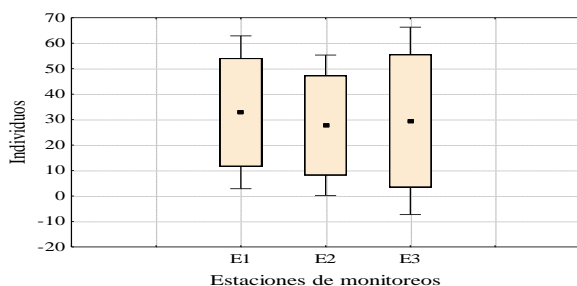
### Population abundance, in March

The absolute abundance total for this month was 721 individuals. The species *Mugil cephalus* (155 larvae and 104 juveniles), being the highest in absolute abundance population; follow him *Dormitator latifrons* (98 larv., 63 juv.), *Mugil curema* (96 larv., 52 juv.), *Diapterus peruvianus* (34 larv., 49 juv.), *Centropomus robalito* (25 larv., 27 juv.); *Centropomus viridis* (10 larv., 13 juv.), *Eucinostomus gracilis* (3 larv., 2 juv.) and was not recorded population abundance for the species *Anchoa nasus*. Chart 9.



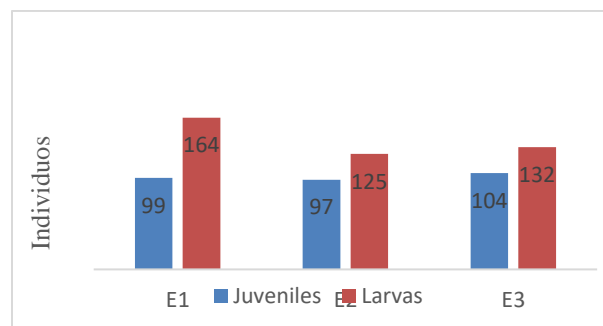
**Table 9** Absolute abundance of fish per stage (youth-larva) in the mangroves of Palmar.

The station E1, was the area with the average value of population in abundance of fish, with 33 individuals ( $\pm 30.01$  STDEV.), followed by the station E2 with 28 individuals ( $\pm 27,59$  STDEV.) and the station E3 with 30 individuals ( $\pm 36.79$  STDEV.). Figure 10.



**Figure 10** Abundance of fish by monitoring stations in the mangroves of Palmar.

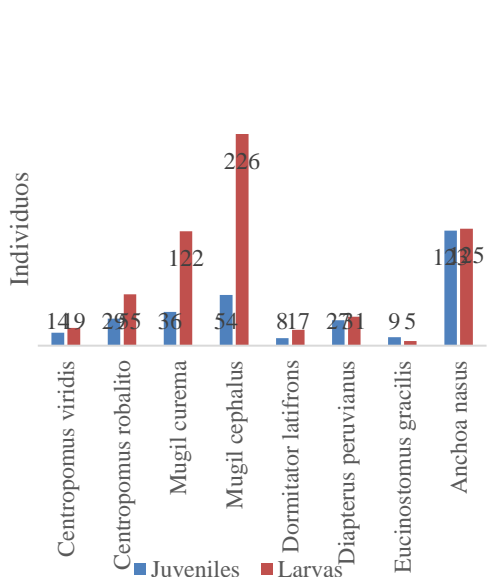
The three stations, show that the stage with greater population abundance of fish is the larval phase; followed by the juvenile stage. Figure 11.



**Figure 11** Abundance of fish per stage in the monitoring stations in the mangroves of Palmar.

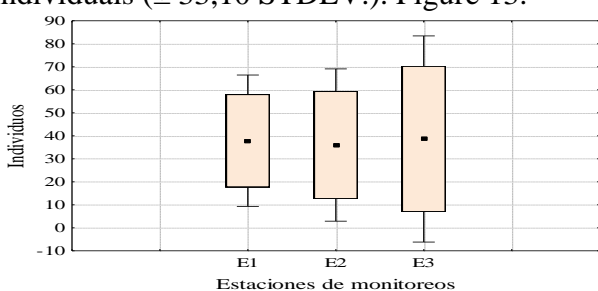
### Population abundance in April.

The total absolute abundance in the month, was 900 individuals. *Mugil cephalus*, registered with 280 individuals (226 larvae and 54 juveniles); followed by *Anchoa nasus* with 248 individuals (125 larv., 123 juv.), *Mugil curema*, with 158 individuals (122 larv., 36 juv.), *Centropomus robalito* with 84 individuals (55 larv., 29 juv.), *Diapterus peruvianus* 58 individuals (31 larv., 27 juv.), *Centropomus viridis* with 33 individuals (19 larv., 14 juv.), *Dormitator latifrons* with 25 individuals (17 larv., 8 juv.); in lower abundance *Eucinostomus gracilis* with 14 individuals (5 larv., 9 juv.). Figure 12.



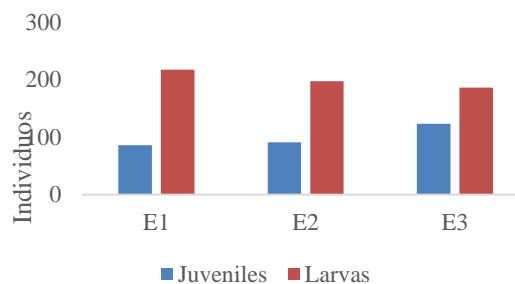
**Figure 12** Absolute abundance of fish per stage (youth-larva) in the mangroves of Palmar.

The station E3 was the area with the highest population average value in abundance of fish with 39 individuals ( $\pm 44,81$  STDEV.), followed by the station E1 with 38 individuals ( $\pm 33,10$  STDEV.), and the station E2 with 36 individuals ( $\pm 33,10$  STDEV.). Figure 13.



**Figure 13** Abundance of fish by monitoring stations in the mangroves of Palmar.

In the three stations the records of population abundance of fish indicate that the stage with high levels in abundance is the larval phase; followed by the juvenile stage. Figure 14.



**Figure 14** Fish abundance by stage in the monitoring stations in the mangroves of Palmar.

**ANOVA analysis between population abundances.**

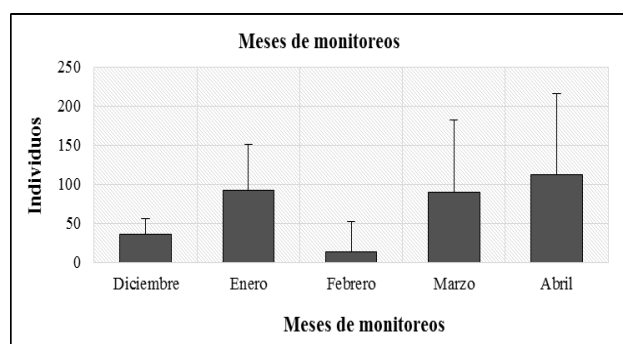
It was considered the absolute abundance of each species monthly registered during the months of sampling in order to contrast the population variance and statistical significance (ANOVA). The significance of the Kolmogorov-Smirnov Test (0,132), is greater than the significance level of  $\hat{1}\pm$  (0,05); shows that the normality of the variances of the population means recorded during the study in the mangroves of the Commune of Palmar, follows a normal distribution.

ANOVA, indicates that the sample of 2,827 F value is greater than the F-critical 2,641; to compare the p-value being less than the value  $\alpha$ , shows statistical significance (0.039 < 0.05); which indicates that among the population abundances registered in the study, presented significant differences. Table 1.

Origin of variations	Origin of variations	Origin of variations	Origin of variations	Origin of variations	Origin of variations	Origin of variations
Inter-grupos	56078,850	4	14019,713	2,827	0,039	2,641
Intra-grupos	173578,125	35	4959,375			
<b>Total</b>	<b>229656,975</b>	<b>39</b>				



Post hoc Duncana, indicates that the abundance population mean more high, was recorded in the month of April; by deducting then that was the month where you found the largest number of individuals of fish in the roots of the mangrove of the Commune of Palmar; being statistically significant ( $0.054 > 0.05$ ). Figure 15.



**Figure 15** Fish population average registered in the roots of the mangrove of the Commune of Palmar.

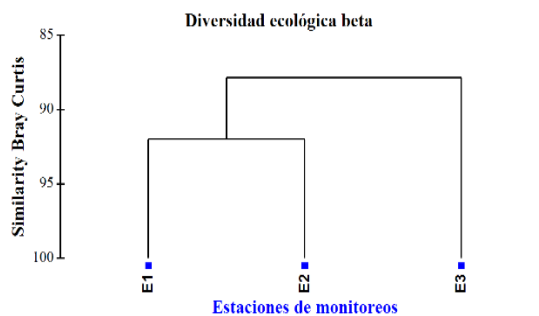
### Ecological Diversity alpha and beta in December

The Margalef diversity index indicates that all stations are low in species diversity; in the station E3 is attached a high level of homogeneity between the species with an index of equity of Pielou 0.98 NATS/ind and for seasons E1 and E2 an index of dominance of Simpson of 0.85 NATS/ind, which shows little dominance of species in this month. Figure 16.



**Figure 16** Ecological Diversity alpha in the mangroves of the Commune of Palmar.

The hierarchical grouping of Bray Curtis, indicates that the station E1 - E2, presented a similarity of 92,01%. This association is determined by 6 species (*Centropomus viridis*, *Mugil curema*, *Dormitator latifrons*, *Diapterus peruvianus*, *Eucinostomus gracilis*, *anchovy nasus*), by its occurrence and similarity in population

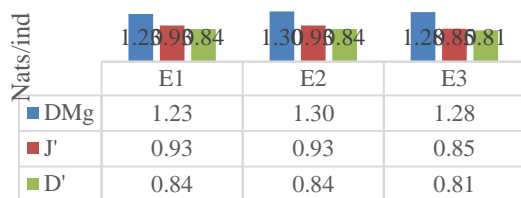


abundance. Figure 17.

**Figure 17** Ecological Diversity beta in the mangroves of Palmar.

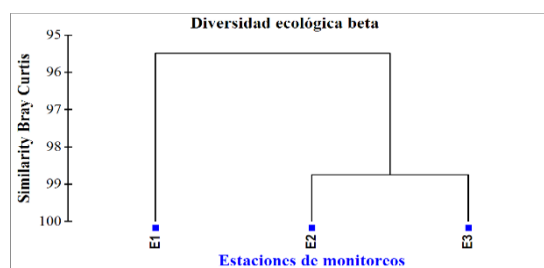
### Ecological Diversity alpha and beta in January

The Margalef diversity index, indicates that the diversity of species in the three stations is low. But pair the stations E1 and E2 are allocated a high level of homogeneity between their species, introducing the Pielou equity index of 0.93 NATS/ind and the index of dominance of Simpson 0.84 NATS/ind, which shows that there is little dominance of species in the study area. Figure 18.



**Figure 18** Ecological Diversity in the mangroves of the Commune of Palmar

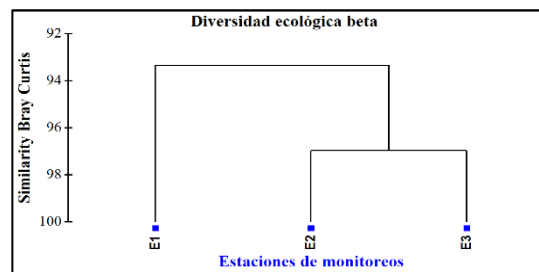
The hierarchical grouping of Bray Curtis; indicates that the station E2 - E3, presents a similarity of 98,75%. The association is determined by 4 species by its occurrence and similarity in population abundance, of whom were; *Centropomus viridis*, *Centropomus robalito*, *Mugil curema*, *Diapterus peruvianus*. Figure 19.



**Figure 19.** Ecological Diversity in mangrove roots of the Commune Palmar.

### Ecological Diversity alpha and beta in February

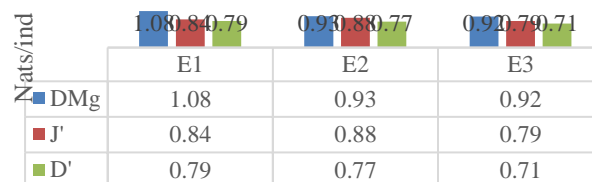
The data obtained for the Margalef diversity, equity of Pielou and dominance of Simpson, determined that the values for each index are lower, because were only recorded a kind *Dormitator latifrons*; however the hierarchical grouping of Bray Curtis; indicates that in the station E2-E3 there is a similarity of 96,97%. Figure 20.



**Figure 20** Ecological Diversity beta in mangrove roots of the Commune Palmar.

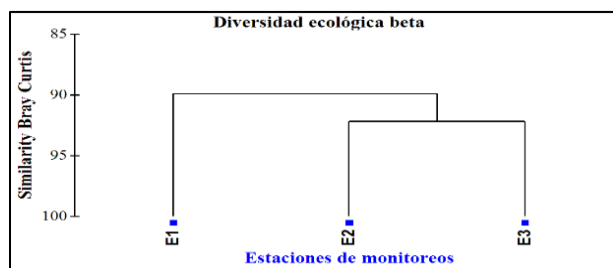
### Ecological Diversity alpha and beta in March

The Margalef diversity index indicates that all stations are low in species diversity. The Stations E1 and E2, presented homogeneity between their heats with index of equity of Pielou 0.88 NATS/ind, index of dominance of Simpson 0.77 NATS/ind, which shows little dominance of species. Figure 21

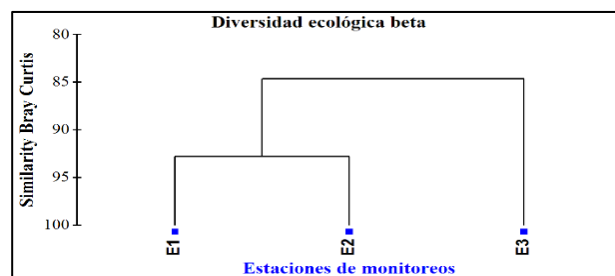


**Figure 21** Ecological Diversity alfa in mangrove roots of the Commune Palmar.

The hierarchical grouping of Bray Curtis, indicates that the station E2 - E3 presents similarities of 92,17%. The association is determined by 2 species *Centropomus viridis*, *Centropomus robalito*, by its occurrence and similarity in population abundance. Figure 22.



**Figure 22** Ecological Diversity beta in the mangroves of Palmar



**Figure 24** Ecological Diversity beta in the mangroves of Palmar

**Ecological Diversity alpha and beta in April.**

In this month the Margalef diversity index, indicates that all stations are low; the station E1 reflects high homogeneity between their species with Pielou equity index of 0.88 NATS/ind, and index of dominance of Simpson 0.82 NATS/ind, reflecting little dominance of species. Figure 23.

	E1	E2	E3
DMg	1.23	1.24	0.87
J'	0.88	0.83	0.81
D'	0.82	0.79	0.73

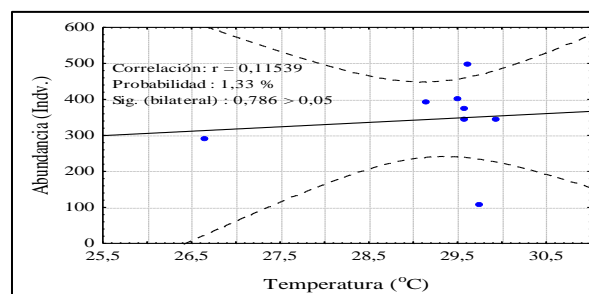
**Figure 23** Ecological Diversity alfa in the mangroves of Palmar.

The hierarchical grouping of Bray Curtis, indicates that the stations E1 - E2 present similarity of 92,79%. The association is determined by 4 species *Centropomus viridis*, *Centropomus robalito*, *Diapterus peruvianus*, *Eucinostomus gracilis*, by its occurrence and similarity in population abundance. Figure 24.

**Correlation of variables**

**Temperature and population abundance**

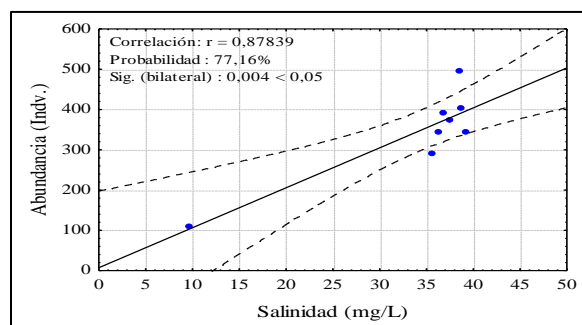
was recorded a linear correlation statistically non significant ( $0,786 > 0.05$ ) low and direct ( $r = 0,11539$ ); with a probability of 1.33%, which increased the water temperature of the mangroves in the commune Palmar, increases the abundance of fish. Figure 25.



**Figure 25** Salinity and population abundance.

**Salinity and population abundance**

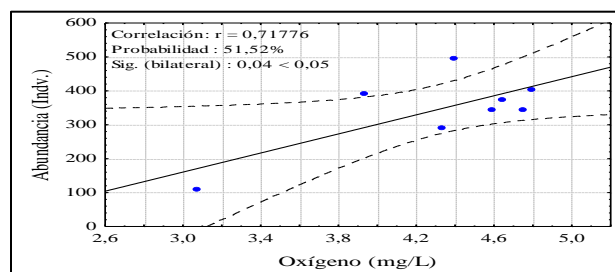
There was a statistically significant linear correlation ( $0.004 < 0.05$ ) high and direct ( $r = 0,87839$ ); with a probability of 77,16%, that with increased salinity in the mangroves of the Commune Palmar increases the abundance of fish. Figure 26.



**Figure 26** Salinity and population abundance.

### Oxygen and population abundance

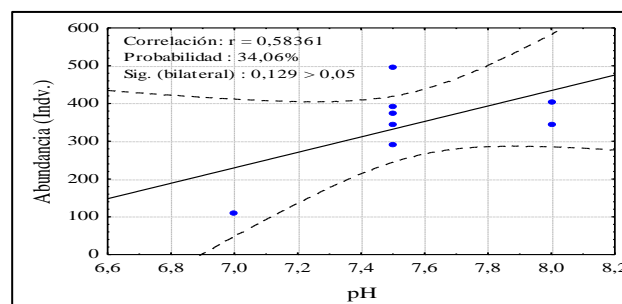
There was a statistically significant linear correlation ( $0.04 < 0.05$ ), high and direct ( $r = 0,71776$ ); with a probability of 51,52%, that by increasing the oxygen dissolved in the mangroves of the Commune Palmar increases the abundance of fish. Figure 27.



**Figure 27** Oxygen and population abundance

### PH and population abundance

was recorded a linear correlation statistically non significant ( $0.129 > 0.05$ ) moderate and direct ( $r = 0,5861$ ); with a probability of 34,06%, that to increase the pH in the mangroves of the commune Palmar increases the abundance of fish. Figure 28.



**Figure 28** pH and population abundance

### Conclusions

The results obtained in this research show that the composition of fish related to the roots of the mangrove is conformed by three orders, 5 families and 8 species present in the three stations, it should be noted that the month of February was presented only the species *Dormitator latifron*, the same that was conditioned by rainfall and water evacuation of the dam San Vicente, causing the low salinity, significantly.

Statistically the high population abundance was recorded during the months of March and April, presenting a greater concentration of individuals in the family mullets (*Mugilidae*) and the family *Eleotridae*; in the month of April the family *Engraulidae*, these occurrences are related to bibliographic references alluding to the periods of spawning of each family observed.

The diversity of the organisms of fish in the three stations, are conditioned by the physical parameters oxygen and salinity, this demonstrates that the mangrove ecosystem is no different in terms of fish fauna, it is worth mentioning that the results depend on the seasonality of the species mainly during the reproductive cycle.

With the foregoing confirms the hypothesis in this study, since the environmental parameters if condition the variation of the fish communities, since marked significant differences, and variability in the community of individuals.

In addition rescues the importance of mangrove roots for fish species both larvae and juveniles, because that grant them protection, shelter and food during the life cycle of each species.

### Recommendations

Should strengthen this study with research in other seasonality, to supplement the information and record other species that use these ecosystems, and at the same time be extended for up to a year to corroborate the patterns that impacted in the present investigation.

It is suggested that consideration be given to subsequent studies, an analysis of water to be able to relate the occurrence or absence of the ichthyofauna with possible polluting factors.

You must make comparisons the ichthyofauna present in the roots of the mangrove in natural environments and environments created by man (water reservoirs), I believe that in these reservoirs are present many species that are not normally found in natural environments and this is due to the fact that in these environments there is much variability in regard to physical factors.

You must consider future investigations that are oriented to the ecological and biological evaluation of the species of ecological importance and/or economic present in these systems, which will support the decision-making and raise alternatives to management and utilization of resources.

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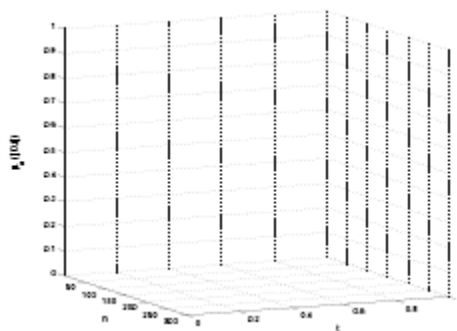
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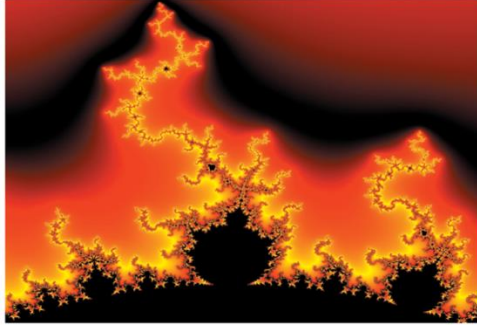


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*Universidad de Guadalajara*

## Agronomy

“Incidence of *Salmonella* and *E. coli* in mango exporting company in the State of Nayarit, Mexico”

IBARRA, L., ALVARADO, S., CASTILLO, A. and ALANÍS, R

*Universidad Autónoma de Nayarit*

## Natural

“Composition, abundance and diversity of larval and juvenile fish associated to the roots of the mangrove trees, in the estuary of the Commune Palmar - Province of Santa Elena”

GONZÁLEZ, Tanya and GONZÁLEZ, Cristhian

*Universidad Estatal Península de Santa Elena*

