VOLUMES 3 & 4 1952-1953

BULLETIN

OF THE

FISHERIES SOCIETY

OF THE

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MANILA

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ERRATA

Page 2 — Line 7, "C. R. Dimen and J. R. Montilla" should read "J. R. Montilla and C. R. Dimen".
Page 2 — Line 17, delete "CRAFT AND".
Page 6 — Line 19, italicize "Chelonia mydas".
Page 6 — Line 24, "*Sargasum*" should read "*Sargassum*".
Page 8 — Line 11, italicize "Chelonia mydas".
Page 9 — Line 22, "if" should read "of".
Page 11 — Line 39, italicize "Chelonia mydas".
Page 14 — Line 35, italicize "Chelonia mydas".
Page 15 — Line 34, italicize "Chelonia mydas".
Page 24 — Line 39, italicize "Chelonia mydas".
Page 24 — Line 40, italicize "Carreta olivacea".
Page 24 — Line 42, italicize "Eretmochelys imbricata".
Page 37 — Line 8, italicize **"L. semifasciata".**
Page 43 — Line 33, "southeast" should read "northeast".
Page 43 — Delete lines 41 and 42 and supply—"The owner of the bombon must be already in the fishing ground before sunset. At the start of dark, mantle lamps of between 500".
Page 45 — Line 20, delete comma between "*bungsod*" and "*Zamboanga*".
Page 46 — Line 26, "the wing" should read "two wings".
Page 46 — Line 27, delete comma after "small".
Page 46 — Line 34, "is" should read "are".
Page 46 — Line 35, delete "The different types" and supply "These".
Page 50 — Line 12, "ang" should read "and".
Page 50 — Line 39, insert "super-" before "imposed".
Page 51 — Line 1, "diagramatic" should read "diagrammatic".
Page 51 — Line 2, insert "Zamboanga" after "bungsod".
Page 54 — Line 27, "renewed" should read "removed".
Page 55 — Line 8, italicize, and read "*Schizostachyum*" instead of "*Schizostachyus*".
Page 55 — Line 35, delete comma between "screen" and "sigin".
Page 55 — Line 43, "diagramatic" should read "diagrammatic".
Page 56 — Line 2, "head rope" and "foot rope" must be written "headrope" and "footrope", respectively.
Page 57 — Line 13, "purse" should read "scoop".
Page 61 — Line 17, delete "of" between "catching" and "fish".
Page 73 — Line 3, "POFIRIO" should read "PORFIRIO".
Page 78 — Line 16, "basningan" should read "basnigan".
Page 86 — Line 24, "*Leignathus*" should read "*Leiognathus*".
Page 86 — Line 26, "*sexfaciatus*" should read "*sexfasciatus*".
Page 91 — Line 6, italicize **"Patis".**
Page 94 — Line 1, "*Gracillaria*" should read "*Gracilaria*".
Page 107 — Line 30, "economic" should read "economics".

THE TURTLE FISHERIES OF THE TURTLE ISLANDS

By JOSE S. DOMANTAY
Bureau of Fisheries, Manila

INTRODUCTION

On May 29, 1951 the Director of Fisheries instructed the writer to proceed to Taganak Island of the Turtle Islands group for the purpose of making a thorough study of the turtle fisheries of Turtle Islands with the end in view of formulating effective remedial measures for their conservation. With the cooperation of the Commander of the Philippine Navy Boat No. 897, the writer left Zamboanga City on August 5, 1951 for Taganak Island and arrived there the next day.

The present paper is a preliminary report on the turtle fisheries of Turtle Islands, giving emphasis on the ecology of the small island groups, species of marine turtles found therein and their feeding and breeding habits, the value of turtle eggs produced annually, and the marketing and preservations of turtle eggs. Likewise, recommendations for the conservation of the marine turtle fisheries of Turtle Islands are embodied in this report.

THE TURTLE ISLANDS

The Turtle Islands group is composed of seven islets which lie on the northern shelf of the island of Borneo, the southern rim of the Sulu Sea Basin. The islands in the group are distributed in a line running roughly northwest-southeast parallel to the International Treaty Line (Fig. 1). They are almost completely surrounded by fringing coral reefs of varying widths. The surrounding waters vary from 12 to 35 fathoms deep although many of the shallower reefs and shoals are exposed during the lowest tide.

Some of the islets in the group, like the Great Bakungan, Boaan, Baguan, and Lihiman, have features in common, with a very low hill or a low table-like surface and elongated in a northeast-southwest direction with their elevated portions on the north end. The similarity in features of these islets may be due to the influence of currents on the corals as their southern ends are made up largely of raised coral reefs. Taganak which is the largest

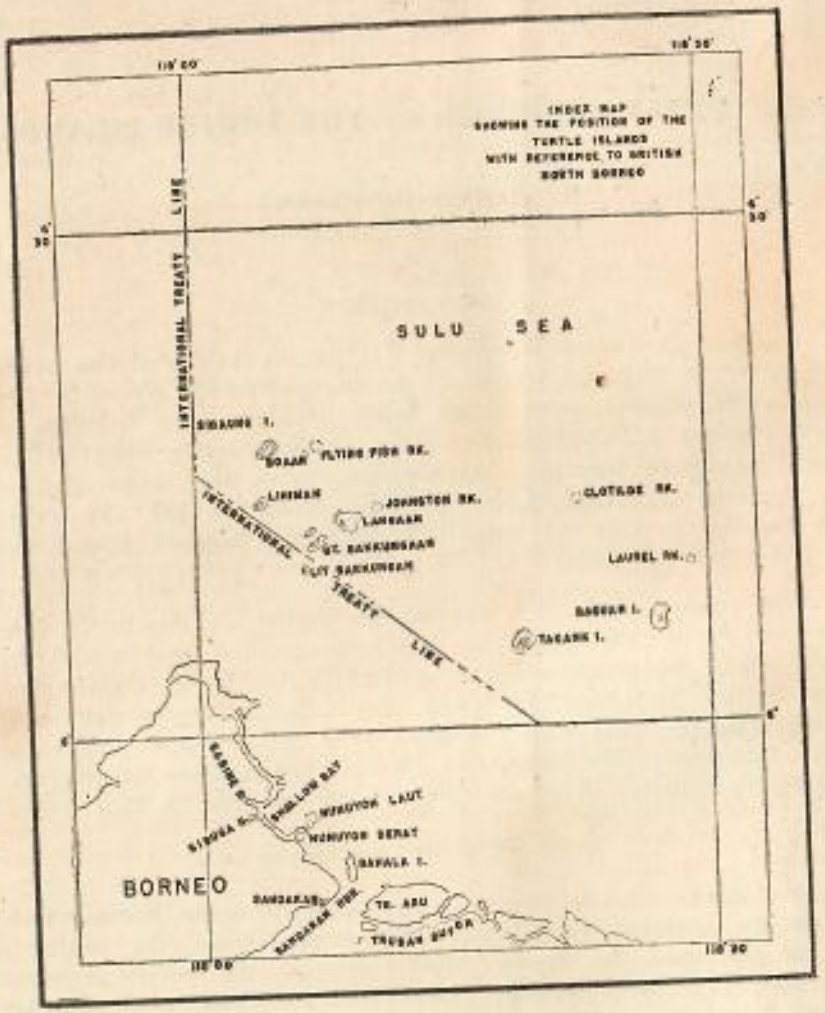

FIG. 1

in the group is hilly with three rounded peaks or knobs aligned on the major axis with elevation heights of 400, 310 and 200 feet. Langawan is the only islet which is flat and practically sandy all around, while Sibaung, the smallest in the group, is rocky all around. In most of these islets, except in Sabaung, there is a good supply of fresh water from beneath the surface although without any spring. Anywhere in the islets, even very close to the seashore or up in the hills, a well can be dug and at a depth of less than two meters, fresh-water can be had.

SPECIES OF MARINE TURTLES AND THEIR COMPARATIVE ABUNDANCE IN THE TURTLE ISLANDS

The species of turtles that breed in the neighborhood and vicinity of the Turtle Islands are the *Chelonia mydas* (*Chelonia japonica*) or the green turtle (Fig. 2), locally known as *pudno* among

FIG. 2

the Tausugs and the Samals, and *tortuga* among the people and residents of Zamboanga and Basilan cities, and the *Eretmochelys imbricata* (Pennant) locally known as *sisikan* or *papakan*. The latter species is the hawksbill turtle from which the tortoise shells of commerce come. It may be differentiated from the green turtle by its hawksbill-like beak adaptable for snapping moving creatures for food, by its smaller size and tortoise shells or scutes that are thicker, and by its imbricated carapace and the smaller size of its eggs. The other marine turtle reported is the leatherneck scientifically known as *Carreta olivacea* which is very similar to the green turtle with slight differences in the size of the head and the number of claws. This species was apparently not encountered by the writer during the survey at night because the two kinds look almost the same in general appearance.

The rareness of the hawksbill turtles in Turtle Islands is quite apparent. In the actual checking of turtle nests and eggs gathered daily during the writer's six weeks stay at the place, there were only half a dozen nests of the hawksbill turtles out of the 1,352 nests of turtles counted during the period.

The comparative rareness of the hawksbill turtle, in spite of the protective measures given to this species as embodied in the Fishery Act No. 4003, cannot very well be explained. At first, the writer believed that the scarcity of hawksbill turtle may be due to the death of the animal resulting from the removal of the scutes which are used in commerce. The method of taking out these scutes from the turtle's back is to pass live flame over the back which makes it easy to remove them. The suspicion that the removal of the scutes caused the death of the hawksbill turtle was disproved when one Ubian boy brought one live medium-sized hawksbill turtle from near the reefs around Taganak Island where he was fishing and was asked to demonstrate how the scutes could be removed. He prepared a torch out of coconut leaves and passed the flame over the back of the turtle gently. The tortoise shells were easily taken out. After the demonstration, the turtle was taken to the sea immediately and was seen to be very much alive as if nothing has happened.

FOOD AND FEEDING HABITS

The Chelonia mydas is a purely vegetarian animal. It feeds mostly on seaweeds as shown by the stomach contents. During the Japanese occupation, the writer had the opportunity to study the stomach contents of this particular species sold at the local market in Zamboanga City. The seaweeds found inside the stomachs were species of *Sargassum* and, in addition, marine green algae were noted. The one butchered in Taganak Island for internal anatomy study had stomach contents consisting of seaweeds with the green algae predominating. No animal form was found. The vegetarian habit of the animal is further evidenced by the form of its beak which is not adapted to catching fish or other animals, unlike hawksbill turtle's beak which can be used to snap some moving creatures in the water. This is apparently the reason why this particular species abounds in places where seaweeds are plentiful. The shoals and reefs of Taganak Island and the rest of the islets of the group are rich in seaweeds. The most predominant seaweeds are in shallower reefs and shoals. During the day no turtles are found in these places, so it is assumed that they usually feed at night. With the use of water glass or telescope one may see several of them swimming around or resting at the bottom and going up to the surface occasionally in the deeper reefs of about 10 to 12 fathoms. During noon time many of them may be seen swimming at the surface with their heads above the water.

SPAWNING GROUNDS

The spawning grounds of the marine turtles irrespective of the species are usually above the tide mark, in fine white-sandy beaches (Fig. 3), although there are places where they build their

FIG. 3

nests below the highest tide line. The uninhabited regions are the favorite spawning grounds although some turtles also spawn in inhabited places. In Taganak Island, the most populated islet among the group, the greater number of nests are found in the uninhabited areas. However, some nests were noted under some houses. There were few nests found among grasses and bushes over 200 meters inland from the highest tide line. The soil in Taganak, except that of the hill is sandy. Turtle nests found inland are not very favorable for depositing the eggs as they are usually shallow and cannot be completely covered because of the presence of roots of vegetation. This being the case, eggs that are laid in the vegetated areas are easy prey for dogs and monitor lizards. At present the spawning grounds in Taganak as well as in the other islets are becoming unfit for breeding because of the numerous piles of logs and coconut husks cast ashore which have not been removed. The fast growing vegetation and the fast spreading roots of the coconuts contribute a great deal in the unfitness of the present spawning grounds.

From the time the Turtle Islands were ceeded to the Philippine Republic in 1947 the spawning grounds were never taken

good care of in contrast to the time when they were still administered under the British North Borneo. According to reliable information, the British government used to clean and clear the spawning grounds from the many logs cast ashore and from other obstructions. The account for the decrease of turtle eggs in some of the islets because the spawning grounds are almost entirely closed by these obstructions. In Great Bakungan and Lihiman Islands, there were practically no turtles going up except for a couple of them observed during the study.

BREEDING HABITS

Sex dimorphism.—In Chelonia mydas sex differences are not very evident on casual examination. Upon close scrutiny, however, one may see slight differences. The male has a bigger and much longer tail than the female and the plastron of the former is slightly concave as in the land turtle. The bigger and longer tail in the male helps to insure perfect copulation which, together with the slight concave plastron, may fit very well with the female carapace. Other than these slight differences both sexes are practically alike externally.

Amplexus or copulation.—Fertilization in marine turtles is internal fertilization, hence, they are provided with copulatory organs. The parent turtles copulate in the water. It takes them the whole duration of the tide of no less than six hours to finish copulation. Before actual amplexus is consummated the male rubs and cleans the carapace of the female with its appendages. This explains the smooth and shiny carapace of the younger egg-layers giving foreign organisms no chance to settle on their carapace.

During copulation the male turtle clings tightly over the carapace of the female with its appendages and long tail. It is at this instance when the long protrusile copulatory organs of the two meet together to insure the entrance of the sperms into the vagina of the female.

The vagina, as seen when the mother turtle lays eggs, is very long and is usually retracted after laying. In the dissected specimen that laid 132 eggs the previous night, the vagina measures over six inches long and is covered with retractile regular skin. The male has a long penis.

Building nests and laying eggs.—The building of a nest (Fig. 4) takes about two hours. When a mother turtle is ready to lay eggs she goes up to the shore at night and looks around for people and if nobody is present in the neighborhood, she continues her

journey and locates a site where to lay the eggs. Once a place is selected she starts clearing the area with her anterior appendage, removing all obstructions. Later she excavates the entire place

FIG. 4

until she finds herself securely hidden and not visible from a distance. Then she begins to bore a hole with her hind appendage using them alternately. In doing this operation she orients herself every now and then for an effective position so that the hind flipper can be used to advantage in bringing up the sand from the hole. Before boring, she shoves the sand that was brought up and throws it forward partly to cover her back. This is apparently done to give space for the next load of sand that is brought up next and at the same time to hide herself from the people that may be around. After boring the hole as deep as she can reach with her hind flipper, she raises her body anteriorly with her fore flipper to deepen the hole further. After this operation, when the hole is very deep and cannot be reached by its hind flipper anymore, she begins to lay eggs. The building of the nest takes from 45 minutes to one hour. The duration of the laying of eggs depends upon the number of eggs laid. Two old mother turtles were actually observed to have laid 18 and 22 eggs, respectively, for a duration if 10 minutes. It takes naturally for younger egg-layers longer time, possibly over 30 minutes to lay more than 100 eggs. After the eggs are laid, the turtle covers the hole with sand and presses the sand over the hole very well

with both hind appendages. It takes the animal at least 10 minutes to cover and press the hole. When this is done the turtle uses mostly the fore flippers to shovel the sand around to cover the entire excavation aided at times by the hind flippers. It takes the animal at least 20 to 30 minutes to finish the covering of the nest before it turns again to the sea to copulate with its mate, going ashore a week later to lay another batch of eggs. Apparently old mother turtles do not leave the place immediately even if they do not actually lay eggs. Observations were actually made on four old mother turtles, the three of which were found still over their nests the following morning. They made their nests alright but did not lay eggs. The fourth one was found around 7:00 in the morning still over its nest and was not disturbed at all by the presence of the egg-gatherers. At 9:15 it was still covering the hole it made. It did not show any sign of disturbance when approached for close-up study and for photography. After noting all the features and characteristics of its old age, it was driven away to the sea at 10:30 in the morning. The nest was examined and opened and amazingly there were no eggs laid. It may be concluded that old mother turtles lose their usefulness as egg-layers and may therefore be utilized for their meat which to some, tastes better than beef. The very old mother turtles still have the instinct of laying eggs hence they go ashore to build their nests. They, however, are a nuisance for they may deprive the other egg-layers of the space at the spawning grounds. There is the possibility for their nests to overlap some nests of younger turtles and destroy the eggs in them.

On August 18, 1951, an old mother turtle went ashore in front of the Philippine Constabulary Barracks to build her nest at 8:30 in the evening. It was marked No. 10 with large white figures. The following morning, no eggs were found in the nest. At around 9:00 in the evening of August 20, the same turtle was seen building her nest again in another place. As in the previous night she did not lay eggs. Apparently she was no longer an egg-layer but had to go up for the instinct of laying eggs.

Number of eggs as an index to the age of a mother turtle.—From the actual observation conducted and confirmed by reliable information, the number of eggs laid determines the age of the mother turtle. Younger egg-layers lay more eggs than the older ones. The average number of eggs laid by the younger ones is about 120 at one time. The highest number actually observed was 226. The lowest number recorded was 18 eggs although according to the egg-gatherers they encountered 3 and sometimes none at all in some nests. The two mother turtles that were actually

observed, which externally appear old, laid 18 and 22 eggs respectively. Their carapaces were darker in color and dull, not as shiny as in the younger ones. The size of the animal cannot be taken as an index of age although some old ones may be much larger than some of the younger egg-layers. The very old ones may lay few eggs or none at all and their carapaces are roughened by some outgrowth on the scutes or by deposits of foreign organisms like oysters, rock barnacles, etc.

Time and manner of laying eggs.—Generally the mother turtle lays eggs at night between 9:00 p.m. to 4:00 a.m. although at times they may lay much earlier or even later. There are two turtles actually observed going ashore at 7:30 in the evening and four seen in the morning still over their nests, one of which did not want to leave the nest until it was driven back to the sea at around 10:30 in the morning. This one was an old turtle with horny chitinoid outgrowth of its scutes. It did not lay eggs at all.

Usually, however, they go up the shore during high tide in the evening. The moonlight does not seem to affect the laying of eggs. However, it was noted that rough seas interfere with the egg laying. It was observed that during the two nights when the sea was rough and the waves were big there were very few new nests spotted in the following morning. What interferes very much is the presence of people around the place. Even if the turtle has already dug its nest, when disturbed, it will leave and return to the sea and postpones laying the eggs. Several turtles were numbered with white enameled paint just after they have gone up the shore. They then returned to the sea and in an hour later they were seen up in another place about 500 meters away building their nests. When the mother turtle has started laying eggs, it is not bothered at all by any outside disturbance. It may suspend laying eggs for a while as actually observed but generally it goes ahead irrespective of somebody's presence. One can go over the animal without its being bothered very much. It is at this particular instant that one can get the eggs by just receiving them with the hand as they drop down from the vagina in groups by twos or fours.

It has been erroneously believed that marine turtles, particularly Chelonia mydas, lay their eggs only but once.

The marine turtles bury their eggs and leave them to hatch by themselves. The mother turtle lays eggs periodically throughout the breeding season as shown by the presence of several stages of ova in the ovary.

A mother turtle that laid 132 eggs on August 11, 1951 was butchered the following morning for the study of its reproductive organs (Fig. 5). The two ovaries practically occupy the entire

FIG. 5

abdominal cavity with their numerous eggs of different stages. The large eggs found filling up the body cavity were composed of two batches of eggs numbering 320 (Fig. 6). All of them did

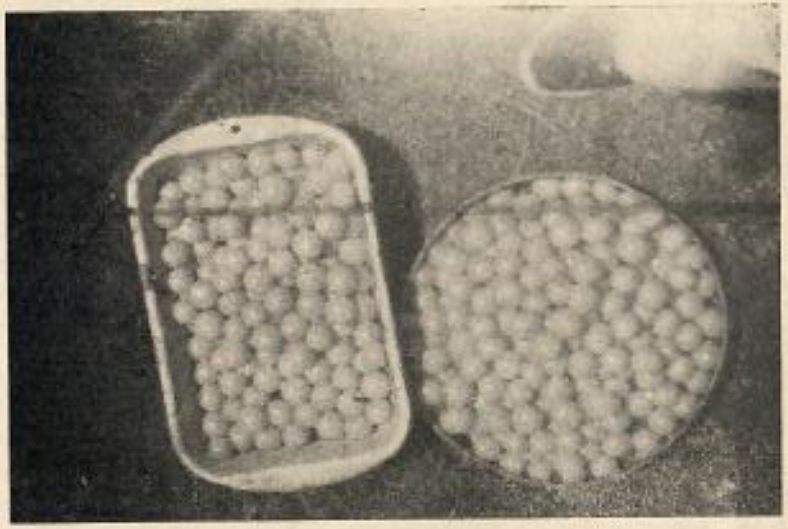

FIG. 6

not have any coating yet and were composed mostly of yolk. The difference of the two sizes was not very conspicuous. It could not be of one batch either because the maximum number of eggs laid and recorded was 226 and this particular turtle laid 132 eggs the previous night. Besides these two batches of eggs there were numerous smaller ones of different stages. Hence, the laying of eggs is periodic, though not daily. The two oviducts are very long, each measures over two meters and united together near the vagina. The length of the oviducts explains the capability of the mother turtle to lay an enormous number of eggs at one oviposition.

The presence of numerous stages of eggs in the ovaries confirms the periodic maturation and laying of eggs. The continuous production of eggs in the ovaries either throughout the year or during the spawning season is still a problem that needs further study and investigation. According to reliable information and some records, there are always turtle's nests and eggs throughout the year although the months of high production fall from May to September with its peak in August.

TABLE I — APPROXIMATE NUMBER OF TURTLE NESTS FOUND DAHA THROUGHOUT THE YEAR IN TAGANAK ISLAND.

Month	No. of Eggs	Month	No. of Eggs
January	— 5 upward	July	—60 upward
February	—15 "	August	—65 "
March	—25 "	September	—55 downward
April	—35 "	October	—40 "
May	—45 "	November	—30 "
June	—55 "	December	—20 "

From the data in Table I, one can, therefore, conclude that the marine turtles breed throughout the year with more turtles laying eggs during the period from May to September, with the breeding peak in August. It may also be inferred that some turtles do not lay eggs continuously throughout the year, and that the rest periods of the egg-layers do not fall under the same months, some resting earlier than the others. Apparently, more turtles rest during the months of November, December, January, February and March as shown by the fewer nests and eggs found during these particular months. Few others apparently rest during the month of high production. The present study has proven, however, that a mother turtle lays eggs several times, the number is still a subject for further study.

The interval of time between the laying of eggs is another problem that the writer tried to solve. There were 38 mother turtles marked consecutively from No. 1 to No. 38 under different dates as follows:

August 13, 1951 — Two turtles marked Nos. 1 & 2.
August 17, 1951 — Six turtles marked Nos. 3, 4, 5, 6, 7, & 8.
August 18, 1951 — Two turtles marked Nos. 8 & 10.
August 19, 1951 — Eight turtles marked Nos. 11, 12, 13, 14, 15, 16, 17, & 18.
August 20, 1951 — Two turtles marked Nos. 19 & 20.
August 21, 1951 — Three turtles marked Nos. 21, 22 & 23.
August 23, 1951 — Four turtles marked Nos. 24, 25, 26 & 27.
August 24, 1951 — Three turtles marked Nos. 28, 29 & 30.
August 28, 1951 — Three turtles marked Nos. 31, 32 & 33.
August 31, 1951 — Four turtles marked Nos. 34, 35, 36 & 37.
September 3, 1951 — One turtle marked No. 38.

One turtle marked No. 10 on August 18, 1951 was seen two days later. It was an old turtle which just went up for the instinct of laying eggs. In both cases it did not lay eggs. Turtle No. 5 which was marked on August 17, 1951 was seen 6 days later laying eggs. Although turtle No. 5 was the only positive case spotted among the several marked ones that went up to lay eggs after marking, it might be taken to represent and made a basis to compute the interval of egg laying. At least, a week interval between laying of eggs is a very close estimate.

Not very many of the marked turtles were seen after they were marked for many obvious reasons. The difficulty of staying all night in the spawning ground especially during dark and rainy nights is one of the main reasons for failure to spot many of them. Many of the egg-layers went up during the highest tide at night which was usually late after midnight. Others may have gone up ashore in the neighboring islands. There were nights the writer could not go out because of continuous rainfalls. On other nights he was away from Taganak while making some survey in the other islets.

Hatching period of the eggs.—The general belief of the people in Taganak Island even among those who claimed to be very familiar with the habits of the marine turtles is that the eggs of Chelonia mydas hatch in two weeks period after laying. This belief was not confirmed by the result of the writer's study on the embryology of this particular species of marine turtle. On August 8, 1951, two new nests were spotted and marked for daily observation. Unfortunately, however, the following day the egg-gatherers dug them out and took the eggs. On August 9, 1951 three new nests with the same age of eggs were marked and people were warned to keep off from them. These nests were lettered A, B & C. The eggs in nests A & B were counted and 50 were placed back in each hole for study. A daily sample of eggs was taken from Nest C. Nest C was not disturbed but it was used for daily materials for study. Nests A & B were opened weekly and two eggs from each nest were taken for comparative

developmental studies with those of Nest C. Unfortunately, however, Nest B was dug up by a dog, with all the eggs lost a few days prior to my departure from Taganak Island on September 12, 1951. On August 17, 1951, another new nest was marked and was not disturbed until September 12, 1951 when the eggs they contained were transferred into a can with sand and I had them brought to Zamboanga for further observation. During the course of my study and observation, it has been found that the development is very slow especially during the first three weeks. In order to complete the observation while in Taganak Island all old nests that were spotted by the egg-gatherers were properly marked and the age of the embryos was determined from their sizes and as indicated by the embryonic vascular system. Materials from these nests were studied and noted down. Later, comparative study with those of Nests A, B & C were made to ascertain the closest age estimated. All these old nests, about a dozen of them, were followed up daily and many of the eggs they contained hatched before I left the island. Other eggs were transferred from the nests to an empty kerosene can separately with sand and brought to Zamboanga for further observation. Some of the eggs hatched on the way and others were hatched in Zamboanga several days later. The estimated hatching period of the eggs from the different series of old nests spotted is 48 to 49 days which is very close to what was observed from the nests orginally spotted from the beginning. The remaining eggs in Nest C which were under observation almost daily up to September 12, 1951, when they were transferred into a kerosene can with sand and brought to Zamboanga for further observation, hatched on September 28, 1951, or a period of 51 days. Those of Nest A remained still unhatched on September 28, 1951. On October 1, 1951, 16 newly hatched turtles were found over the surface while others remained beneath. They might have hatched on September 29 or 30 but have remained beneath the surface for a while. It may be concluded therefore that the incubation period of the eggs of Chelonia mydas is from 51-53 days.

After hatching, the young do not go up the surface until after two or three days. The young are packed together with their heads oriented toward the surface in an inclined position. Apparently they move gradually and simultaneously pushing each other toward the surface. The few that may hatch later are liable to perish under the sand. Observations were made on few that were placed back into the nest to see if they could go up the surface singly. It was found that they could hardly push themselves upward. Even when the hole was opened, the couple could not climb up the sloping pile of sand.

On reaching the surface after hatching, the young turtles immediately run toward the sea. Some of them brought far inland struggled hard among the grasses to find their way to the sea-

shore. In a clean non-vegetated sandy flat, however, although rather far from the seashore, they easily find their way to the sea. This habit of the young turtle seems to be instinctive in nature. To further check this observation, some newly hatched young were let loose in Zamboanga behind the Fishery Station building after orienting them. They again tried to rush toward the seawall.

It is usually during night when the young go out from the nest to reach the sea. Not one was found leaving for the seashore during the day except those that were trapped inside the gasoline drum placed over the old nest under observation, which apparently went out of the nest the previous night. This may be an adaptation to protect themselves from their enemies when they make the journey to the sea. The dogs and monitor lizards are usually not around the spawning grounds at night.

Hatching of eggs in the nursery.—Newly laid eggs may be made to develop and hatch in the nursery ground other than the spawning ground. Observations were made on eggs transferred from the spawning ground to a nursery ground near the writer's quarter for the study of the development of this particular species of marine turtle. The eggs must be handled with care to insure 100% development. Eggs that were handled roughly and washed with sea water did not hatch. Eggs in more advanced stage of development need more care than the newly laid ones. When handled roughly the embryonic vascular system is liable to be injured. A tiny blood vessel that may be ruptured would cause the death of the embryo.

Enemies of turtles.—On land, the eggs and the newly hatched young are preyed upon by the dogs and the Monitor lizards. In the sea the young are preyed upon by big fishes and the sharks. The dog can locate the nest with its keen sense of smell and can dig it out easily with its forelegs.

The lizard uses its tail to spot the nest in the same way the egg-gatherers use their sounding rods in detecting same. Once the nest is found, the lizard uses its legs in digging up the eggs. The lizards are the most common and worst enemies of the turtle's eggs in the Baguan Island, the most productive of turtle's eggs among all the islets in the Turtle Islands.

There is a certain species of crab encountered in several turtle's nests that usually bore big holes below the tide mark. As to whether it also preys upon the soft-shelled eggs inside the nest could not be ascertained by the writer and needs further observation.

Besides the above mentioned enemies, man is also destructive because he can gather all the eggs either during the laying or after with some device to locate the hidden nests. The turtles, especially the egg-layers, are easy victims of man were it not for any regulation or law prohibiting people killing them for their meat.

APPROXIMATE NUMBER OF TURTLE EGG-LAYERS AROUND THE TURTLE ISLANDS

The number of mother turtles living in the waters around the Turtle Islands cannot be as many as estimated in the report of the Philippine Delegation in 1948. Inasmuch as the mother turtle lays eggs periodically at least weekly, the number of holes or nests recorded in a month does not represent the number of heads of turtles that laid their eggs in that particular month. The 10,954 number of nests estimated in a month in the said report were therefore actually built by around 2,738 mother turtles only. A mother turtle lays eggs several times in a year so it is really hard to figure out the number of egg-layers in the waters around the place based from the number of holes found each month.

Their number might have been reduced as a result of Japanese occupation because, according to reliable information, the Japanese butchered no less than 20,000 to 25,000 heads of egg-layers. The information gathered from fairly dependable sources by the members of the Philippine Delegation in 1948 gave their number to be about 150,000 individuals which apparently might have been exaggerated. Others gave the fair estimate of about 3,000 to 5,000 heads more or less.

ANNUAL PRODUCTION OF TURTLE EGGS

Since the administration of the Turtle Islands was returned by the British Government to the Philippine Republic in 1947, data on the annual production of turtle eggs have been based only on the records of the Deputy Treasurer of fees collected from the sales of the turtle eggs. The fee imposed is ₱15.00 per thousand eggs but not all sales reported so that data obtainable from the records are inaccurate.

During the months of high production usually from June to September, it is said that it is hard to send laborers to gather the eggs from the less productive islets because they are busy gathering eggs from the more productive ones, hence they are leased to some private individuals. In 1951 as well as in previous years these islets comprising the Langawan, Great Bakungan, Lihiman and Boaan were leased to a certain resident of Taganak for ₱150.00 monthly for three months representing a total municipal income of ₱450.00 for this period.

The only islet producing sufficiently large quantity for commerce is Langawan. The others, with the exception of Sibaung which is non-productive, production is so insignificant as to make exploitation hardly profitable. The poor production is due to the

present condition of the spawning grounds which are almost unfit for use because of the presence of piles of logs, uprooted trees, coconut husks and shells cast ashore, and of the fast growing vegetation and the roots of the coconut palms growing close to the edge of the tide mark. During the months of high production, Langawan alone gives no less than 1,500 eggs daily or 45,000 a month, representing an income for the lessee of P675.00 a month or P2,025.00 in three months as against the P450.00 paid to the Government under contract by a private individual. In this transaction, the government is losing about P1,575.00 or to be exact P1,050.00 because the egg-gatherers get one third from the entire income.

The monthly collections of the Deputy-Treasurer for the past four years, including part of 1951, are based on the inaccurate records from which the volume of eggs gathered from the entire group were computed. Consumption of the local officials, the army and the egg gatherers was not included in the report of sales collection. The number of eggs computed from the said collection, therefore, does not represent the accurate monthly production of eggs from the entire Turtle Islands group. Neither can the egg production from each islet be fairly estimated from the said report.

TABLE II. VOLUME OF TURTLE EGGS PRODUCTION IN THE TURTLE ISLANDS AS COMPUTED FROM THE REPORT OF THE DEPUTY TREASURER'S COLLECTION

Month	1947	1948	1949	1950	1951
January			10,020	5,500	8,500
February		99,806	3,500	4,000	770
March			2,000	8,444	6,661
April		39,800	4,900	33,300	21,314
May		44,200	21,012	43,996	43,061
June		19,300	41,902	96,834	83,686
July		357,886	104,149	128,264	184,847
August		121,000	55,150	192,389	203,845
September		93,460	102,540	205,351	
October		81,034	52,150	181,832	
November	3,200	63,600	25,000	36,467	
December		23,705	11,400	9,060	
TOTAL	3,200	724,011	433,223	963,437	532,484

TABLE III. DAILY RECORD OF NESTS AND EGGS GATHERED FROM AUGUST 8TH TO SEPTEMBER 11TH, 1951 IN TAGANAK ISLAND ALONE

1951	No. of Nest	Lowest No. of Eggs	Highest No. of Eggs	Av.	Total
Aug. 8th	38	60	150	112	4267
" 9th	45	51	175	110	4951
" 10th	31	41	127	104	3217
" 11th	43	33	164	112	4815
" 12th	34	62	132	104	3552
" 13th	34	18	162	105	3575
" 14th	36	81	151	107	3747
" 15th	34	73	147	105	3552
" 16th	31	66	171	114	3540
" 17th	37	64	158	111	4066
" 18th	38	64	163	113	4230
" 19th	46	38	144	100	4586
" 20th	54	51	226	119	6411
" 21st	38	56	136	106	4034
" 22nd	33	77	153	107	3521
" 23rd	31	54	138	96	2982
" 24th	43	80	189	105	4509
" 25th	44	39	170	102	4475
" 26th	42	43	167	105	4400
" 27th	51	70	143	117	5973
" 28th	52	43	165	111	5789
" 29th	37	42	159	104	3859
" 30th	51	63	155	108	5518
" 31st	49	52	167	100	4876
Sept. 1st	35	78	144	101	3540
" 2nd	39	71	166	101	3942
" 3rd	33	60	150	106	3492
" 4th	37	25	148	103	3814
" 5th	40	64	173	100	4018
" 6th	34	60	151	100	3388
" 7th	37	70	145	101	3753
" 8th	34	72	163	102	3457
" 9th	30	98	149	106	3169
" 10th	32	65	144	99	3165
" 11th	30	61	138	76	2291
TOTAL	1352	2025	5466	3682	137,254
AVERAGE	39.47	59.55	160.76	108.29	4,037

From the above daily record, an average of 4000 eggs was gathered in Taganak Island alone. Valued at P15.00 per thousand, it represents an income of P60.00 daily or P1800.00 monthly. Baguan Island which produces more than Taganak Island can easily give a return of no less than P2400.00 a month during the period of high production. Taganak and Baguan Islands may yield no less than P4200.00 monthly during the same period of high production, or P12,600.00 in three months. Langawan islet, the third in the group, produces no less than 1500 eggs daily or 45,000 eggs in a month, representing an income of P675.00 per month or P2,025.00 for three months. The three producing islands gave an income of P14,025.00 in three months. The remaining nine months of low production based on the 1950 report gave a total of 547,950 eggs valued at P8,219.25 from the entire group or an average of 60,883 eggs monthly representing an average monthly income of P913.25. The yearly income, therefore, from the entire group, not including the four other islets, is around P22,244.25 which is far below the estimates given by the Philippine Delegation in 1948. Deducting one-third from the income which goes to the egg-gatherers, the net return to the local government will be around P14,829.50 only. The egg gatherers, who render very little service for just a couple of hours a day, get the lion share from the entire income derived from the turtle eggs. At present the income derived from the turtle eggs in the Turtle Islands is far below the pre-war production when the group of islets was still under the administration of the North British Borneo for several obvious reasons speculated as follows:

1. Depletion of the marine turtle fauna during the Japanese occupation.

2. Neglected spawning grounds since the turning over of the group of islets to the Philippine Republic, which are fast becoming unfit for breeding purposes.
3. Inefficient administration by the local government official.
4. Grafts and irregularities on the part of the local official administering the sales of the turtle eggs.
5. Rapid increase of the natural enemies of the eggs, such as, the *Varanus salvator* in the most productive islet of Baguan and the dogs in the populated island of Taganak.

TABLE IV. ANNUAL COLLECTION FROM THE SALES OF TURTLE EGGS TAKEN FROM THE OFFICE OF THE DEPUTY TREASURER IN TAGANAK

Month	1947	1948	1949	1950	1951
January	—	—	₱100.20	55.00	₱ 85.00
February	—	₱ 968.06	35.00	40.00	7.70
March	—	—	20.00	84.00	64.61
April	—	396.00	49.00	333.00	213.14
May	—	442.00	210.12	439.96	430.61
June	—	196.00	414.02	968.34	336.86
July	—	1,576.66	1,041.49	1,262.64	1,648.47
August	—	1,210.00	551.50	1,923.39	2,038.45
September	—	934.00	1,025.40	2,053.51	—
October	—	810.34	521.50	1,818.32	—
November	₱32.00	436.00	250.00	564.67	—
December	—	237.05	114.00	90.80	—
TOTAL	32.00	6,340.11	4,332.23	9,634.37	5,239.84
Average per month		528.34	361.02	802.86	665.61

The yearly total collection shown above represents the two-third net income derived from the sales of the turtle eggs after deducting the one-third share given to the egg-gatherers. The collections in 1948 and 1949 were very irregular due to irregularities on the part of the local official who handled the collection, according to reliable information.

GATHERING OF TURTLE EGGS

The turtle eggs are usually gathered every morning from 6:00 a.m. to around 9:00 a.m. or earlier in Taganak by six laborers mostly recruited from Cagayan de Sulu by the administrator who was formerly connected with the Municipal Treasurer's office as Principal Clerk. This is the cause of a complaint of the old residents of Taganak Island who are more familiar with the work and are being deprived by the importation of unexperienced laborers. In Baguan island there are four laborers stationed in the place to gather the eggs every morning. One of them is an experienced resident who has grown up with this work and does not use the sounding rod in locating the eggs. By just tapping the surface of the sand where he thinks the nest is located he can locate the place with more accuracy.

The Langawan islet together with the rest of the low producing islets group during the months of high production were leased to

a private individual who hired laborers to gather the eggs. After the expiration of the lease the local administrator assigned four laborers to gather the eggs from these places which are near each other with Langawan as the provisional headquarters. They use a sailboat "Kumpit" from Taganak to Langawan and stay there for at least three days and gather the eggs from all the other islets. From Langawan they return to Taganak. They gather the eggs at least twice a week from the other islets of less production.

The gatherers are equipped with a jute sack, an iron sounding rod of about a meter long and a centimeter in diameter provided with a wooden handle and slightly knobbed at the other end for locating the nest, and a shallow coconut shell with a hole at the center. The shell is usually strung to the iron sounding rod when not in use.

In spotting the nest the gatherers are guided by the turtle's new trails. New trails are easily recognized below the tide mark since the older ones are usually obliterated by the previous receding tide. Above the tide mark in loose sand, the new trails may hardly be differentiated from the old ones especially after a hard rain. A mother turtle that goes up and down during the highest tide at night may hardly leave a trail for the gatherers to follow in locating the nest. Occasionally some nests are not found at all, giving the eggs a chance to develop and hatch. At times, however, some of these old nests are spotted later and the eggs are gathered for their personal use if they are not yet in the advanced stage of development.

Spotting nests above the tide mark in loose sand criss-crossed with numerous old trails and lettered with many old nests is hard but experienced egg-gatherers could find many of them by hit and miss method with their iron sounding rods. (Fig. 7). When the trails are clear the gatherers may recover the nest with one or two strokes only. The mother turtles going up far inland and laying their eggs among grasses inside bushes may not leave any trail for the gatherers to follow and their nests are liable to be missed. Eggs laid in such places, however, are easy victims of the lizards and dogs because they are not usually covered with mounds of sand.

It is very interesting to see how the experienced gatherers work with their iron sounding rods (Fig. 7). After tracing the upward and downward trails, they begin sounding the spot with the iron rod right on the place where the trails are obliterated by mounds of sand. By trusting their rods downward they can tell right away if they hit the hole or not by the absence of any resistance or obstructions when the knobbed end of the rod reaches the nest, or if they have thrusted the rod too far they could tell by any indication at the tip of the rod which might have punctured an egg or touched the moist eggs. With this indication showing the presence of eggs they start excavating the spotted nest

FIG. 7

with their shallow coconut shell until they reach the hole and bring up all the eggs with one of their hands.

The average depth of the hole is 60 centimeters although in some instances it may be over a meter or almost 2 meters deep including the mound of sand over it (See Fig. 4). Some holes are shallow, about 15 centimeters deep in harder ground inland with vegetation and are usually not covered with a mound of sand. These nests, however, are easy victims of their enemies and the eggs have very little chance of surviving.

MARKETING AND PRESERVATION OF TURTLE EGGS

Marketing of the turtle eggs is not a problem in Taganak except during the months of November to February when the southeastern wind prevails. This part of the year is a period of less production so it does not affect the market very much. During the months of high production, the eggs are already considered sold even before they are laid. There are many "kumpits" going to the place to buy the eggs. Apparently the demand is greater than the supply so the buyers have to stay several days or weeks before they can buy the turtle eggs. Few buyers are lucky to buy the eggs during a few days stay.

It is said that there is a good business in the turtle eggs these days. In Taganak the eggs are being sold for ₱15.00 per thousand. In Jolo they are sold for ₱40.00 per thousand. The buyers in Taganak bring the eggs to Jolo and make more than 100% profit. This is precisely the reason why there are many buyers

going to Taganak to buy the eggs. Before the turning over of the Turtle Islands to the Philippine Republic most of the eggs were marketed in Sandakan. At present, according to reliable information there is no market in Sandakan apparently because they have more supply than the demand due to the present situation in China when the market is closed because of the war. It is said that in Sandakan these days the turtle eggs are being sold for $18.00 per thousand. A Philippine peso (₱1.00) is worth 1.30 British Bornean dollar. The $18.00 per thousand in Sandakan, therefore, is still cheaper than ₱15.00 per thousand in Taganak, (₱15.00 = $19.50). The present price of the turtle eggs in Taganak is too low compared with the chicken's eggs.

There is no chance of losing the eggs even if they are packed and roughly handled because of their soft pliable shells. Because of the usual rough handling of the turtle eggs from the time they are gathered up to storage and transit they do not usually develop at all. Even some of these eggs gathered after development has started, may not continue while in transit because of the rough handling to which they were subjected. Normally the turtle eggs develop and hatch in no less than 51 days with very slow development in the first three weeks so that even if they continue developing while in transit they do not readily spoil.

The longer the eggs are kept the better for many consumers. They usually dry them under the sun before serving them to give better taste. Refrigeration, therefore, is not necessary to preserve them while in transit.

One practical way of preserving them indefinitely is by salting. Salting them for at least three days and later drying them under the sun are still the better way according to the experience of some consumers. Salting them with a cool boiled brine is apparently the best method of preserving them. It is also presumed that the yolk though much coarser than the yolk of chicken eggs can be powdered and canned for export or for future use.

RECOMMENDATIONS

1. The present Fisheries Administrative Order No. 23 entitled "Regulations establishing a closed season period for the conservation of turtles and their eggs in the Turtle Islands" be amended. Instead of making the closed season a rotation among the seven islets and confined only in the Turtle Islands, it should be applied to all over the Philippine Archipelago or have it confined to the whole Mindanao and Sulu Archipelago, including Palawan where the marine turtles are also found in abundance. The period of closed season may be either from April 1st to June 30th or from October 1st to December 31st, either yearly or every odd year.

The present closed season period from May 1st to August 31st in rotation to all the seven islets is defective. One of the seven

islets does not produce any turtle eggs and only three produce them in commercial scale, namely, the Baguan, Taganak and the Langawan Islands. The rotation system is hard to check unless one is detailed in that particular islet during the closed season, whereas if applied all over the Archipelago or localize it to the whole Mindanao and Sulu Archipelago including Palawan, it will be easier to have it enforced and to have it checked up wherever the eggs are marketed. Although the peak of the season is August, it is not necessarily advisable to have this particular month closed because there will be overlapping of nests and many eggs will be damaged and besides, it may deprive the government of its income and the market as well.

Considering the weather condition in the Turtle Islands the writer believes that the best period for a closed season will be from November 1st to March 31st yearly, which is the period of lowest production. With this period, the government will not lose much income and the market will not be affected either because during these months, according to information, no Kumpit could go to the place to buy the eggs. It is this part of the year when the problem of transportation is acute and it is said that many of the gathered eggs get rotten. With the fewer eggs laid during this part of the year there will be no danger of overlapping nests and the spawning grounds will not be overcrowded unlike during the peak of the season when there are at least 60 to 65 nests daily in Taganak Island alone.

During the open season not all the nests are spotted and many hundreds of eggs developed and hatched into young turtles which augment those that propagate during the closed season. During the five months of low production the average number of nests daily will be around 20 with at least 100 eggs each. In a month there will be approximately around 60,000 eggs and in five months there will be around 300,000 eggs. If we allow at least 25% of these eggs to survive to maturity there will be at least 15,000 turtles every year to augment the present turtle fauna of the place. This estimate is very conservative. It may be much more but not less. Adding those that may escape from the egg-gatherers during the open season there will be more turtles that will replenish the present fauna.

2. The gathering of turtle eggs should be confined only to the eggs of the green turtle, Chelonia mydas locally known as "pudno" and to the leatherneck turtle, Carreta olivacea. The eggs of these two species are recognizable by their bigger size compared with the very small eggs of the hawksbill turtle, Eretmochelys imbricata locally known as sisikan. Eggs in advanced stage of development or say at least 6 days old should be spared by the egg-gatherers. Turtle eggs at this stage are recognizable by the size of the white calcareous area of the shell. Newly laid eggs do not have the white calcareous area and a 6-day old developing egg has its shell covered with this white area to almost half the entire surface of

the egg. It should, therefore, be unlawful to gather the eggs under this condition. They should be allowed to develop and hatch into young turtles. When gathered, at this stage, the eggs cannot be commercialized because they just spoil and rot in transit. They may be gathered by the egg-gatherers for home consumption.

The small eggs of the hawksbill turtle should not be collected by any means. It should be declared unlawful to remove hawksbill turtle eggs from the nest and there should be no open season for them. This species of turtle is now very rare.

3. Butchering of the hawksbill turtle, should be absolutely prohibited irrespective of age and size. People with the necessary permit or license to remove the tortoise shells from this particular marine turtle must not kill the animal and should release it immediately to the sea after the scutes are removed.

The very old green turtle and the leatherneck turtle may be allowed for butchering when used for food upon certification by any competent official of the Bureau of Fisheries, an Army Officer of the Philippine Constabulary or other reliable officials who may be allowed to issue such certification on the part of the Secretary of Agriculture and Natural Resources. Very old green turtle that does not lay eggs anymore may be recognized by its dark worn out carapace with many chitinoid outgrowth of the scutes, the growth of foreign animals like oysters, rock barnacles, etc. on its back. The scutes of the carapace may be worn out also due to old age. All these characteristic features of an old turtle are due to complete absence of copulation when the male turtle no longer rubs and cleans its back. The younger female turtles before copulation have their carapaces robbed and cleaned by the male turtles with their appendages, making them smooth and shiny.

Green turtles of old age are already useless from the standpoint of egg laying. They only obstruct and crowd the useful younger egg-layers of their spawning grounds. From actual observation even if they do not lay eggs anymore, they still go up to the spawning ground apparently due to the instinct of egg laying. Butchering young turtles and small ones should be absolutely prohibited by law.

4. The spawning grounds should be kept clean and levelled all the time. Pile of logs, uprooted trees, coconut husks and shells and vegetation are great obstruction to the egg-laying turtles. The spawning grounds in the other islets like the Great Bakungan, Lihiman and others have already outlived their usefulness because of these obstruction. (Fig. 3) This explains why very few turtles go up these places to spawn. In Taganak and Baguan islands are similar obstructions found all over the group of islets but the spawning grounds are more extensive hence there are still many turtles that go up to these places. If nothing is done to clean and clear all the spawning grounds in these islets, eventually the turtles will be

looking for more suitable places somewhere else where to breed. In fact many of them apparently are spawning in the neighboring islets and the mainland of Borneo which are very close to the Turtle Islands. The British government keeps the spawning grounds always clean and clear of the obstructions. This explains why the turtle spawning grounds in the British North Borneo are more productive.

5. Fishing with lights proves a great annoyance to the spawning turtles during dark nights. No fishing with luminous lights should be allowed within 500 meters from the water edge in any islet of the Turtle Islands, in the Bankawan islet of the San Miguel group, in the Sulu Archipelago, and in other places like Palawan where marine turtles spawn.

6. The newly hatched young should be protected by impounding them for some time in concrete tanks or improvised marine ponds connected to the sea until they are big enough to protect themselves from their many enemies. In Taganak Island as well as in the other islets it will not be expensive to construct an impounding marine pond or aquarium because of the nature of the ground which is partly sandy and because of the presence of fresh water below the surface of around a meter and a half in depth which will naturally prevent seepage. In Taganak Island particularly, there are already concrete tanks which are just about twenty meters away from the sea. Some of them are ready for use once connection is made with the sea, others need little deepening. There are several of these concrete tanks already abandoned which can be easily acquired by the present administration without cost.

Feeding the impounded turtles is not a problem because the young as well as the adults feed on seaweeds which are abundant around the place. The newly hatched young can be fed with the fragments of coconut husks, chopped fish and fine seaweeds. The young can be easily gathered as they come out from their nest by placing wooden traps or open gasoline drum over the nest before hatching.

7. If the turtle fisheries cannot be administered directly by the Bureau of Fisheries it will be advisable to request the Commander of the Philippine Constabulary detachment to administer it for the Director of Fisheries or to supervise the local administration in order to avoid irregularities in the collection of sales, etc.

8. A certain sum should be appropriated from the income derived from the sales of the turtle eggs for the acquisition of an outboard motor launch for the use of the Bureau of Fisheries personnel in the administration of the collection of turtle eggs, rehabilitation and improvements of the different spawning grounds, and patrol work.

9. The present selling price of turtle eggs should be increased from ₱15.00 to ₱20.00 per thousand.

10. The share-basis payment for the egg-gatherers should be abolished and laborers employed under the daily wage system, who should be required to render the required number of working hours and be made to clear and clean the spawning grounds of any obstructions.

11. If the Government ever leases the spawning grounds to private individuals, it is recommended that the six islets, with the exception of Sibaung which is all rocky, should be leased as a whole. The six islets are not equally productive so that if a concessionaire is allowed to lease one or two of the islets, the remaining ones can not be leased at all under the same concession fee and consequently the group should be offered for lease as a whole irrespective of the amount of production of each islet. If the concessionaire is allowed to select only the three productive islands, the only available lineal kilometers that can be leased will not be more than three, and at the rate of ₱4,000.00 per kilometer, the Government can get only ₱12,000.00, whereas if the Government will administer it efficiently the income will be much greater after the entire group is properly rehabilitated.

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P.I. SHELLS USED IN BUTTON MANUFACTURING AND THE P.I. BUTTON INDUSTRY

By JOSE R. MONTILLA
and
CRESCENCIO R. DIMEN
Bureau of Fisheries, Manila

There are four kinds of shells from Philippine molusks that go into the manufacture of shell buttons. These shells are: the gold-lip pearl shell, *Pinctada maxima*, commonly known as "M.O.P." or "gold-lip"; the black-lip pearl shell, *Pinctada margaritifera*, commonly known as "black-lip"; the top shell of which there are four species used, viz., *Trochus niloticus*, *Trochus maximus*, *Trochus obeliscus*, and *Trochus nodiliferus*, all of which are commonly known as "trocas"; and the turban shell, *Turbo marmoratus*, commonly known as "green snail" or "turbo."

Most of these shells are found in fairly large quantities throughout the Philippine Archipelago. The gold-lip pearl shell is found in waters from five to forty meters in depth. The entire Sulu Archipelago is one extensive pearling bank, and is considered the largest and the most prolific in the country. Other known fishing banks are: Davao Gulf and Illana Bay in Mindanao; Cagayan de Sulu, Palawan, Cuyo, Bohol, Cebu, Bantayan, Masbate, Ilacaon, Gigantes, and Guimaras Islands; New Washington, Balasan, and Estancia in Panay; Masinloc Bay in Zambales; the western and northern coasts of Samar; Cape Engano, Polillo Islands; and the Batan Group.

The black-lip pearl shell is more widely distributed than the gold-lip. It is common in waters from two to thirty meters in depth. The most important grounds are in the Sulu Archipelago; Cuyo Islands; Bohol, Tanon Strait, Cebu, and Bantayan; the northern coast of Negros and the southern and eastern coasts of Guimaras Island; Balasan and New Washington in Capiz; around Masbate, Leyte, Samar, Sibuyan, and Mindoro; in some bays along the coast of Zambales and in Lingayen Gulf; along the shores of Cagayan, Quezon, and the Bicol Peninsula; and the Batan Islands.

The top shells are found in abundance in the waters of two to fifteen meters in depth, around many of the islands in the country. They usually inhabit the edge of coral reefs and rocky shoals. Commercial quantities of these shells are taken from the shallows of the Sulu Archipelago; in Davao Gulf, along the east coast of

Mindanao; the north and west coast of Palawan; around Fuga, Polillo, Cuyo, Bantayan, and Cebu; along the east coast of Bohol; the north and west coast of Negros; around Lingayen Gulf; along the coasts of Ilocos Sur, Ilocos Norte, Cagayan, Quezon, and the Bicol Peninsula; and the northern coasts of Mindoro and Lubang Islands, the east coast of Leyte and Sibuyan islands.

The green snail shell is also found throughout the country. It is found in almost all coral reefs, rocky shoals, and coasts in waters several meters deep. Fishing grounds of importance are the islands in the Sulu Archipelago; the north and west coasts of Palawan; all the islands in the Visayas; the coasts of Pangasinan, Cagayan, Quezon, Camarines Norte, and Camarines Sur.

No historical records give accounts that shells from these mollusks were treated as products of commerce during the Spanish regime. Early Spanish historians have references to the uses made of different Philippine shells, but no inference could be drawn from these that the use of any of the shells now employed in the manufacture of buttons were gathered in commercial quantities. For this reason it can safely be said here that it was not until the American regime that shells from these mollusks were gathered in commercial quantities.

American button manufacturing interests which were in search for shells to feed their button machines afforded the stimulus which stirred up local interest into gathering these shells on a commercial scale. Local interest responded splendidly and in no time, the Philippines was producing quantities of shells that went into the export trade. Exports of shells grew considerably with increased production that in but a few years, the Philippines was recognized in the world market as a supplier of this raw material.

Shell gathering activities took firm roots in the Philippine economy as a distinct industry. There were considerable numbers of families directly dependent on this industry for their livelihood.

A new twist in the economic significance of this industry took shape with the establishment of the first shell button factory in the country, under the name of Koppel B. Newman, in 1911. Exports of Philippine shells suffered a big drop—shells which, otherwise, would have been exported were retained in the country and were used up to meet raw material requirements of the newly established button factory. The resultant decrease in income, a consequence of decreased shell exports, was, however, more than counterbalanced by increased income originating from shell button exports.

The industry fared well until 1932 and 1933 when a shortage of shells slowed down production. The government took concern

in the plight of the industry and had fieldmen investigate the cause of the shortage. From the reports and recommendations turned in of the findings, the Government took action to remedy the situation by effecting the passage, on November 2, 1935, of the Fish and Game Administration Order No. 11, "Rules and Regulations for the Protection of Marine Mollusca."

Shell production picked up again by 1934, and the three button factories then existing, viz., Philippine Button Corporation, New York —originally under the name Koppel B. Newman Shell-Craft Button Corporation, and Manila Pearl Button Corporation, were all busy manufacturing buttons for exports when war came in 1940.

From interviews made of persons previously connected with these factories, it was gathered that, aggregatively, the monthly payrolls of these factories which, all together, employed some 470 employees, amounted approximately to P20,000.00. The aggregate production capacity per month, of these three factories was around 78,000 gross of buttons. Most of the shell buttons produced found their way into the export trade and only about 5% of the total production were sold in the local market.

Tables I and II show some facts about the shell and button industries immediately before the outbreak of the last war.

TABLE I.—QUANTITY AND VALUE OF M.O.P., TROCA AND SNAIL SHELLS EXPORTED: YEARS 1939 AND 1940

YEAR	M.O.P.		TROCA		SNAIL	
	Qty.	Value	Qty.		Qty.	Value
	Kilogram	Pesos	Kilogram	Pesos	Kilogram	Pesos
1939	14,630	1,352	116,888	38,265	1,740	1,270
1940	56	72	12,239	3,541	—	—

Source: Census of the Philippines, 1940.
Note: —, Symbol used for "nil."

TABLE II.—QUANTITY AND VALUE OF SHELL BUTTONS EXPORTED WITH ESTIMATE OF SHELLS USED IN THEIR MANUFACTURE: YEARS 1939 AND 1940

Year	Quantity	Value	Estimate of Shells Used
	Gross	Pesos	Kilograms
1939	808,106	541,055	525,330
1940	505,144	462,354	329,030

Source of basic data: Census of the Philippines, 1940.

With the entries in Tables I and II as bases, and assuming that all shells produced went into the manufacture of shell buttons, 95% of which went into the export trade and 5% into the domestic trade, and the rest exported as raw shells, it is estimated that

the total shell production, i.e., production of M.O.P., troca and snail shells taken together, was around 686,000 kilograms in 1939 and around 359,000 kilograms in 1940. From these estimates it can be established that in 1939, 81% of the total shell produced went into the manufacture of shell buttons, and in 1940, 97%.

The shell and button industries suffered a big set-back with the last war. The destruction and chaos churned up in the wake of the war did not spare these industries. Gathering paraphernalia and boats were either lost or destroyed, and of the three button factories, then operating, two were destroyed and the third, the Manila Pearl Button Corporation, rendered inoperative. During all the four years of the Japanese occupation, shell gathering activities and button manufacturing lapsed into a state of paralysis.

Immediately after cessation of hostilities however, motivated by big demands for raw material in shell button factories in the United States, shell gathering activities were resumed. Before long, the shell industry was back on its pre-war footing. With the shell factories, it took some time before they could start operation. The Shell-Craft & Button Corporation, first factory to operate after the war, started manufacturing buttons in October of 1946 but did not export until the next month. Although it appeared in "Shell Button Industry in the Philippines" by R. E. Racela, that the Philippines exported 30,405 gross of shell buttons in 1945 investigation of the fact revealed that what was exported were shell button blanks produced before the outbreak of the war.

In Table III may be culled how fast shell gathering activities recovered from its wartime paralysis.

TABLE III.—QUANTITY AND VALUE OF GATHERED M.O.P., TROCA AND SNAIL SHELLS: YEARS 1946 TO 1951

YEAR	M.O.P.		TROCA		SNAIL	
	Qty.	Value	Qty.	Value	Qty.	Pesos
	Kilogram	Pesos	Kilogram	Pesos	Kilogram	Value
1946	304,000	486,400	811,770	282,237	48,913	9,783
1947	433,902	650,853	360,810	301,284	36,428	7,286
1948	309,411	407,293	615,750	215,513	39,804	7,961
1949	247,471	292,016	351,281	122,941	27,296	5,585
1950	325,195	390,234	558,784	212,338	48,612	11,667
1951	401,607	481,208	687,274	261,164	78,386	18,813

Source: Division of Commercial Fisheries, Bureau of Fisheries.

Foremost among post-war dealers of shell are the names: Yap Yet, Kummer & Comins, Arsencio Siy, Philippine Shells & Company, and Philippine Industrial Raw Products. Except for Yap Yet, who was in the business even before the war, all the rest of the named dealers went into the business only after the war.

in the plight of the industry and had fieldmen investigate the cause of the shortage. From the reports and recommendations turned in of the findings, the Government took action to remedy the situation by effecting the passage, on November 2, 1935, of the Fish and Game Administration Order No. 11, "Rules and Regulations for the Protection of Marine Mollusca."

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Tables I and II show some facts about the shell and button industries immediately before the outbreak of the last war.

TABLE I.—QUANTITY AND VALUE OF M.O.P., TROCA AND SNAIL SHELLS EXPORTED: YEARS 1939 AND 1940

YEAR	M.O.P.		TROCA		SNAIL	
	Qty.	Value	Qty.		Qty.	Value
	Kilogram	Pesos	Kilogram	Pesos	Kilogram	Pesos
1939	14,630	1,352	116,950	38,265	1,740	1,270
1940	56	72	12,239	3,541	—	—

Source: Census of the Philippines, 1940.
Note: —, Symbol used for "nil."

TABLE II.—QUANTITY AND VALUE OF SHELL BUTTONS EXPORTED WITH ESTIMATE OF SHELLS USED IN THEIR MANUFACTURE: YEARS 1939 AND 1940

Year	Quantity	Value	Estimate of Shells Used
	Gross	Pesos	Kilograms
1939	868,106	541,665	525,330
1940	506,144	462,354	329,630

Source of basic data: Census of the Philippines, 1940.

With the entries in Tables I and II as bases, and assuming that all shells produced went into the manufacture of shell buttons, 95% of which went into the export trade and 5% into the domestic trade, and the rest exported as raw shells, it is estimated that

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YEAR	M.O.P.		TROCA		SNAIL	
	Qty.	Value	Qty.	Value	Qty.	Pesos
	Kilogram	Pesos	Kilogram	Pesos	Kilogram	Value
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Foremost among post-war dealers of shell are the names: Yap Yet, Kummer & Comins, Arsencio Siy, Philippine Shells & Company, and Philippine Industrial Raw Products. Except for Yap Yet, who was in the business even before the war, all the rest of the named dealers went into the business only after the war.

Table IV shows how much of the gathered shells, appearing in Table III, were exported as raw material. Except for a negligible amount which were exported to other countries, all shell exports were shipped to the United States.

TABLE IV.—QUANTITY AND VALUE OF M.O.P., TROCA AND SNAIL SHELLS EXPORTED: YEARS 1946 TO 1951

YEAR	M.O.P.		TROCA		SNAIL	
	Qty.	Value	Qty.	Value	Qty.	Value
	Kilogram	Pesos	Kilogram	Pesos	Kilogram	Pesos
1946	253,333	339,752	676,475	495,740	23,365	16,850
1947	361,585	750,043	717,342	518,912	30,357	19,706
1948	315,917	671,174	314,287	197,434	23,997	13,641
1949	89,907	172,009	40,636	20,776	4,140	2,202
1950	244,054	495,911	138,678	91,258	...	...
1951	292,240	750,979	125,256	114,469	27,672	26,615

Source: Division of Commercial Fisheries, Bureau of Fisheries.
Note: Symbol used for "nil."

There are six button factories operating at present, all of which are located in Manila and its suburbs. Except for two factories, Shell-Craft & Button Corporation and Manila Pearl Button Corporation, which were established before the war, the rest, viz., L. R. del Rosario Button Works, Pacific Pearl Button Factory, Philippine Buttoncraft, and Philippine Shells & Company were established only after the war. The Philippine Shells & Company, which actually is a button blanks factory and not a full-pledged button factory, operates a subsidiary button blanks factory in Zamboanga.

From interviews with persons connected with these factories, it was learned that the total number of employees in all 6 factories is 565, aggregate amount of the monthly payrolls was around ₱50,000.00, and the aggregate production capacity per month, around 110,000 gross of buttons.

Except for Philippine Shells & Company which is responsible for all button blanks exported, as appear in Table VI, all other button factories contributed their share in the export of shell buttons appearing in Table V.

TABLE V.—QUANTITY AND VALUE OF SHELL BUTTONS EXPORTED WITH ESTIMATE OF SHELLS USED IN THEIR MANUFACTURE: YEARS 1946 TO 1951

Year	Quantity	Value	Estimate of Shells Used
	Gross	Pesos	Kilograms
1946	...	1,825	...
1947	...	1,334	...
1948	1,556	1,440	1,040
1949	21,332	31,841	13,910
1950	155,899	187,038	101,335
1951	190,618	226,271	124,602

Source: Division of Commercial Fisheries, Bureau of Fisheries.
Note: ..., Symbol used for "not available."

TABLE VI.—QUANTITY AND VALUE OF SHELL BUTTON BLANKS EXPORTED WITH ESTIMATE OF SHELLS USED IN THEIR MANUFACTURE: YEARS 1946 TO 1951

Year	Quantity	Value	Estimate of Shells Used
	Gross	Pesos	Kilograms
1946	...	40,139	...
1947	81,675	143,234	53,105
1948	363,081	697,707	236,015
1949	314,037	604,371	204,165
1950	602,257	1,023,051	391,495
1951	610,533	1,012,659	396,899

Source: Division of Commercial Fisheries, Bureau of Fisheries.
Note: ..., Symbol used for "not available."

An analysis of Tables III, IV, V and VI shows that a considerable amount of the shells produced, i.e., those appearing in Table III, are not accounted for in Tables IV, V and VI. These apparently unaccounted for shells made up the raw materials used in the manufacture of shell novelties, such as, M.O.P. tablewares, shell napkin rings, shell flower vases, shell lamps, shell pins, etc., and also those used in the manufacture of shell buttons which were not exported but were used locally. In addition, there were shells confiscated by the Bureau of Fisheries for not satisfying the minimum requirements prescribed in the Fisheries Law. Lastly, it can not be overlooked that some of the shells appearing in Table III were, prior to packing them for exports or prior to their manufacture into buttons, were discarded when they were found to be "dead" shells and therefore, of no industrial value.

An analysis of Tables IV, V and VI shows that, unlike in pre-war time, more shells were exported as raw material than were manufactured into buttons. In 1939 and 1940, 86% of the total shell produced went into the manufacture of buttons and 14% into the export trade as raw material exports. While the percentage of shells used in button manufacturing is greater than that which were exported as raw material during the pre-war period, post-war period presents an altogether different picture. During the four-year period, 1948 to 1951, only 42%[1] of the total shells produced went into the manufacture of buttons and 43% exported as raw material.

This situation is bitterly criticized by local button manufacturers on the ground that while they are having a hard time to procure raw material to keep their factory going continuously, a lot of shells are being exported out of the country. The duty free quota of 850,000 gross of buttons to be admitted yearly into the United States has never been filled by local button manufacturers on this account. Given enough shells, manufacturers contend they could easily produce over a million gross of shell buttons a year.

1 Export of shell buttons represents only 95% of total manufactured, the remaining 5% went to domestic consumption.

Projecting one's vision into the future, one cannot fail to perceive the dark cloud lying low over the button industry. The characteristic high production cost obtaining in Philippine industries has predisposed the shell button industry to an unfavorable position in international trade. Philippine manufactured shell buttons are highly priced, a consequence of high production cost, that only the United States, on account of the existent free trade relationship it has with the Philippines, could afford market for them. At present, although covered with duty-free quota protection, Philippine shell buttons in the United States encounter stiff competition with duty-paying shell buttons manufactured in Japan, England, France, Italy and other countries. It is not hard to imagine what the plight of the industry would be when the free trade relationship between the United States and the Philippines is terminated.

Unfortunately, the Philippine Trade Act of 1946 was ratified in the United States Congress. Under that Act free trade between the United States and the Philippines will come to an end in July, 1954, and thereafter United States duties on Philippine goods will be progressively levied.

The dark cloud settles lower with each passing year after 1954. Beginning in 1955, by virtue of the Act, the duty free quota will be reduced annually by 5%, so that by 1974, the quota will have been reduced to nil. This means that by 1974, all shell buttons entering the United States from the Philippines will have to pay duty.

With this in view, Philippine button factories stand the possibility of closing up unless raw material and manufacturing costs improve, or unless new and better markets are found, or unless a favorable revision of the Philippine Trade Act of 1946 with respect to the quota provision on shell buttons is effected.

COMMERCIAL MISCELLANEOUS AQUATIC PRODUCTS AND THEIR USES

By CLARO MARTIN
Bureau of Fisheries, Manila

Philippine waters have, for the past several decades, been yielding various commercial products besides food fishes. Some of these products have occupied positions in both foreign and local trades. Economic changes and technological progress after the recent war have affected the trade of these products.

INDUSTRIAL SHELLS

Considered the most important of Philippine aquatic products are the industrial shells. It is probable that shells of Philippine mollusks have been put to many and varied uses even during the pre-Spanish era of Philippine history, although their exploitation to a commercial extent did not take place until during the second decade of the present century.

There are several kinds of commercial shells that are gathered in Philippine waters, namely, the gold-lip pearl shell (*Pinctada maxima* (Jameson), black-lip pearl shell (*Pinctada margaritifera* Linn.), top shell or troca (*Trochus niloticus* Linn.), window shell (*Placuna placenta* Linn.), the green snail shell (*Turbo marmoratus* Linn.) and the chambered nautilus (*Nautilus pompilus* Linn.). All these shells are used in the manufacture of pearl buttons. Large quantities of these shells are gathered annually and a sizeable amount are exported either as raw shells or in the form of finished and blank buttons.

The gold-lip, black-lip, top shell, turban shell and the nautilus have a wide range of distribution and are observed to occur more frequently in the southern waters of the Archipelago. Of these waters those of Southern Mindanao and the Sulu group are most productive. All these four commercial shells, besides serving as main raw materials for the manufacture of buttons, are turned into various objects of many uses for the office, the home and for personal purposes, especially ornaments.

To appreciate the importance of the gold-lip, it is of interest to note the properties of this shell, which is reported to consist principally of calcium carbonate in crystalline form and other materials, notably conchiolin, a protein material. It is greatly prized for its special qualities of hardness and durability. Its beautiful

lustre makes it suitable for ornaments and knick-knacks of various kinds. It is not susceptible to changes in temperature, humidity and atmospheric pressure.

According to Talavera (1930), pearl fishing, which is the second most important industry in the Sulu Archipelago, produces most of the shells and pearls for export from the Philippines. Sulu pearls are well-known in foreign markets like Singapore, Paris and London. French pearl dealers have been known to come to Zamboanga and Jolo to buy pearls. Seale (1916) stated that it is well-known that the Philippine beds yield a far greater percentage of pearls than the Australian or the Celebes fisheries.

The pearl shells are also known to yield blister pearls, besides the natural rounded pearls produced by the animal. Blister pearls are cut from the shells following the shape and size of the blister occurring on the shell itself. These pearls, being irregular and of varied sizes, are used for brooches, pins and pendants.

The window shells are known to occur from the waters of northern Luzon down to the Sulu Archipelago in the south. They are, however, found in definite localities in the waters of the eastern and western sides of Manila Bay, Pangasinan, Bohol, Occidental Negros, Guimaras Island, Iloilo, Masbate, and Capiz, and along the shores of small islands near Basilan and in Buan Island in the Tawitawi Group of Sulu.

Bacoor Bay in the eastern part of Manila Bay seems to be the richest window shell bed. The town of Kawit on the eastern shore of Manila Bay is the center of window shell fishing. A sort of artificial cultivation of window shell is carried on along with the oyster cultivation in the beds of this locality.

This shell has long been utilized in the Philippines as window panes. By actual laboratory test at the Bureau of Science (now Philippine Institute of Science) it was found that window shell is much stronger than plate glass of 3 mm. thickness. The windows in some of the old churches and convents in the pre-war Walled City of Manila and in some of the old convents, churches and residences in the provinces are proofs of the durability of this shell. It is translucent and has been found to have a low ultra-violet ray transmission. It admits a soft diffused light which is not glaring to the eyes. This characteristic makes it suitable for window panes especially in tropical countries where the glare of the sun is rather intense.

In spite of the modern architectural trend in house construction, this window shell has remained a steady item in the list of Philippine current construction materials. It is still used for window panes. It is manufactured into shell craft products such as screens, lamp shades, paneling, trays and innumerable other novelties for the home and office. It is claimed that the present export

of this shell is utilized by U.S. importers for the manufacture of pearl essence for pearl beads.

REPTILE SKINS

The Philippine commercial reptiles comprise the sea snakes (*Laticauda semifasciata*, *L. laticauda* and *L. colubrina*), the common monitor lizard (*Varanus salvator*) and the crocodiles (*Crocodilus palustris* and *C. porosus*). Sea snakes are widely distributed in Philippine waters. A species, **L. semifasciata**, was discovered to inhabit the partly submerged caves of Gato Islet, northwest of Cebu as its breeding ground where they are caught by the thousands. The crocodiles are found in rivers and lakes, especially in sparsely populated regions. Rich crocodile catching grounds are found in Palawan and Mindanao. The monitor lizards are present in large islands of the Archipelago.

Exported reptile skins are mostly in the form of salted raw skins. In pre-war years a German leather curer in Manila used to export reptile leather and manufactured reptile leather products to Europe and the United States.

Reptile skins are manufactured into fine leather which is used in making quality and novelty leather goods. Crocodile leather is a good material for traveling bags, ladies' handbags, portfolios, billfolds and shoes. Lizard leather is usually made into ladies' handbags, shoes and billfolds. Snake skin leather is suitable for belts, billfolds, cigarette cases and other novelty articles.

COMMERCIAL ECHINODERMS

There are two groups of echinoderms of commercial importance in the Philippines, the holothurians or sea-cucumbers and the starfishes. The common commercial names for the dried bodies of sea-cucumber are beche-de-mer, *trepang* and *balatan*. Many species of holothurians occur in Philippine waters. They are widely distributed throughout the islands, and are found mostly in sandy littoral areas and reefs, most abundantly in the Sulu Archipelago. About 12 species of commercial value are gathered and dried. The most common species fall under the following genera: *Actinopyga*, *Argiodia*, *Holothuria*, *Microthele*, *Stichopus* and *Thelenota*.

Beche-de-mer used to be an important export of the Philippines to China where they were used as important articles of food served in restaurants. It has a characteristic taste which is particularly appealing to Oriental people especially when served in soup dishes. Proximate chemical analysis of two common varieties show the following composition:

Moisture	8.33 — 15.55%
Ash	17.32 — 41.30%
Protein (N x 6.25)	40.51 — 51.60%

The supply of beche-de-mer for the Manila dealers and exporters come from Leyte, Polillo island and the Camarines provinces while the Sulu Archipelago supplies direct exports to Singapore and Hongkong. In 1925, 200,614 kilograms valued at 122,622 pesos were exported. Immediate pre-war export figures are not available. World War II disrupted the export trade on this item. It was resumed sometime in 1947. The following year, the exportation of beche-de-mer started to decline because of tariff restrictions. It was considered a luxury food item.

Starfish of various species are found in many littoral areas of Philippine waters, especially in the reefs of the Sulu Archipelago. Feed problem in the Philippine poultry industry and the findings in the United States on the possibilities offered by this marine animals after it is reduced into meal spurred the gathering of starfish in 1948. Starfish meal is utilized as protein supplement when used in laying mash and to supply the needed calcium.

SHARK PRODUCTS

While there are thirty six species of sharks recorded in the Philippines, a systematic shark fisheries industry has never been developed in the Archipelago. Fishing for sharks is done primarily for the fins. The drying and curing of shark fins for export to China used to be a profitable minor industry in the Sulu Archipelago.

Warfel and Clague (1950) stated that the chief commercial utilization of sharks before World War II was an export business of the fins which amounted to 8,223 kilograms in 1939. This trade which was renewed in 1946 with a production of 9,699 kilograms, is currently suspended due to import restrictions in China, its former principal outlet.

The meat from large sharks are seldom eaten by Filipinos. The meat of young sharks and small rays are, however, relished by many. It will be noted also that large rays are also fished for the fins. In certain places, especially fishing villages, the oil from livers of sharks and large rays is used for lighting in the homes and in the painting of water crafts. Shark oil is not exploited commercially. Investigations undertaken by the erthwhile Philippine Fishery Program, of the U.S. Fish and Wildlife Service in which the liver oil of fourteen species of sharks have been analysed show that a large-scale shark fishing for vitamin A oil cannot be recommended.

Dried shark fins are classified according to color, size and variety. Big dorsal fins and sometimes large caudal fins of uniform color are classed as "white fins". The rest are classed as "black fins". These fins are soaked in boiling water for a short time and the skin is removed to expose the cartilage. The cartilage

is then shredded into small rods which resemble spaghetti. These rods are served in soup dishes in Chinese restaurants.

MARINE TURTLES

The principal species of Philippine marine turtle of commercial importance are the green turtle, *(Chelonia japonica* (Thunberg), the hawksbill turtle *(Eretmochelys imbricata* (Pennant) and the loggerhead, *(Carreta olivacea* (Eschscholtz). These three species seem to be fairly well distributed throughout Philippine waters.

Spanish historians as early as the beginning of the 17th century had it on record that fisheries of fine-shelled turtles already existed during that period and that turtle shells were utilized and sold as articles of commerce. About two or three decades ago the tortoise-shell of commerce, which consisted of the bony plates taken from the carapace of the hawksbill turtle, was an export item. However, at present, while the turtle fisheries still retains its importance as a segment of the country's economy, its main product, the tortoise shell, seems to have lost its role in the Philippine export trade.

The center of the Philippine turtle fisheries is the Turtle Islands, a group of seven islets lying on the southern rim of the Sulu Sea near Borneo. The marine turtles crawl up the sandy shores of these islands and deposit their eggs which are gathered as the main product of the fisheries. Domantay in his study of the turtle fisheries of the Turtle Islands observed that although marine turtles breed throughout the year most turtle eggs are gathered from June to September. The eggs are transported by fast sailboats to Jolo. It is said that before the transfer of the administration of the Turtle Islands to the Republic of the Philippines in 1947, most of the eggs were marketed in Sandakan, Borneo, from where they were exported to China. The Moros use the turtle eggs as one of their staple foods. These eggs are also relished by the Chinese for food, more so for its acclaimed revitalizing properties. Turtle eggs are also gathered in small islands in the Sulu Sea as Cavili, Arena, Lumbucan, Bancoran, San Miguel and others.

Tortoise shell is made into combs. There are still Chinese shops in Manila, Zamboanga and Jolo where hand-made combs are made out of this beautiful materials. Turtle meat is commonly utilized for food by the inhabitants of the Sulu Group but rarely in other places of the Philippines. It is said that during World War II a considerable number of egg-laying turtles of Turtle Islands were butchered by the Japanese apparently to bolster their food production effort.

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FISHING WITH "BOMBON" IN BATANGAS PROVINCE

By BIENVENIDO Y. DATINGALING
Bureau of Fisheries, Manila

TWO TEXT FIGURES

INTRODUCTION

Bombon is defined as "a general term for fish shelters made of twigs, grasses, water hyacinths, etc., which lure fish seeking food and cover" (Umali, 1950). In Batangas Province, the bombon has become an auxiliary fishing unit very useful to the basnig or bag net.

The use of twigs, plants or any usable material for fish shelter in shallow waters of wading depth to aid in the catching of fish is an old practice in the Philippines. Some years before the outbreak of World War II, the construction of bombon in deeper waters was introduced in the municipality of Taal, Batangas by some transient fishermen from the Visayan Islands. The development of the unit was interrupted by the outbreak of war in 1941. In the later part of 1947 the use of the bombon was resumed by the local fishermen of Taal. It is now of commercial importance to the fishery of Batangas Province, especially in Balayan Bay.

It is estimated that there are about 300 units actually in use which represent a total annual investment of around ₱10,000. At present majority of the bombon are concentrated along the coastal waters from 70 to 100 fathoms deep in the municipalities of Taal and San Luis.

DESCRIPTION

There are two kinds of bombon depending on the type of floats used (See figs. 1 and 2). Of the two types, the one shown in fig. 1 is the most common.

The typical bombon has the following parts: fish shelter, float, main line, and weight. Twigs and grasses are also used, but the use of coconut leaves is common because the material is easy to secure and affords better shelter for the fish. The types of float used are the (1) vertical float and (2) horizontal raft type float. An entire piece of bamboo of about 11 fathoms long by 4-3/4 inches diameter at the base can be made into a vertical float. If this size of bamboo is not available, two or three entire pieces of small-size bamboo are tied together from end to end to form a similar float. In the case of the horizontal raft type float, six to ten pieces of bamboo of about

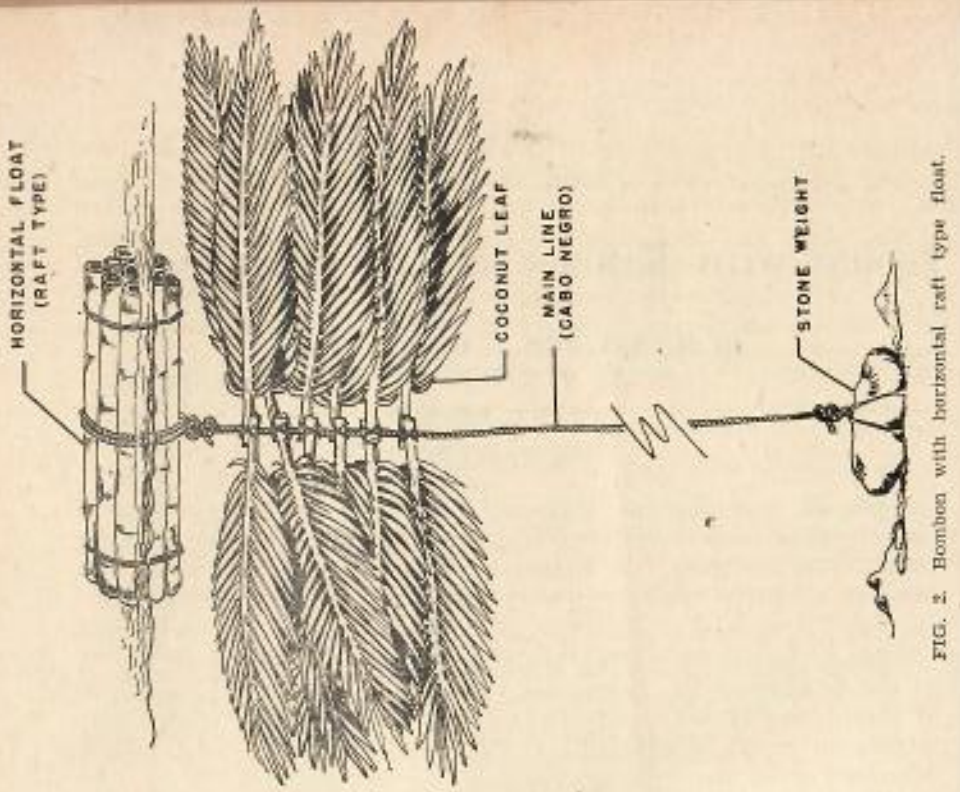

FIG. 2. Bombon with horizontal raft type float.

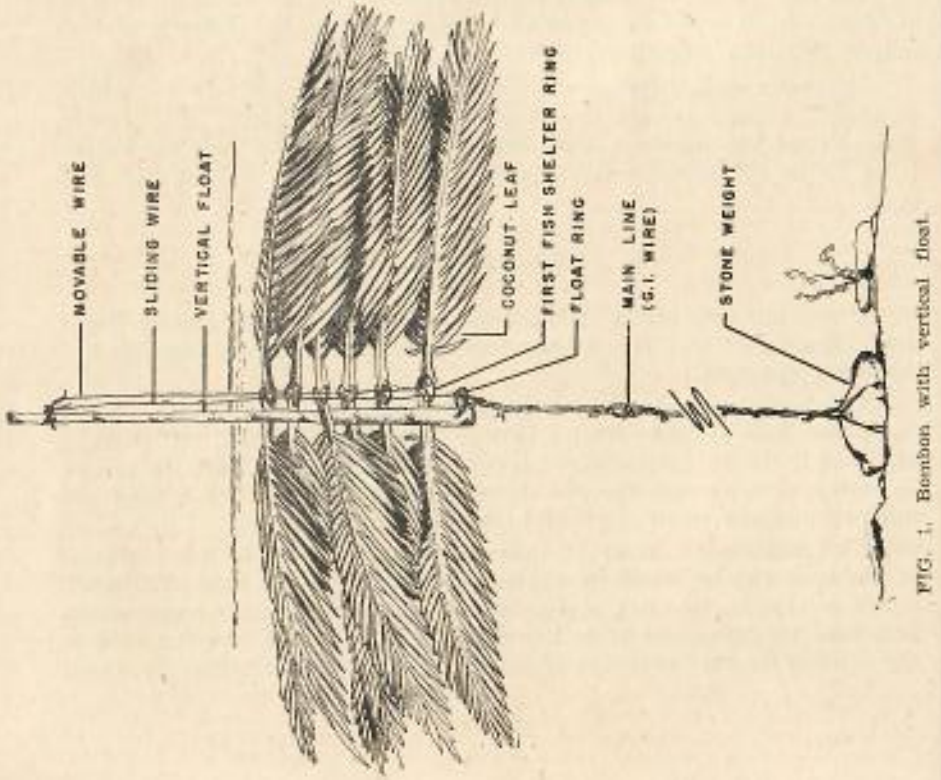

FIG. 1. Bombon with vertical float.

2-3 fathoms long are bundled together to form the said float (See fig. 3). The main line is made from either galvanized iron wire or *cabo negro* (*Caryota urens L.*) rope. Two galvanized iron wires each of about 1/8 inch diameter by 15 fathoms long are twisted together and rings are formed at the ends. A series of these wires are connected end to end by the rings to form the main line. If cabo negro is available, this is made into rope of about 1 inch diameter. The length of the main line in either case depends upon the depth of the place where the bombon is to be set. The stone weight which is used as anchor of the unit weighs about 500 lbs.

SETTING

Usually four men are required to set the bombon. Setting is done when the sea is not rough. When all of the materials are prepared and the desired spot is located, one of the crew members sounds the depth. To the stone weight is tied the main line which is measured about 5 fathoms shorter than the actual depth of the place if vertical float is to be used. The weight is dropped and the main line slowly lowered. After the required length of the main line is reached it is tied securely to the float ring. The sliding wire is also tied to the same float ring and fastened to the ring of the first fish shelter. The movable wire is tied to the ring of the first fish shelter and both the sliding and movable wires are fastened through the next succeeding fish shelter rings. The free ends of the two wires are tied to the floating end of the bamboo float.

If the horizontal raft type float is desired, the length of the main line must be equal to the depth of the place during high tide. At a distance of 20 fathoms from the float the first two coconut leaves are tied directly to the main line. The next succeeding leaves are tied to the main line by twos at intervals of 2 fathoms until the float is reached (See fig. 2). The bombon is set in the same manner as previously described.

The construction of bombon starts in the month of December which is the beginning of the southeast moonsoon or *amihan*. Normally the bombon can last for one year if the fish shelter made of coconut leaves is replaced once every three months.

FISHING GEAR OPERATED WITH THE BOMBON

The bag net commonly called *basnig* is the only gear that is operated with the bombon in commercial scale. In case the school of fish that gathers about the bombon is scarce, the fish are caught with a scoop net or by hook and line.

The bag net commonly called *basnig* is the only gear that is operated with the bombon in commercial scale. In case the school and 1,000 candle power are lighted. Upon detection of the abundance of school of fish around the bombon, the fisherman makes signal to the basnig outfit of the presence of school of fish. When the

basnig has arrived and a sizeable quantity of fish are noted, the bag net is set at a distance close enough to the bombon in such a manner that it will not interrupt the hauling operation of the net. After the net has been set, the bulbs of 1,000 watts are lighted to attract the fish. A big basnig may carry from 6 to 14 bulbs each of 500 to 1,000 watts. When the fish has been concentrated around the boat, the net is hauled in and the catch is brailed to the fish hold. In case the fish cannot be attracted by light and do not want to leave the fish shelter, the sliding wire and movable wire are untied leaving the sliding wire free. The movable wire with all the fish shelters are carried around the fishing boat. The net is rapidly hauled and fish brailed to the boat.

THE CATCH

The species caught in commercial abundance are the round scad, anchovy, tuna, bonito, mackerel, and slipmouth. The share of catch that goes to the bombon owner ranges from one-sixth to one-third of the total fish caught. In the municipality of Balayan only one-sixth of the total catch is shared by the bombon owner while in the municipalities of Taal and San Luis the share is increased to one-third. Variation in the amount of share in catch depends upon the amount of effort exerted by the bombon owners during the fishing operation.

DISCUSSIONS AND RECOMMENDATIONS

The bombon serves as a good shelter for small fish and fry. Incidentally, the big fishes prey on the sheltering fish; thus, almost all kinds of fish are caught with the use of bombon. Construction of bombon in fishing grounds where the natural habitat has been destroyed is one way to increase fish production.

It has been found that the bombon becomes an obstruction to fishing boats operating the half-ring net. Time will come when the bombon will be an obstruction also to navigating interisland vessels due to its ever increasing number.

A decrease in fish caught has been reported by the local fishermen if the bombon is constructed near a fish corral though it is beyond the distance required by law. Bombon must be constructed at a distance which will not intercept fish coming near a fish corral. The float must be marked by a good size flag which can easily be seen at a distasce.

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FISH CORRAL FISHING IN THE PHILIPPINES

By SANTOS B. RASALAN

Bureau of Fisheries, Manila

There is hardly any sheltered water in the Philippines where fish corrals are not used for either subsistence or commercial fishing. This may be due to the fact that the materials used in their construction are not only found growing abundantly in the country but that they also could be obtained during any part of the year at a reasonable cost. They are of varied forms, ranging from a simple movable wire operated in shallow waters to a more or less complicated structure operated in deeper waters, which require a sizeable amount of capital. Such variation is the result of alterations made by fishermen in their fish corrals, based upon cut and tried methods, in their effort to have more effective fishing. They are all, however, operated with the principle of guiding the fish, during the course of their migration, into the corral where they can easily be caught. Hence, they are known as "guiding barriers."

Here are presented the different forms of fish corrals operated in the Philippines, which may be grouped into *pahubas*, *tuangela*, *paupuad*, *bungsod*, *Zamboanga* and *basang*, with their methods of construction and operation.

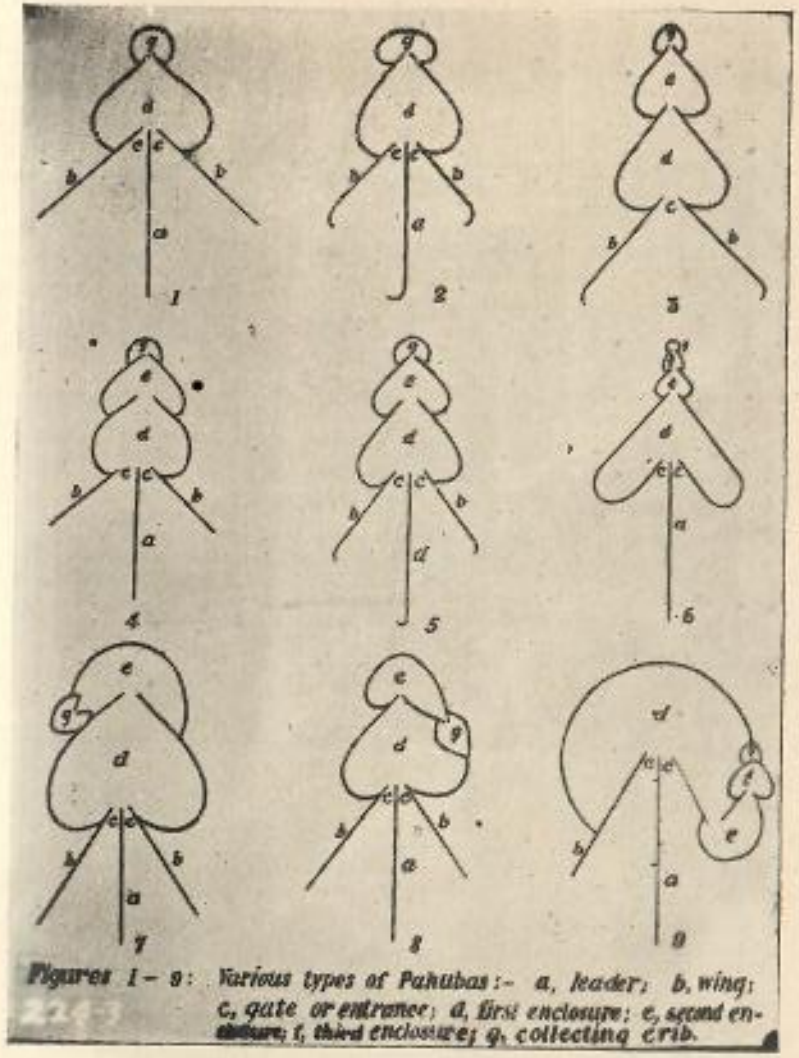
PAHUBAS

Fish corrals, generally called pahubas or *aguila*, are usually constructed in tide flats close to the shorelines where the bottom is partly or entirely exposed at low tide. They usually consist of one or more enclosures with a small collecting crib, a gate, two wings and may be with or without a leader. The splints of the bamboo screens are finer and laced together at closer intervals than those used in deeper waters. This type of fish corral is set during the early part of the season and may be transferred from one place to another, depending upon the availability of catch. Generally, however, it is set or removed once every thirty days during the season, especially when laid out in sheltered waters. Sometimes it is removed when a typhoon is in the offing and reset after the bad weather has passed away. It catches littoral species, such as crabs, shrimps, squids, mullets, etc.

Based on the shape of the enclosures, the pahubas may be divided into *bakdad ordinario* and *tulis*.

Baklad ordinario.—Classified under *baklad ordinario* are shallow-water fish corrals (Figures 1-12) which are characterized by having two or more heart-shaped enclosures and two wings, with or without a leader. Figure 1 is the simplest type of baklad ordinario. It consists of a straight leader, two wings formed by the outward extensions of the inner sides of the first heart-shaped enclosure, which in turn is superimposed by another smaller enclosure and serves as the collecting crib. Figure 2 is similar to Figure 1, except that the leader and wings are curved at their distal ends. Figure 3 has three compartments and two wings but is without a leader. In Busuanga, Palawan province, the wings are sometimes made of piles of stones. Figure 4 is similar to Figure 3 except that it has two straight wings and a straight leader. Figure 5 has also three compartments with the two wings and the leader curved as in Figure 2. Figure 6 has no wing but is with a leader and four enclosures, a large first enclosure and three smaller ones, superimposing one another and alined with the leader. Figure 7 has two wings, a leader and three enclosures. The first compartment is the biggest and is superimposed by the second, the left arm of which opens into the collecting crib. Figure 8 is similar to Figure 7, except that the collecting crib of the former superimposes the right arm of the second. Figure 9 has a leader, one wing and four enclosures. The first one, in the form of a semi-circle, terminates at the right arm into three other smaller ones. The inner side of the left arm is extended to form the only wing. Figure 10 is composed of the wing, a leader and a heart-shaped fore-compartment superimposed by a small, semi-circular enclosure. On the upper part of the left arm are a series of smaller enclosures. Figure 11 has also a leader and only one wing. The two collecting cribs which are triangular in form are, however, found on the inner side of the first enclosure. Figure 12 has three smaller chambers on both arms of the semi-circular enclosures and are without wings.

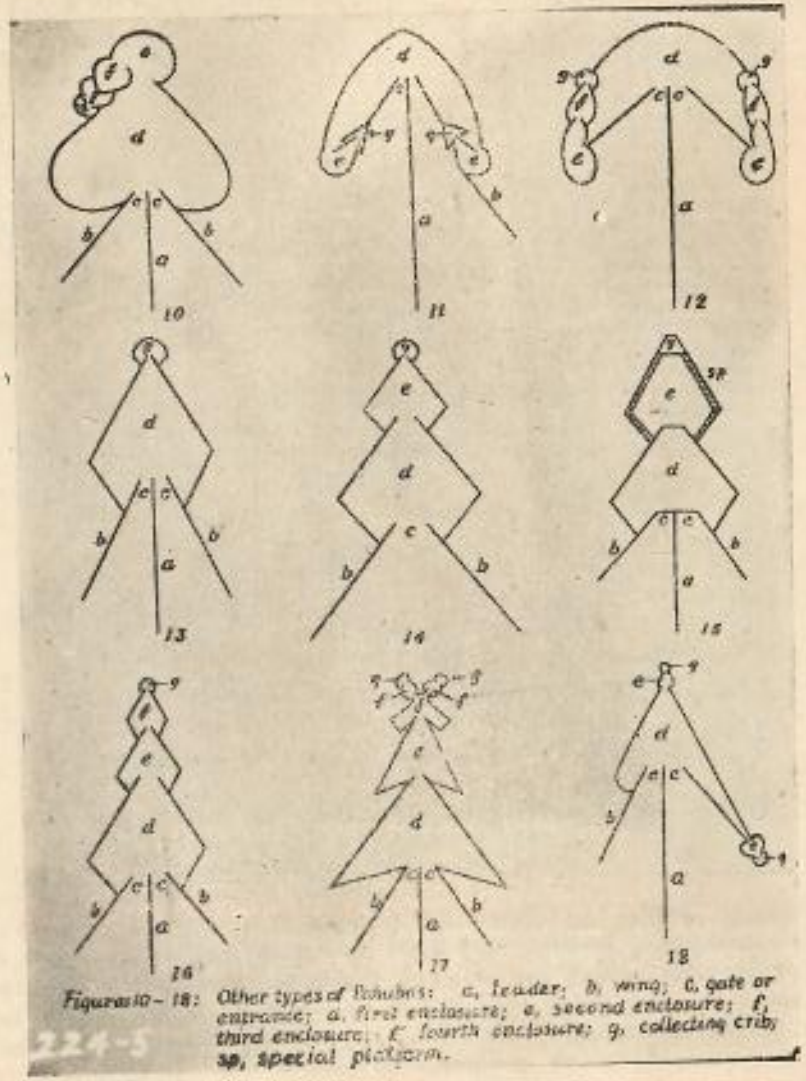
Tulis.—There are several types of tulis (Figures 13-18) which is also known as pahubas in the Visayan Islands. The different types are set in tide flats in such a way that all the parts, except the collecting crib, are subject to exposure during low tide. The term tulis or *tuis*, meaning pointed, is derived from the arrowhead appearance of the layout. This gear is used to catch shrimps, crabs and other littoral species that frequent the seashores during high tide. Three different forms of tulis, generally grouped into *pangalato*, *baenakan*, and the tulis proper, are known. Figure 13 is the simplified typical form of tulis and is usually called *pangalato* in Ragay Gulf. It consists of a leader, two wings, a diamond-shaped compartment with its upper apex superimposed by a circular collecting crib. The leader is usually constructed perpendicular to the shore. Figure 14 is a variation of the pangalato with an



Figures 1 – 9: Various types of Pahubas:- a, leader; b, wing; c, gate or entrance; d, first enclosure; e, second enclosure; f, third enclosure; g, collecting crib.

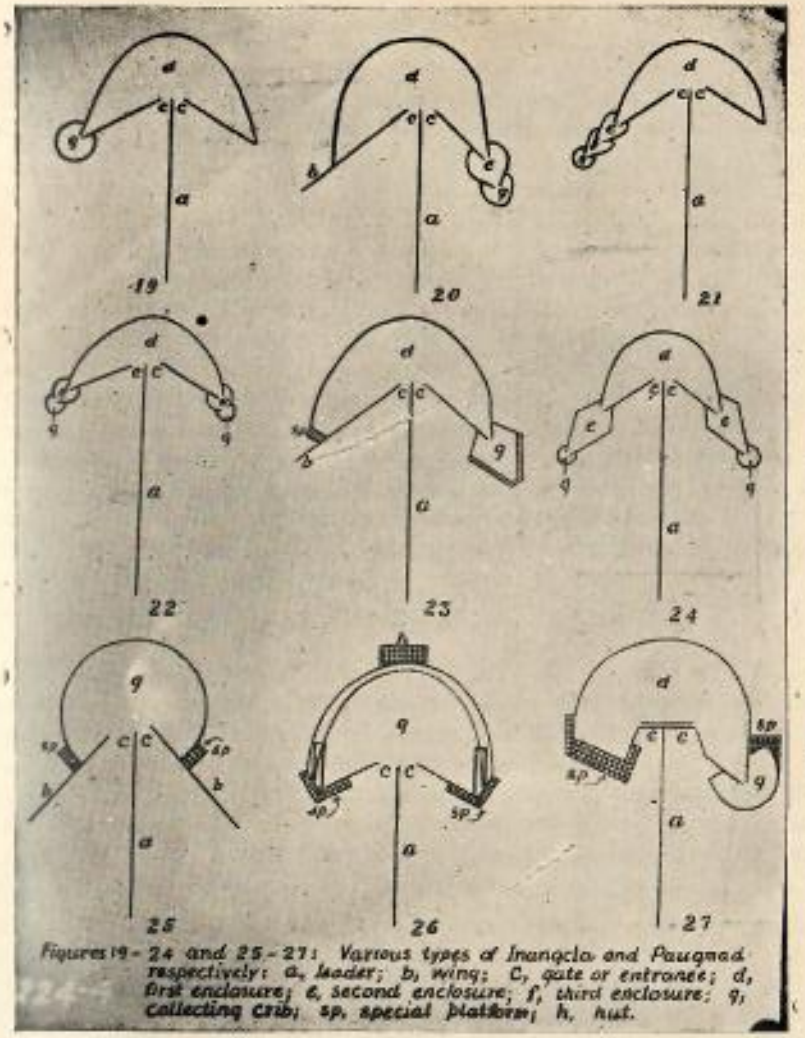
additional smaller enclosure and is without a leader. Figure 15, called baenakan, is commonly used near the mouths of rivers of Capiz province, where the water is from one to three fathoms deep in order to catch adult mullet and milkfish. It is similar in layout to Figure 14, except that it has a leader. The collecting crib is also made to serve as live box where the catch is kept to await delivery to the market. Along the sides of the second compartment is a bamboo platform where the fish may land should they attempt to jump over the enclosure. Figure 16 is another variation of the tulis type of fish corrals with three enclosures. This

is widely operated in Negros, Cebu and Panay islands. Figure 17, another variation of the tulis, is operated in 1 to 2 fathoms deep of water in Alaminos, Pangasinan province where it is locally called *aguila*. The tip of the third triangular enclosure branches into two small heart-shaped enclosures each of which is superimposed by the



Figures 10 - 18: Other types of tulubes: a, leader; b, wing; c, gate or entrance; d, first enclosure; e, second enclosure; f, third enclosure; f' fourth enclosure; g, collecting crib; sp, special platform.

collecting crib. Figure 18 has a modified enclosure with a small heart-shaped enclosure superimposed by a collecting crib in one arm and another set of the same kind at the apex.



Figures 19 - 24 and 25 - 27: Various types of Inangcla and Paugnad respectively: a, leader; b, wing; C, gate or entrance; d, first enclosure; e, second enclosure; f, third enclosure; g, collecting crib; sp, special platform; h, hut.

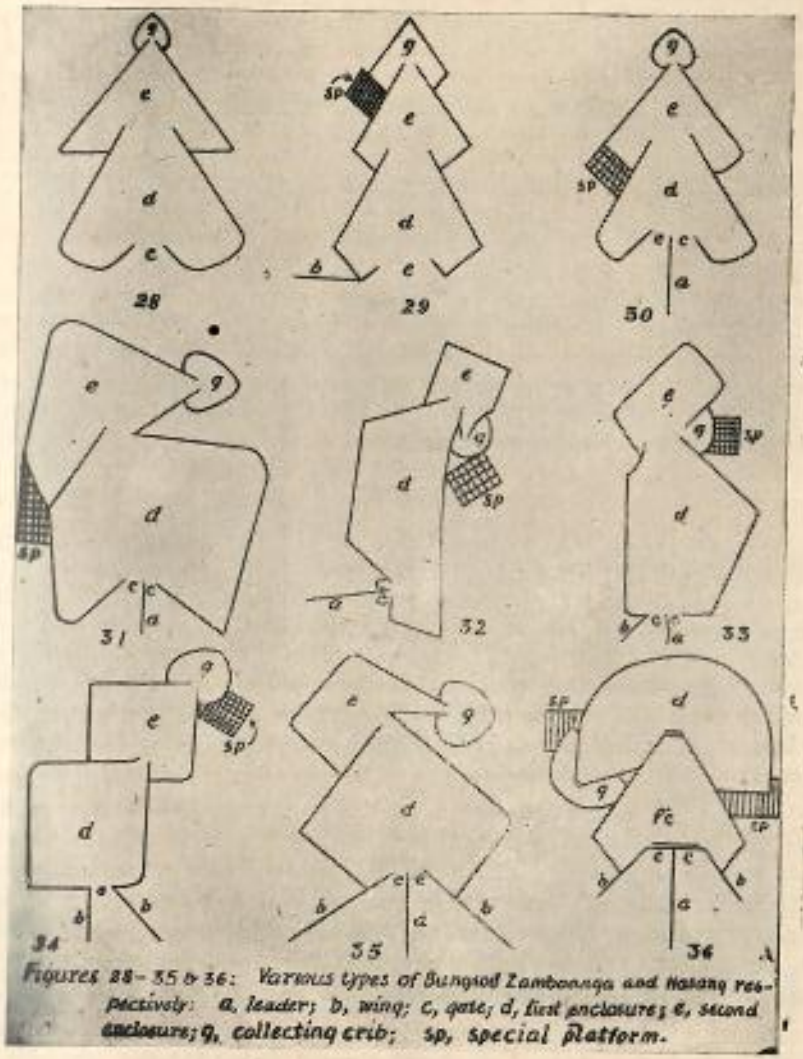
This type of fish corral (Figs. 19-24) derives its name from the word "angcla" (Spanish word for anchor) in which form its lay-out is generally constructed. The main feature is a leader which corresponds to the shank of the anchor in the crown. This fish corral is operated both in shallow and in deep waters. The variation lies in the shape of the collecting crib at the tip of the arms, the place where this is located, the shape and number of the smaller enclosures, and the size of the collecting crib.

Figure 19, called *kinavite* is operated in Ragay Gulf by fishermen from Cavite province, hence, its name. Figure 20 is widely used in the Philippines where it is constructed in depths ranging from two to eight fathoms. This type has a wing on either arm and a heart-shaped compartment which in turn is also superimposed by a circular collecting crib on the other arm. Sometimes these two compounds are located at the middle of the outer fence of the semi-circular enclosure at the same axis with the leader. Figure 21 is similar to Figure 20 differing in the absence of the wing and in the presence of smaller heart-shaped compound. This gear is operated in Cebu province, in waters from one to five fathoms deep. Figure 22, known as aguila in Manila Bay ang angcla in Samar province, has on the tips of both arms small heart-shaped compounds each superimposed by a small circular collecting crib. Figure 23 is known in Negros island as "Hasang simple." Its main feature is a special platform at the tip of one arm where there is a wing extension, and a more or less large collecting crib, diamond in shape and with a cut-work for fishermen. Figure 24 is constructed in three to seven fathoms deep of water around Iloilo province. It has a diamond-shaped enclosure at the tip of its arms superimposed by a circular or heart-shaped collecting crib.

PAUGMAD

This group of fish corrals (Figures 25 to 27 and 45) is the simplest type of fish corrals in the Philippines. It is constructed in waters 7 to 12 fathoms deep. Each consists of a leader, with or without wings, and one or two semi-circular enclosures. A landing platform and a small hut are usually found on one side of the compartment where the hauling is done by the fishermen. It is used to catch pelagic as well as demersal fishes.

Figure 25, called *linati* (Talavera and Montalban, 1932), is commonly operated in the Visayan waters where the depth ranges from 7 to 15 fathoms. It has only one semi-circular enclosure, two wings, a leader and a special landing platform on the outer side of each arm. Figure 26 is similar to the linati but differs from it in the presence of a platform around the semi-circular enclosure. Also, a hut is constructed at the outer mid-arcs of the enclosure besides the special platforms on both arms, it has no wing while Figure 27, called inangcla in Capiz where it is operated, has the right arm of the semi-circular enclosure imposed by a collecting crib. One special platform is also found on the left arm of the semi-circular enclosure and another on the side of the collecting crib. Figure 45 is the "paugmad" of Bohol province with curved wings and a leader.



Figures 28–35 & 36: Various types of Bungsod Zamboanga and Hasang respectively: a, leader; b, wing; c, gate; d, first enclosure; e, second enclosure; g, collecting crib; sp, special platform.

Figures 28 to 34 are the diagramatic representations of the various types of fish corrals, called bungsod, operated in Zamboanga waters where the depths range from 5 to 7 fathoms. They are all characterized by the presence of two triangular or quadrangular enclosures, with either semi-circular or heart-shaped collecting crib which, including the wings, leader and special platform, if present, are irregularly arranged. They are used to catch both demersal and pelagic fishes, especially tuna, sardines and mackerels.

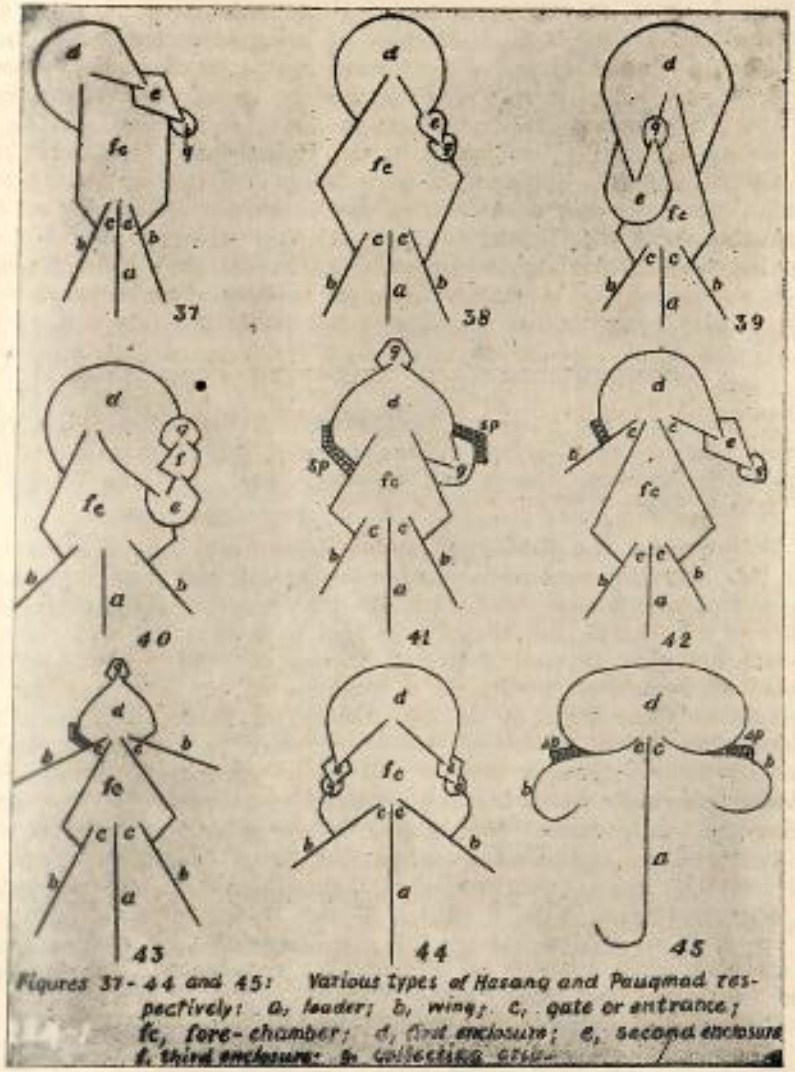
Figure 28 is the simplest form of bungsod Zamboanga. It has no leader and wing while the two compartments are triangularly shaped, the second being superimposed by a heart-shaped collecting crib. Figure 29 is similar to Figure 28 except that the collecting crib is triangular in shape and has a landing platform in its left arm. The wing is tangent to the inner foreleft angle of the first triangular compartment. Figure 30 is similar to both Figures 28 and 29 in having a heart-shaped collecting crib and a landing platform and also a leader constructed at the same axis with the gate leading to the collecting crib. Figure 31 has a leader and two more or less quadrangular enclosures and a heart-shaped collecting crib. The landing platform is found on the left side of the junction between the first and second enclosures. Figure 34 has its heart-shaped collecting crib super-imposing one angle of the right second enclosure, and the landing platform is located on the outer right side of the collecting crib and the second compartment. Figure 35 is similar to Figure 31 except the presence of two wings and the absence of a landing platform.

HASANG

This group of fish corrals (Figs. 36 to 44) is constructed exclusively in deeper waters ranging from 3 to 15 fathoms. It is characterized by the presence of a fore-chamber, aside from having one or more enclosures, a collecting crib, two or more wings, one or more gates or entrances, a leader and one or more landing platforms. The fore-chamber is either rectangular, triangular or diamond in shape and is called in the Visayas, hasang meaning "gill" (Talavera and Montalban, 1932), from which its generic name was derived.

Figure 36, called *bolonan* in Capiz, is the simplest form of hasang. It consists of a triangular fore-chamber which leads into a semi-circular collecting crib, with the landing platform constructed at its outer side. It has also a leader, one gate and two wings. Figure 37, called *hasang antiguo*, has a rectangular fore-chamber, one gateleader, two wings, a semi-circular enclosure, a triangular compond and a heart-shaped collecting crib.

Figure 38 has a leader and two wings converging at the gate on the anterior side of a diamond-shaped fore-chamber, the upper extremity of which is superimposed by a semi-circular enclosure. This, in turn, has its right arm and that of the fore-chamber form two heart-shaped enclosures, the lower of which is the collecting crib. Figure 39 is similar to Figure 38 except that the collecting crib, which is superimposed by a small semi-circular enclosure, superimposed the fore-chamber. Figure 40 is also similar to Figure 38 and 39 except that it is bigger and, the terminal collecting crib is on the posterior right side of the semi-circular enclosure.



Figures 37-44 and 45: Various types of Hasang and Pauqmad respectively: a, leader; b, wing; c, gate or entrance; fc, fore-chamber; d, first enclosure; e, second enclosure; f, third enclosure; g, collecting crib.

Figure 41, which is oftentimes called *bolonan ordinario*, is considered an improvement of the bolonan in Capiz, because of the presence of two collecting cribs. One of these is found outside the semi-circular enclosure at the same axis with the leader, while the other is on the right arm of the same semi-circular enclosure. Fishes that enter into the fore-chamber are driven into the semi-circular enclosure where they are caught with a scoop seine, while the two terminal or collecting cribs are seined by a lift net. Figure 42, called hasang moderno, is likewise an improvement of the hasang

antiguo because of the presence of three gates and three wings. These afford the fishes more chances of being intercepted and enter into the intricately arranged enclosures and less chances of escaping. Figure 43 is the new hasang moderno which was introduced for the first time at Kalibo, Capiz, in 1950, and found, so far, to be the most effective fish corral in the Philippines. It differs from its prototype in the presence of four wings and the collecting crib which directly superimposed the semi-circular enclosure at the same axis with the leader. Figure 45 has a heart-shaped forechamber leading into the semi-circular enclosure, each arm of which is superimposed by a diamond-shaped smaller chamber which in turn is also superimposed by a rounded collecting crib.

CONSTRUCTION OF THE FISH CORRAL

Three steps are observed in the construction of a fish corral, namely, the selection of the fishing ground, the preparation of the framework, bamboo screens and accessory gear, and the setting of the fishing gear.

Selection of the fishing ground.—The success of the operation of a fish corral depends on whether or not it may last throughout the season, and the availability of fish that enter into the compound. Hence, a fish corral operator always sees to it that the water where he sets his gear is well sheltered throughout the season and the sea-bottom is sandy, muddy or a combination of both, and full of vegetation. Once the gear is set, it remains there throughout the season. Any screen destroyed by waves may be changed piece by piece. When the season is over, all parts, except the frames, are renewed, cleaned, dried, further repaired and stored for use again during the next season. If the gear is set in open waters, it may be destroyed or completely washed out by strong current due to unpredictable gales or typhoons and may result in the total loss of the investment. This condition is not, however, fully observed by operators of shallow water fish corrals as their gear can easily be removed when there is an approaching typhoon, to be reset only after the latter has passed away.

Fish corrals must also be set in fishing grounds frequented by schools of fish, if not within their migration route. Unlike other fishing gear which can be carried from one place to another while scouting a school of fish, fish corrals can only effect the catching of fish by guiding them through their leaders, or wings, into the compound. Hence, fish can only be caught when they are intercepted by the gear. Fishing grounds subjected to fishing with the use of explosives are not good for corral fishing.

Preparation of frames and screens.—Fish corrals are made of frames and screens the size and kind of materials of which depend upon the depth of the water where they will be set. Fish corrals set in one to two fathoms deep of water have their frames made of

mangrove trees and quarters of bamboo poles without braces, except in the collecting crib. Deeper fish corrals have, however, their frames made of well-seasoned bamboos, *anahaw* (*Levistona* sp.) or coconut trees or a combination of all these. These are braced also with well-seasoned bamboos in order to make them stronger and more resistant to the action of waves and the current.

The screens are usually made of cleaned splints of *kiling* (bamboo without spines, *Bambusa* spp.) or *buho* (Schizostachyus spp.). Recently, however, chicken wires are used instead, especially in shallow water fish corral.

Tying materials are usually the *hagnaya* or *diliman* (*Polypodium* sp.), rattan (*Calamus* spp.), and threaded influorescent sheaths of coconut buds.

The preparation of these materials is done by labor contract or by fishermen employed by the operator. Whole bamboos, anahaw or coconut trees for the posts are used full length, depending upon the depth of the water where the gear is set. When bamboos alone are used, two to four pieces are bundled together and are used one after every three posts to give more strength to the gear. Holes are bored on the upper portion of every internode so that this would sink faster in water. Their bases are also sharpened in order to facilitate staking them.

The bamboo screens are made of different sizes depending upon the depth of the water where they will be set. They are made of separate sections, each of which is made of a definite number of cleaned splints, laced side by side at regular intervals of from one to ten centimeters. Those which are laced closer have their splints finer than those with wider spaces. Usually, a finished bamboo screen is from 5 to 20 meters long and from 5 to 25 meters in depth or width. Those having the same specifications are grouped together and are sometimes tied end to end, then rolled like mat ready to be set in the fish corral.

Accessory gear.—The accessory gear are the *sigin*, which may be either a bamboo screen or scoop seine, a lift net, and one or two rowed dugouts. The bamboo screen, sigin, is used for catching fish in shallow-water fish corrals. It consists of two or three separate sections joined together and has a bamboo brail at its vertical border which is rotated to facilitate the rolling or unrolling of the screens.

The scoop seine, the size of which varies according to the extent of the chamber where it is operated, is used to catch the fish in the semi-circular enclosure or the collecting crib of a deep sea fish corral. Figure 45 is a diagramatic structure of a typical seine and tables 1 and 2 give its specifications. It consists of a bunt

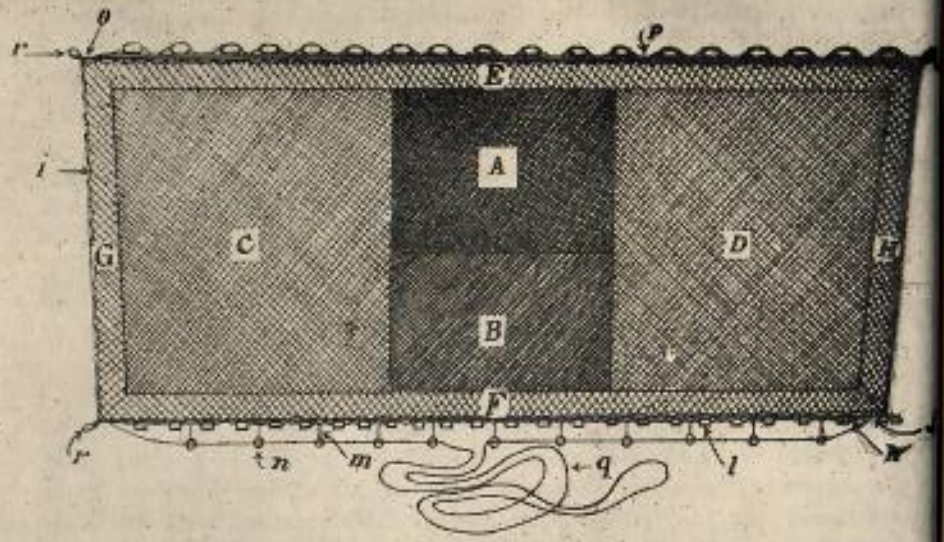


Figure 46 : Structural plan of the sigin :- A and B, bun C and D, wings; E, F, G and H, selvages; i, breast line; secondary lead line; k, primary lead line; l, lead we m, bridle; n, ring; o, secondary float line; p, prim float line; q, pursing rope; r, eye splice.

(Figure 46: A & B), flanked by two wings (Figure 46: C & D), hung on a 27.13 meters of head rope, 22.56 meters of foot rope and 12.19 breastline. Each wing is made of a 9-thread cotton twine netting of 2.54 centimeters mesh-stretch, 573 meshes wide and 500 meshes deep. The bunt is composed of two nettings, the upper portion of which is 312 meshes wide and 500 meshes deep, 2.24 centimeters mesh-stretch and is made of 18 thread cotton twine, while the lower portion is a 9-thread cotton twine netting, 2.54 centimeters mesh-stretch, 312 meshes wide and 300 meshes deep. These are joined together mesh to mesh.

The selvage (Fig. 46: E, F, G, H) of coarser nettings are made of a 36-thread medium laid seine twine having 5.72 mesh-stretch and joined with the wings and bunt in a ratio of one to every four meshes. The selvages are then seized by a 9-thread twine and hung to the secondary corkline, breastline and secondary leadline. Each end of the handling line is an eye-splice (Fig. 46: r). The floats each 7.62 centimeters long and 4 centimeters at its greatest diameter are tied along the primary floatline (Figure 46: p) at 30.48 centimeters interval. To the leadline are strung, at intervals of 35.56 centimeters, 65 lead weights (Figure 46: 1) each weighing four

ounces. In operation, two additional stone-weights of 40 pounds each are tied to each end of the leadline to help in sinking the net. The primary corkline and the primary leadline are spliced to the secondary corkline and the secondary leadline respectively.

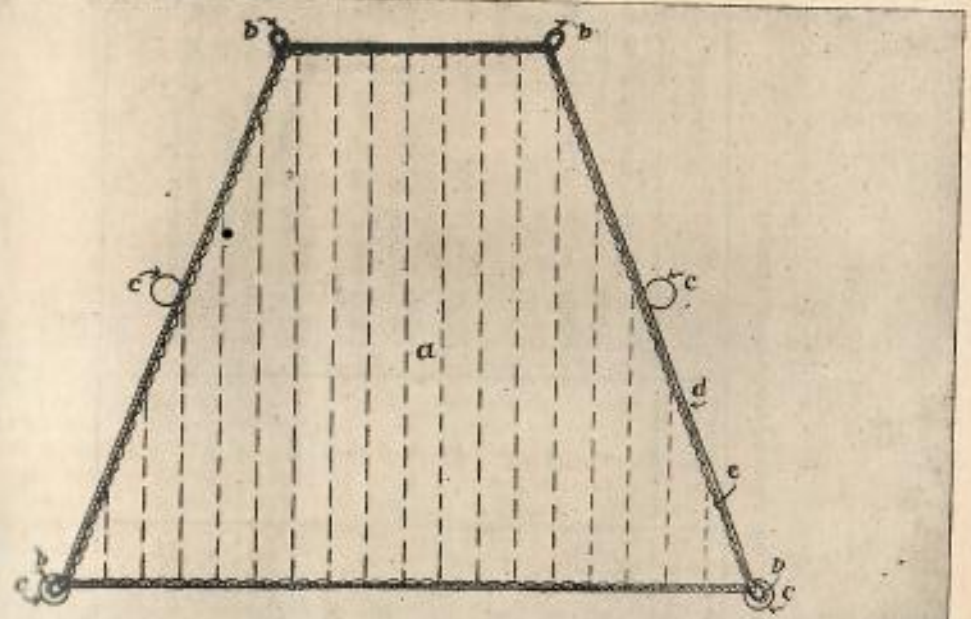


Figure 47: A diagramatic presentation of the structural plan of the shrimp net (not drawn to scale). a, sinamay cloth b, sling; c, G.I. ring; d, hanging line; e, lacing twine.

Figure 47 is a diagramatic presentation of a typical shrimp net. This is used to catch shrimps and other fishes that enter the collecting crib of the new hasang moderno. It is in the form of an isoceles trapezoid made of several pieces of sinamay cloth sewed together. This is hung to a Manila rope, 1.27 centimeters in diameter and with a 40% slack, by a 9-thread cotton twine. The finished shrimp net is 7.74 meters and 3.43 meters on its parallel sides while each of the non-parallel sides is 8.43 meters.

Like the purse seine, each end of the hanging line is an eye-splice (Figure-47: b) where the pull rope is tied during the operation. On the mid-point of each of the non-parallel sides and at the ends of the longer parallel sides are tied GI rings (Figure 47: C) which are threaded into gliding ropes when the net is shot or hauled in at the terminal point.

TABLE 1. — SPECIFICATION OF THE SCOOP SEINE (SIGIN)

PARTS	MATERIALS	Size in Centimeters	Length in Meters	Number of Pieces	REMARKS
Primary Floatlines	Manila rope	21 diameter	27.13	1	Where 70 floats are tied 30.48 centimeters distances.
Secondary Floatlines	Manila rope	1.59 diameter	27.13	1	Where the lacings of selvage are hung.
Breastline	Manila rope	1.56 diameter	12.9	1	Where the lacings of the width is hung.
Primary Leadline	Manila rope	91 diameter	22.56	1	Where the lacing of the cotton selvage is hung.
Secondary Leadline	Manila rope	1.58 diameter	22.56	1	Where the leadweight are tied at 35.56 centimeters distance.
Pursing rope	Manila rope	1.27 diameter	50	1	Each end is tied to the end of the primary leadline.
Briddle line	Manila rope	.91		62	Distributed along primary leadline 45.72 centimeters distances interval.
Floats	Soft wood	4 diameter	7.62 cm.	70	Equally distributed along the primary corkline 30.56 centimeters apart.
Sinkers	Lead	4 ounces	4 cm.	62	Equally distributed along the primary leadline 35.56 centimeters apart.
Rings	GI	6 x 7 diameter		18	

TABLE 2. — ROPES AND OTHER ACCESSORIES OF THE SEINE

PARTS	SYMBOLS	MATERIALS		Size of meshes stretched in cm.	No. of Horizontal meshes	No. of Vertical meshes	No. of Pieces	REMARKS
		Kind	No. of Twine					
BUNT	A	Cotton	9	2 24	312	500	1	Nettings joined mesh to mesh.
	B	"	12	2 54	30	300	1	
WINGS	C	Cotton	9	2 54	573	80	1	Nettings joined mesh to mesh.
	D	Cotton	36	2 54	373	800		
SELVAGES	E	"	36	5.72	7	488		Outer edges of bunt and wings are joined to the selvage 4 mesh of the latter and then laced by a twenty six-thread cotton twine to the hanging line.
	F	"	36	5.72	7	488		
	G	9	"	5.72	7	220		
	H	"	36	5.72	7	220		

One or two boats of different sizes are used in the fishing operation. The bigger boat is used to transport fishermen and nets to and from the fish corral, while the smaller one is used to carry the catch from the fish corral to the shore. A typical bigger boat is an ordinary dugout, 14 meters long, 1 meter wide and 0.54 meter deep, with one wooden planking on each side. An outrigger is provided only on the port side so that it may be brought close to the fence of the fish corral.

The small boat is flat-bottomed with pointed bow and no outrigger. An example of this boat is about 3.84 meters long, 0.7 meter wide and 0.49 meter deep. A piece of bamboo is tied on top of each of the gunwales where the oars are tied when the boat is rowed. Like the bigger boat, the depth and deck are increased by plankings on each.

Setting of the fish corral.—The fish corral is set during low tide, after the fishing ground has been carefully mapped out and all materials for the framework, screens, and other accessory gear have been prepared. Two men are needed to set a shallow-water fish corral while deep-water ones require 16 or more men, consisting of a master-fisherman, two assistant master-fisherman, four divers and the rest, ordinary fishermen.

The outline of the fish corral is carefully laid or plotted on the proposed ground by using imaginary lines and temporary stakes to indicate the parts and position. The collecting pound must be built in the deeper waters and the leader in the shallow waters. The leader, the length of which varies with circumstances, should extend in straight line from a point towards or closer to the shore and at right angle to the supposed direction taken by the fish as they drift with the current. The wings, which have the same functions as the leader, diverge towards the shallower waters and at an angle with the current in order to intercept the passage of fish and direct them into the corral.

After the outline of the fish corral has been plotted, the staking of the posts commence. Guide posts are first planted, next the anterior and posterior ends of the leaders and wings, then the ends and corners of the different chambers. The planting of the other posts follow by setting them at one or two meters apart at the enclosures and at three or more meters at the wings and leader. Care is taken so as to make them properly aligned and stand perpendicularly to the water. A bundle of two to four bamboos is used to every third post in deep-sea fish corrals in order to strengthen their hold at the bottom and to prevent them from reclining due to the wind and wave action. This is not done, however, when anahaw or coconut trees are used instead. Instead, one or four lines of bamboo, about two to four meters apart, are braced to connect the posts with the lowest line just about a meter above the surface of the water.

The setting of the bamboo screens follows the completion of the frames. As in the setting of the posts, a stone weight of about 15 kilos is tied to the lower end of the rolled screens before it is allowed to sink standing close to the frames. This procedure is repeated until all the screens are set in the different parts of the fish corrals.

The setting of the screens is usually begun with the terminal pond, followed by the succeeding chambers, the wings and leader. This order is followed because fishes oftentimes begin to enter into the enclosures as soon as they are set and therefore could be seined readily.

Bamboo screens with closer and finer splints are used around the collecting crib while the coarser ones are used in the next two compounds immediately preceding it. Those with largest spaces are placed at the wings and leader.

METHOD OF OPERATION

In all fish corrals, the methods of catching of fish that are impounded are generally the same, although they may differ in some minor details. Like in the setting of the gear, shallow-water fish corrals need two men, while in deep water, as many as 16 men are employed to catch the impounded fish. One acts as master fisherman, four as divers and the rest as general utility men. All are paid on the share basis.

Pahubas.—The compartments are dragged successively, with the bamboo sigin starting from the first chamber down to the collecting crib. The sigin is first stretched across the main gate to preclude the escape of fish, then it is worked slowly towards the next chamber. Care must be taken in order that no fish may escape back by keeping the bottom of the sigin very close to the ground and the two sides close to the walls of the compartment. The fish are driven into the next chamber, and the same procedure is repeated in each succeeding section until the fish are finally impounded along the wall of the collecting crib, about a meter in diameter, from which they are brailed out with a dip net and placed into a basket or into a waiting banca.

Inangcla.—Fish corrals, of this type when set in shallow waters, are operated like those of the pahubas type. A scoop seine is, however, used in those constructed in deeper waters. The first chamber is seined to drive the fish into the succeeding chambers until they are impounded into the collecting crib, from which they are scooped with a dip net.

Paugmad:—Fish corrals of the paugmad type require a watchman at all times to close the gate and to signal to his co-workers on the shore whenever it is time to make a haul. The scoop seine is dropped from either platform. This is extended across the gate

to the other side of the enclosure, then dragged slowly and closely following the fence until it is brought back to the platform where it started. Parts of the scoop seine is then pulled up while a smaller area is enclosed and as the weighted side is also raised, thus converting it into a large hammock. The fish are then concentrated into the bunt where they are scooped into a waiting boat.

Bungsod Zamboanga and Hasang.—These types are operated in the same manner as the inangcla, except that with the new hasang moderno and the bolonan ordinario, the fish impounded in the semi-circular enclosure and the terminal crib are seined separately with different nets. In the former, a scoop seine is employed as in the paugmad, while in the latter the sinamay-shrimp lift net is used. This net is dropped to the bottom, then carefully spread and raised from time to time to collect the catch.

REMARKS

In view of the fact that fish corrals generally last until the fish season ends in a particular fishing ground, it is the main concern of every operator to see to it that he may be able to get returns of his investment at the earliest time after his gear is set. To do this, he must make his gear strong enough to resist the effects of unpredictable weather during the season and to have a maximum catch once it is set. This may be made possible by:

1. Well-seasoned materials, especially bamboos, for making bamboo screens and posts should be used. The cost of these materials constitutes the major part of the investment. It is more economical in the end to have a fish corral constructed of well-seasoned materials which last longer in water than the immatured ones.

2. At present there is a tendency to use chicken wire netting instead of the bamboo screens. Some operators from Palawan and Zamboanga use this material and find it more durable in salt water. Fish corrals constructed with chicken wire are found to outlast the fish corral season. **This is not true, however,** with fresh water corrals.

3. Lights to attract fish into the compound of fish corral are becoming widely used in the Philippines. The lights come either from ordinary petroleum lamps or incandescent lamps of 200 to 500 candle power, hung at the middle of the semi-circular enclosure or in the terminal crib.

In 1948 Mr. T. Sasaki of the Nashima Laboratory of the Physical and Chemical Research Institute near Cape Uomi, Japan, experimented on the use of light in connection with the operation of a stationary fish trap and found the catch to have increased 20 to 30 percent. He used twenty 150-Watt, 100-Volt lights, with reflectors, connected to a hand-based power unit. These lights were

placed in a single row at a depth of two meters and kept 20 meters from the proximal end of the leader to the pocket of the gear. The first 19 lights shone towards the bottom while the last shot beamed toward the row of lights.

As the fishes were attracted, the lights were successively turned off at five minutes interval, beginning with the first light. This caused the fish to move to the next light when the light above them was switched off, until they were finally led into the pocket of the net where they were trapped.

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FISHING WITH ARTIFICIAL LIGHT IN THE PHILIPPINES

By S. B. RASALAN and B. Y. DATINGALING
Bureau of Fisheries, Manila

SIX TEXT FIGURES

The use of artificial light in fishing is not unknown in some countries of the world. Japanese fishermen use artificial light with the operation of a lift net *(boeki ami)* to catch *aoumo, Cololabis saira* (Brevoort); with the purse seine to catch horse mackerels, and with some set nets for various species of fishes. In Australia, fishermen operate purse seines with electric lamps to catch pilchard, while California fishermen use lights for live bait fishing and fishing for sardines for the canneries. There is no country in Southeast Asia, however, where artificial light is as widely and extensively used in fishing as in the Philippines. Out of the 1,115 commercial fishing boats licensed by the Bureau of Fisheries in 1952, a total of 788 were operated with the use of artificial light of different intensities. This number does not include those with a gross capacity of three tons or less which constitute the greatest number of vessels operating with light in this country.

The introduction of light in fishing in the Philippines is not well known. It is, however, the common belief among old fishermen that this practice is as old as the industry itself. The earliest forms of light used were torches made from bundled dried coconut or banana leaves or from split bamboos. These were used mostly with hand operated gear for subsistence fishing such as gaffs, spears, cover nets, etc., along the shores, rivers, and lakes during the dark phase of the night. In order to operate long enough to be able to catch sufficient fish for his family, a fisherman had to bring several of these bundles which were too bulky to carry from place to place while looking for fish to catch. This led, perhaps, to the use of the kerosene torch. A piece of rag was soaked in kerosene and then rolled to closely fit the inside of a green bamboo tube about one meter long and 2 to 3 inches in diameter.

Because the kerosene torch was easier to handle than its predecessor, it was used not only with the hand-operated gear but also with more complex ones which were operated on board dugouts farther from the shore. Fishermen came to learn also that bright lights effected more catches. Thus when mantle lamps were introduced

in the country in 1924, they readily became popular in the fishing industry. These lamps (*Petromax, Hasag, Coleman* and *International*) had intensities varying from 150 to 500 candle power. Incandescent lamps of 1,000 to 2,000-candle power appeared later and the fishermen were quick in adopting them. At present, motorized boats with generators are operated with 1,000-watt bulbs with reflectors, numbering from 8 to 16 in one fishing boat.

The wide use of high powered lights in fishing has presented some problems in the local industry. Seiners object to their use because they claim that besides making the fishing ground so bright that a school of fish could hardly be detected by the posphorescent glow of the surface water, these high powered lights also tend to disperse an otherwise big and compact school thus resulting in their lesser catch. Some conservationists have advanced the opinion that the apparent decline of fish in our waters is primarily due to the extensive use of lights in fishing.

Very little is known regarding the effect of light to the fishery. Sasaki (1948) found that by using 20 electric lights of 150 watts each with reflector of 100 volts in fixed nets, the catch was increased by 20 to 30 percent. The set-up was also successfully tried with purse seines to catch horse mackerels. Blackburn (1949) also used two electric lamps of 1,000 candle power each with reflector with the purse seine, 110 fathoms long and 17 fathoms deep, and found that he could invariably catch one to two tons of pilchards per haul. This also made possible the catching of this once seasonal fish throughout

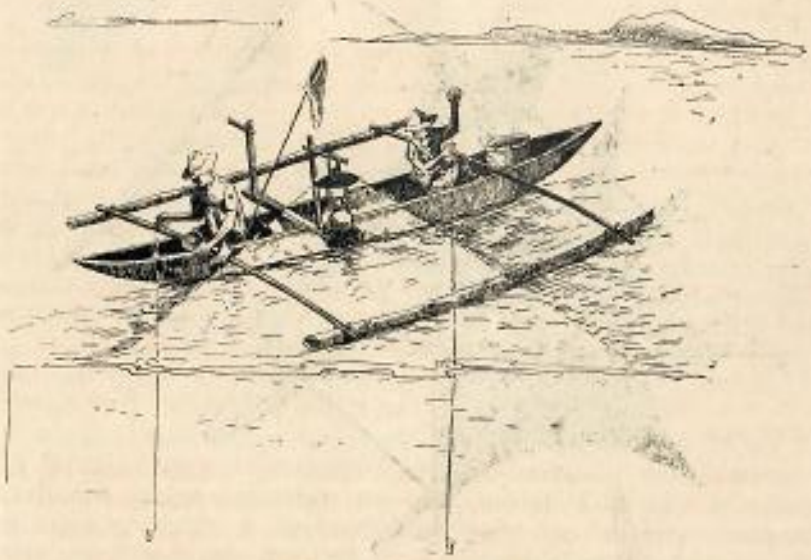

FIG. 1. DROP LINE

the year, as this fish, found in deep bottoms during off season, could be made by the light to go to the surface where they could be caught by the purse seine.

As a preliminary step in our inquiry into the destructive effect of light on the local fishery, a study has been made on the different local fishing methods which in some way or another use light in their operations. Such gear are the handlines, fish corrals, beach seines, gill nets, scoop seines, bag nets, and scissors nets. This paper also presents a brief discussion of the construction and methods of operation of these gear and their possible effect upon the fisheries.

Drop Lines — One of the most widely used gear for subsistence fishing (Figure 1) is this simple gear consisting of a main line, a sinker, and one or more leaders with hooks. Although most often operated during the day, it is also operated more effectively during the night in catching big fishes, such as mackerels, tuna, and caranx on board a small dugout equipped with an incandescent lamp ranging from 500 to 1,000 candle power. Lights attract the fry and other small fishes which are preyed upon by big fishes that are caught by hook and line.

The Scissors Net — The net is triangular (Figure 2) in form

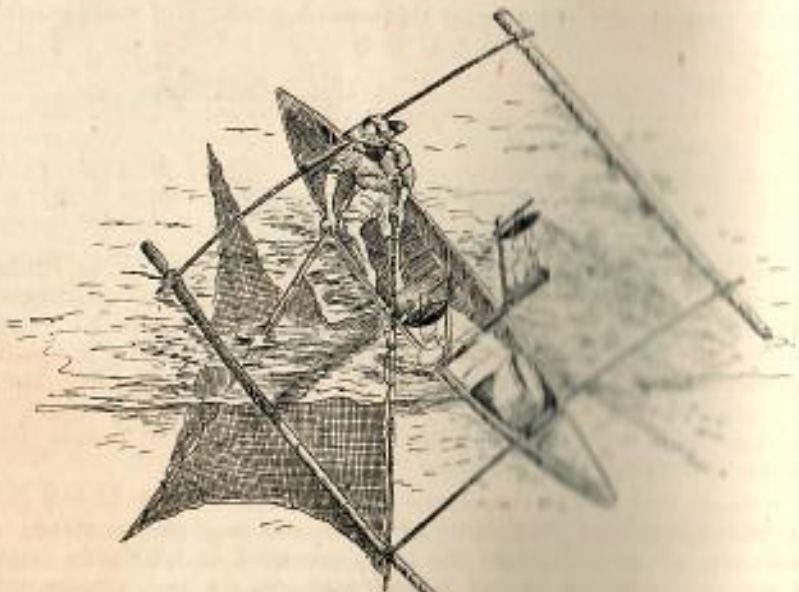

FIG. 2. SCISSORS NET

with a long conical bag and framed with two bamboo poles at the mouth. The netting, although generally made of fine mesh cotton net, is sometimes constructed out of coarse abaca cloth. Nylon mosquito netting has, to a certain degree, been used for this purpose because of its durability. The gear is operated along rivers, lakes, and shores to catch crabs, shrimps and other littoral species. It is also operated farther from the shoreline on board a small banca with incandescent light of 500 to 1,500 candle power to catch all fishes that are attracted by light especially sardines, anchovies, and mackerels. In their effort to effect more catch, the fishermen resort to the use of explosives or poisons to stun the fish for easy capture.

Fish Corrals — Fish corrals (Figure 3) of various form and sizes

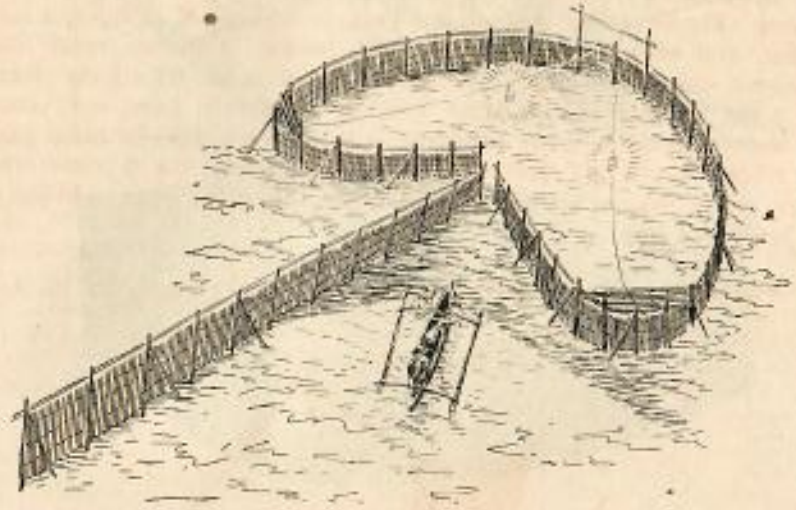

FIG. 3. FISH CORRAL

are widely used for catching fish in sheltered waters up to fifteen fathoms deep. These are guiding barriers which are so constructed as to lead the fishes during the course of their migrations to an enclosure where they are caught. Fish corrals are made of fences consisting of frames and bamboo screens. Those constructed along the shores in shallow waters have their bamboo screens made of fine slats laced so closed together that even the fry cannot pass through once inside the inclosure.

Because they are permanently set, the effectiveness of fish corrals depend upon the availability of fish found near them. Hence, to induce the fish to enter into the trap, operators install lights inside the gear, or utilize a dugout rigged with one or two incandescent lamps to attract the fish 100 to 500 meters away and lead them inside the corral where they are scooped or seined.

The Bag Net — This indigenous gear, commonly called *basnig* (Figure 4) is one of the most important commercial fishing gear

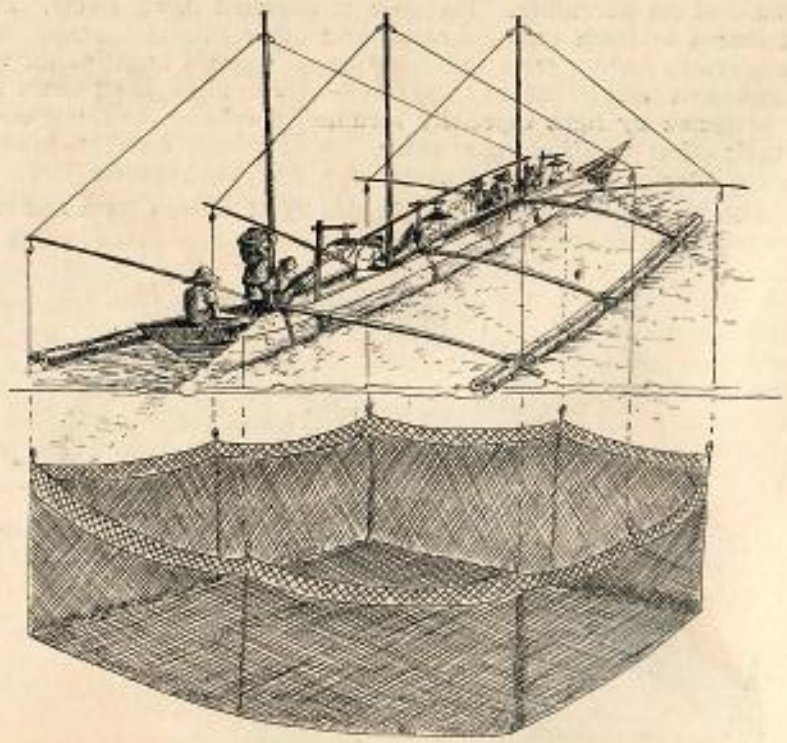

FIG. 4. Manila Bay type of baanigan equipped with electric generator for lighting and bamboo "horns" for operating net.

operated in the Philippines. The net is in the form of an inverted mosquito net, the size of which varies according to the range of the outrigger or booms of the vessel upon which deck it is operated. It is dropped under the boat then raised to impound the fish attracted by one or more incandescent lamps installed on both sides of the vessel.

The net is usually made of 1 to 2-1/2 centimeters mesh stretched, although coarse sinamay cloth is often used instead to catch the small fishes that come under the influence of the light. Inasmuch as this gear is usually operated in sheltered waters where fry abound or where matured fishes usually seek shelter to breed or feed, most of the fishes caught are either immature or small. They, too, are the

ones most attracted by the lights. The bigger fishes which are also attracted are also caught with the use of explosives.

The Beach Seine — Figure 5 is a diagrammatic representation

FIG. 5. BEACH SEINE

of a beach seine locally known as *sinsoro*, *daclis*, *baring*, or *bayakus* in different parts of the Philippines. Like those of other countries, this gear consists of a bag flanked by two long wings. It is usually made of cotton nettings, the bag having finer meshes than those of the wings. It is not, however, surprising to note that oftentimes the bag or the entire gear is made of coarse sinamay cloth.

The gear is operated during the day or at night, in which case one or more incandescent lamps of 500 to 1,500 candle power each are used. One or two lights are installed on board a small boat called *lawagan*. During the dark phase or when the moon does not shine brightly, the light boats go out to attract fish bringing them nearer the shoreline where they are caught by the net. This procedure is repeated until day break.

The Sapiao — This indigenous commercial gear is rectangular or ovate in shape with a perimeter of about 123 meters. It is operated on board two big boats called *sapiaoan* of 3 or more tons gross each.

These are regular dug-outs with outriggers on one side only so that both can lie close together during operation. Three or more lawagans are also used. These are half ton gross regular dug-outs but with outriggers on both sides. Two or three incandescent lamps of 1,000 to 2,000 candle power intensity are installed on the mid-deck of each lawagan to attract the school of fish.

The net is made of fine nettings one centimeter mesh stretched at the bunt and one and one-half to two centimeters mesh at the sides or wings.

Like the basnig, the sapiao is operated in sheltered waters during the dark phase of the night. The outfit is towed from the shore to be in the fishing ground at dusk. Here, the different lawagan (light boats) anchored at about 50 to 100 meters apart light their lamps to attract fishes. When a school of fish has been attracted, it is led between the two sapiaoans which have already been in position with the net set between them to impound the fish. Because the meshes are fine, all fishes attracted by the light are caught.

The Gill Net — Gill nets of various sizes are generally operated during the day or night to catch fishes found in schools. When operated at night, incandescent lamps of 1,000 to 1,500 candle power are used. (Figure 6).

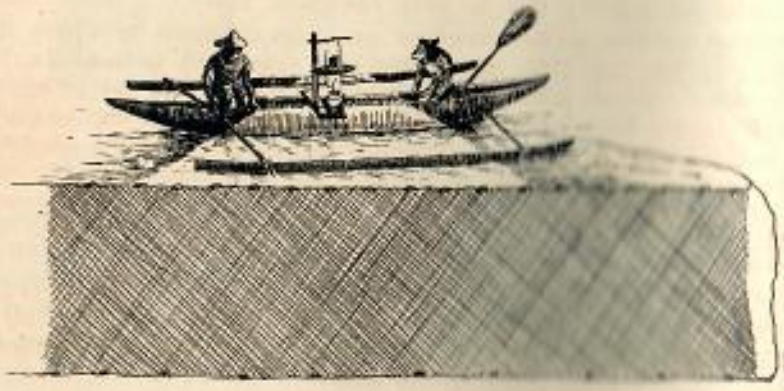

FIG. 6. GILL NET

DISCUSSIONS

From the foregoing discussions the following salient features are noted:

1. With the exception of gill nets, the other fishing gear use fine mesh if not coarse sinamay cloth for catching fish. This would enable the operators to catch all fish attracted by light irrespective of their sizes and stage of maturity.

2. All the gear observed are operated in sheltered waters where small fishes abound. These fishes are easily attracted by the lights and therefore constitute the major catch of the gear.

3. Explosives or fish poisons are generally used by operators of bag nets, scissors nets and scoop seines. Without these they cannot effectively catch big fishes such as tunas, Spanish mackerels, etc., which prey on the small ones that are attracted by the light.

4. Over 70 percent of the methods used for catching fish provide for the use of high-powered lights.

The destructive effect of any fishing gear made of fine mesh nets, more so of sinamay cloth, need not be over-emphasized. It has been observed throughout the investigations that the catches consisted mostly of small fishes, especially anchovies, sardines, herrings, round scads and mackerels which are mostly in their immature stage. These are usually found in sheltered waters and are easily attracted by the light. They are all caught by the gear which are made of fine mesh nets or coarse sinamay cloth.

The indiscriminate catching of the young fishes is certainly detrimental to the stability of the supply. Millions of small fishes are destroyed which if allowed to grow would increase the commercially valuable stock available to the fishermen thereby improving his catch and at the same time providing a larger reserve to tide over the period of scarcity due to poor spawning years.

Added to this is the frequent use of explosives to effect the catching of the big fishes that come near the light to feed on the small fishes. Umali and Warfel (1949) claim that the use of explosives in fishing is wasteful, kills all fishes of all stages and destroys the natural habitat of the bottom fishes. It is generally admitted that only a small proportion of the fish are recovered while the rest are left as wastes. It is also doubtful whether those that could escape the blast would return to the same place, especially when their habitat is destroyed by the explosions.

That fishing with the use of strong incandescent light increases the efficiency of the gear is beyond question. The predominant use of destructively constructed gear operated with strong incandescent lights, however, adds a great strain to the fishery.

RECOMMENDATIONS

1. The use of any fishing gear constructed from fine mesh net or coarse sinamay cloth should be outlawed. Further study should be made on the composition of catch with the use of light relative to the size of immature fishes caught to establish regulatory measures on the size of mesh to be used.

2. There should be more extensive and intensive patrol work so as to minimize the use of explosives and fish poisons in the capture of fish.

3. A study of the use of light with reference to distance between fishing gear should be made to avoid future conflicts among fishermen.

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TWO OUTSTANDING COMMERCIAL FISHING GEAR USED IN PHILIPPINE WATERS

By POFIRIO R. MANACOP

and

SIXTO V. LARON

Bureau of Fisheries, Manila

During the last five years some significant developments in the field of gear technology in the fishing industry took the Philippines "by a storm." Outstanding among these are the introduction and commercial adoption of the American otter trawl in demersal fishing and the development of a bag net operated on a motor-vessel *(baesigan)* in pelagic fishing. These gear are used either singly or in combination with each other in a fishing vessel. No other gear or their combination in the same fishing vessel has contributed so much in the overall increase in the nation's production of fresh fish as these two. They have not only increased fish production substantially but also stabilized the supply of fresh and cured fish products in many urban and rural centers in the country. They have likewise paved the way for the development of and the revolutionary improvement in the mechanization of commercial fishing craft and gear of the Philippines.

An investment of no less than twenty million pesos has been channelled to these two important fishing craft and gear. Their wide use has caused the development of a distinct fishery and likewise stimulated other subsidiary industries such as ice plant and cold storage, fish salting and smoking, and home net-weaving in different fishing centers of the country. Other concurrent developments were the evolvement of a seaworthy fishing vessel for a combination method of fishing with a comparatively longer range of operation, the installation of high-powered full diesel engines, the use of electric generating units for light fishing, the improvement on deck hauling equipment (winches and combination of blocks and tackle), the proper handling of fish at sea with the use of refrigeration equipment, and the use of a suitable practical fish container the "banyera system" for storage and for transporting iced fish.

The combined production of these two fishing gear alone amounted to 54,634,566 kilograms, equivalent to 87 percent of the total landing of all commercial fishing crafts and gear operated on fishing vessels of three tons gross over (Fig. 1). Since 1950, the

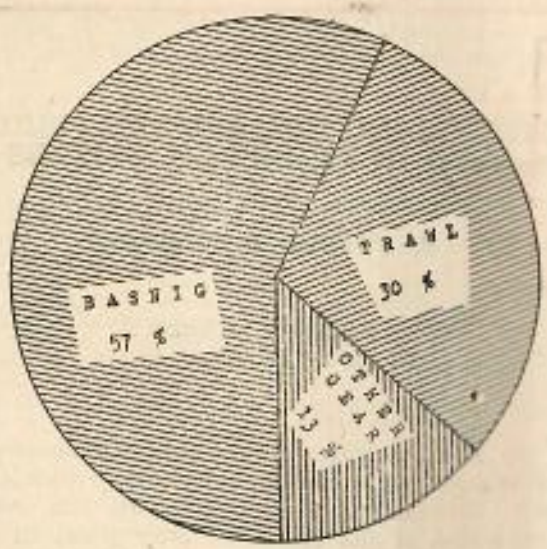

FIG. 1. Comparative percentage production by commercial fishing gear in 1952.

number of operating units of these two fishing gear have far exceeded the total number of other commercial fishing appliances (Fig. 4). As to production per man per gear, they are rated as the first two among the ten leading commercial fishing gear (Fig. 2) in 1952.

In the following paragraphs are discussed the history, the description and method of operation, comparative efficiency in catching fish, and future developments of these gear.

THE OTTER TRAWL

History—The otter trawl is a non-indigenous fishing gear which is probably of English origin. It found its way into the Philippines when in 1946, a private company under the technical management of the senior author introduced the stern-set otter trawl of the West Coasts of the United States. With the joint concerted demonstration work by the Philippine Bureau of Fisheries and the U.S. Fish and Wildlife Service Rehabilitation Program, this was commercially adopted by the fishing industry in 1948-1949. The old Japanese beam trawl which was then in vogue gradually gave way to this better trawling gear. At the present writing almost 95 percent of the trawling fleet are using the American stern-set otter trawl.

Description and method of operation—The otter trawl gear (Fig. 3) consists of a conical form of net flanked by a short wing on each side of the body. In operation it is held open vertically by glass, steel, or plastic floats and laterally by a pair of paravanes, called otter doors or boards. Each door is rigged to a towline from the

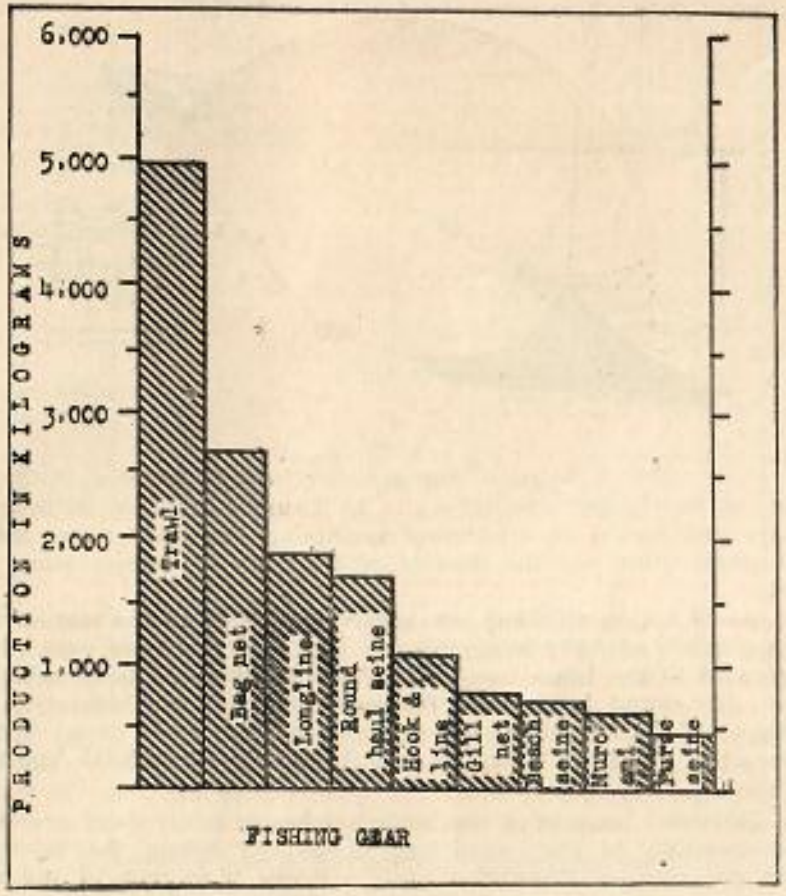

FIG. 2. Comparative fish production per gear, per man in 1952.

vessel. The net is dragged over the smooth bottom and catches fish and other aquatic animals living on or close to the ground floor of the sea. Essentially, it is a demersal gear although later developments have diversified its use at different levels up to the surface of the water.

In 1952, the trawl industry as a whole produced 17,589,320 kilograms equivalent to 30 percent of the total production by commercial fishing vessels in the Philippines. The development of the trawl industry started with a few salvaged craft immediately after liberation, increasing year by year until in 1948, about 100 units were in active operation. This number continued to increase reaching its peak in 1952, with a total of 234 operating units (Fig. 4). In 1952, it started to decline on account of overfishing in many trawling grounds. Thus, many of the otter trawl vessels were converted to basnigan, carrier boats and tow boats. At this writing conver-

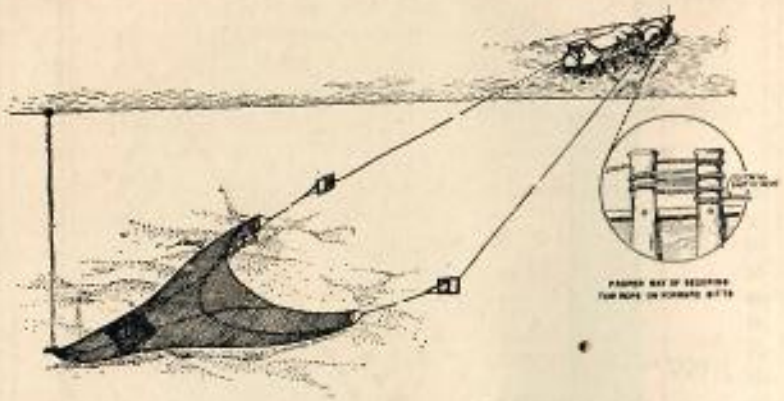

FIG. 3. A typical Philippine otter trawl in operation.

sion of the larger trawler crafts to basnigan is still in progress. Ways and means of effectively regulating the otter trawl fishing are under study by the Bureau of Fisheries for conservation purposes.

As to fishing efficiency, the otter trawl is rated the highest with a production of 5,562 kilograms per gear, per man, per year (1952) compared to the beam trawl with 4,544 kilograms. As to catch per gear, the round haul seine *(sapyaw)* produced the highest in the amount of 71,936 kilograms followed by the otter trawl with a production of 66,752 kilograms and the basnig with 55,489 kilograms (Table 1).

However, because of the large number of man power needed in the operation of the round haul seine and basnig the catch per man per year of these two gear is lower than that of the otter trawl.

The otter trawl is present undergoing some noteworthy technological changes which may revolutionize the method of catching fish by trawl throughout the world. Significant among this is the development of electro-magnetic trawl and diesel electric trawler by the Germans, the "atomic trawl" operated on a pair of boats by the Icelanders, the high opening Kiska trawl, the deep-sea and kite trawls of the Americans and the multiple trawl (Schatz) for fishing at various depths and deep-sea trawl of the British. Most of these modern developments in gear technology have, according to recent reports, passed the experimental stage and are now commercially used or under field commercial test. Other later development includes the use of factory ships trawler by the British which fish and process the catch at sea.

The development of the fishing precision instruments used as auxiliaries in fishing had produced far-reaching effects upon increased fish production and had placed the art of fishing on a scientific basis. Gone are the days when catching fish was by "hunch"

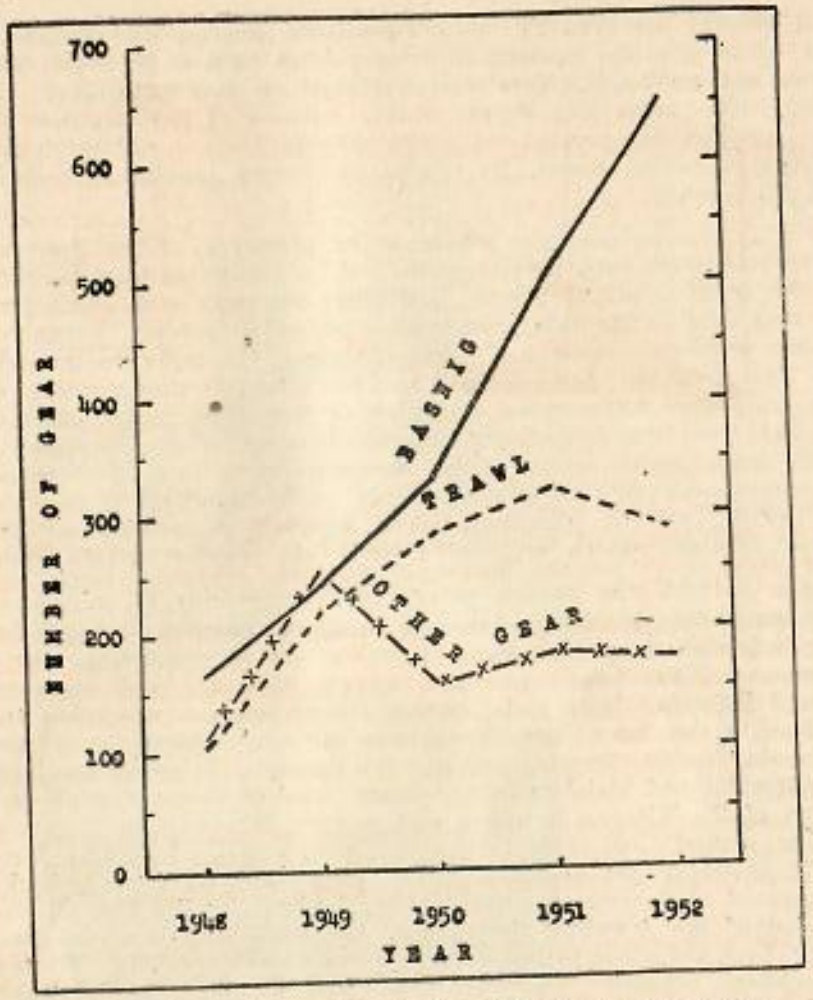

FIG. 4. Comparative number of commercial fishing gear by year

or by the "hit and miss" method. These instruments are the supersonic echo-sounder for automatic determination of the nature of the depth of the sea bottoms, the kind, size and quantity of fish, the surface radar and loran for safe navigation even through fogs and storms; the radio-telephone to facilitate communication at sea, and the underwater (Asdic) which can detect fish and other obstruction within a certain radius of the fishing vessel. On the whole, the 20th century finds the fishing industry practically abreast with the advanced development in other industries.

THE BAG NET (BASNIG)

History—The basnig is an indigenous fishing gear developed in

and around Bantayan Island, northwestern Negros, and Panay in connection with the catching of pelagic fishes such as anchovies, sardines and mackerels. This was developed as an alternative to the costly and cumbersome *sapyaw* outfit. Because of the fact that the bag net can be operated on crafts ranging from a sailing dugout to the motorized vessel, its popularity spread rapidly throughout the Philippines.

The Visayan basnigan which is the prototype of the gear has undergone some rapid development both in design and construction of the craft, nature of lighting and other accessory gear. Sometime in 1940, the Cavite fishermen started to install fishing "horns" or booms on their *dugout* and *parao* (basnigan) in order to increase the size of the net used on the same craft. At this time majority of the craft were either wind propelled or towed by motor launches to and from the fishing ground. Immediately after liberation in 1945, mechanization of the parao basningan came into effect thereby doing away with the use of towing motor launches. Some time in 1946-47, electric generators were successfully installed on the parao basnigan which replaced entirely old mantle petrol lamps.

In 1949-50, the nearby pelagic fishing grounds of the parao basnigan outfits in Manila Bay and its approaches and in the Visayan Seas started to show signs of decline due to overfishing. As a consequence, the basnig and the sapyaw fishermen and operators around Estancia, Capiz and Gigantes Island began a wholesale migration to the more lucrative fishing grounds around Coron and Dumaran Islands, Taytay, Bacuit, and Panacan, Palawan province. The Navotas and Malabon fishermen got wind of the successful operation of the Visayan basnigan and sapyaw fishermen in this new fishing ground. In 1950-51, medium size trawls of Manila Bay, Southwestern Samar and Ragay Gulf were suffering some setbacks on account of decreasing catches brought about by the over-all expansion of the trawling fleet. Only the small trawlers operating inside bays and close to the homeport were making profits. Pressed by economic necessity, the motor vessel basnig came to be developed by installing the gear on former "outside" trawlers operating from Manila Bay. As a matter of fact some of the trawlers still carry the trawl gear as a combination fishing equipment so that in case of poor catches with the basnig which sometimes happens, they operate the trawl in order to pay for the trip. This "make-shift" operation of the combination basnigan-trawler, has led to the opening of the trawling areas of Malampaya Sound, Bacuit and Imuruan Bays. Later, special types of vessels, formerly fish carriers such as Torpedo Boat (PT), Submarine Chaser (SC) and Mine Sweepers (FS) were installed with big bag nets, supported by long bamboo booms. On board this motor vessel basnigan, are installed 10 to 25 kilowatt self-contained electric generator units employing a total from 8,000 to 10,000 candle power electric light. Today the motor

vessel basnigan is an established gear both for inshore and offshore pelagic fishing.

Description and method of operation (Fig. 5)—The net is cu-

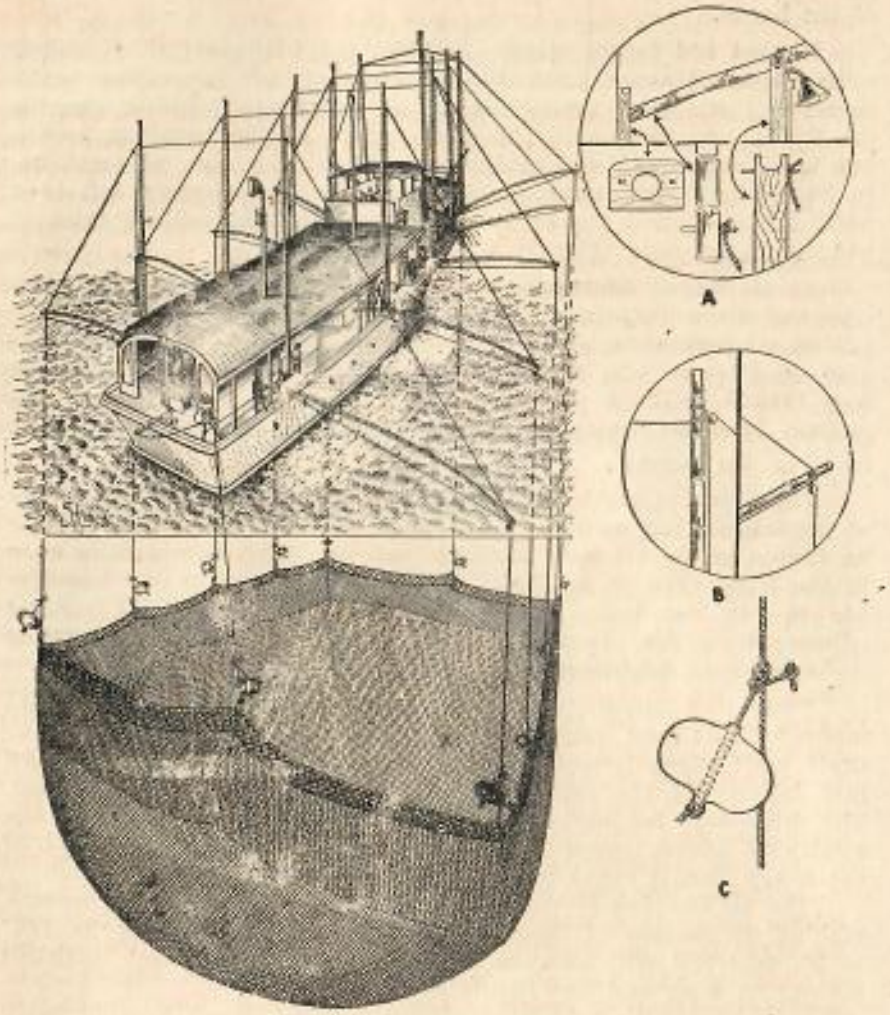

FIG. 5. A motor-vessel basnigan in operation.

bical in form which is held by from 6 to 10 pull ropes *(paliban)* from the outrigger "horns" or booms of the vessel. The operation is usually conducted during the dark of the moon and is the same on all basnigan types mention above. The craft is anchored in a sheltered area and the net lowered to the bottom or close to it. The lights are put on and as soon as a sufficient number of fish

are attracted, the lights are dimmed and the net hauled to the surface. The catch is impounded in one corner of the net and the fish brailed out into the craft. Hauling-in of the net is mostly done by manpower with the aid of a single block at the terminal end of the horns.

Present and future status—In 1952, the 648 basnigan operating units produced about 3,956,872 kilograms of fish equivalent to 57 percent of the total production of all commercial fishing gear in the Philippines (Fig. 1). The development of the basnigan fishery has been very rapid and continuous without any sign of recession. In 1948, the fishery started with 168 units and steadily increased until the maximum number was attained in 1952 with a total of 648 operating units (Fig. 4).

As to fishing efficiency, the basnig ranks third to the otter trawl with an estimated production of 2,774 kilograms per gear, per man in 1952. Similarly it comes third on the production per gear used which was 55,489 kilograms. This gear employs almost twice the number of fishermen of the trawling gear but half the number of that of the sapyaw. In effect the basnig is an improvement of the sapyaw.

The future of the basnig fishery is apparently bright with plenty of possibilities for further improvement of the craft and gear. The hauling-in of the net with the pull ropes is still done manually even in the latest type of basnigan. At this writing, only one basnigan has so far installed a driver-shaft geared to individual hauling winches along the promenade deck of the vessel, thereby reducing the number of fishermen to half the usual requirements.

Since the fishing grounds for basnigan are located over submerged shoals and reefs, the development of a suitable shallow-draft craft characterized with some ease of maneuverability and fast delivery of the catch is one avenue of possible improvement. The drive-shaft hauling winches may be further improved by using electricity driven power gurdy using small steel cables instead of the heavy Manila ropes which can be operated by an individual.

The net has fine meshes, consequently it is too heavy to operate. Making the meshes of the upper selvage of the net wider by 1/2" to 2", stretched will increase fishing efficiency and effect sufficient savings on wear and tear of the net.

Experiments on various color of light, with high penetration and the use of submarine light may increase fishing efficiency. A basnigan operates with comparatively limited efficiency since it can fish only during the dark of the moon. In Australia and Malaya success was attained with the introduction of light purse seine net using light as an aid in fishing. This lighter type of seine can possibly be substituted to basnig net with much less manpower needed and with possibly more catches. The use of purse seine net is a decided advantage over the basnig net in that it can be operated both during the dark phase of the moon and during the daytime by working on surface schools of fish. Moreover, the purse seine can be operated without the necessity of anchoring and during under fairly adverse weather conditions.

A suitable purse seine outfit consists of a 200 fathom net by 30 fathoms on the bunt, made of lighter netting and one accessory dinghy for lighting. A series of dinghys with powered lights from the mother vessel passing through long electric cords can supply the needed light attraction for the fish. When sufficient fish has been attracted, they can come close together and at a given signal the mother craft can set out the net to enclose the fish attracted by the lighter dinghys.

The use of fish detector can further increase the fishing efficiency and range of operation of the purse seine as it can fish night and day irrespective of the phase of the moon or whether the schools of fish are visible on the surface or on the sub-surface layer of the water.

COMMENTS AND RECOMMENDATIONS

These two outstanding gear are non-selective and their extensive and intensive operation have been adversely affecting the fishery resources in many fishing grounds of the country. In recent years increasing evidence on the decline of both the pelagic and demersal stock is being noted. While further advancement in the technology of gear is necessary, concurrent studies on the biological effect on the fisheries concerned demand equal attention by the constituted authorities if we are to preserve this very important patrimony of the nation for posterity.

TABLE I

Number of units, total catch, catch per unit, and estimated catch per man per gear of ten leading commercial fishing outfits in the Philippines for the year 1952.

Gear	Number of units	Total catch in kilograms	Catch per unit, gear used in kilograms	Estimated catch per man, per gear, per year in kilograms	Normal No. of men in crew per gear
Bag net	648	35,956,561	55,489	2,774	20
Otter	234	15,620,559	66,752	5,562	12
Beam	56	3,055,020	54,536	4,544	12
Beach seine	45	881,770	19,594	784	25
Gill net	2	32,000	16,000	800	20
Hook and Line	3	171,030	1,102	570	50
Longline	1	29,115	29,115	1,941	15
Muro-ami	1	14,490	14,490	659	22
Purse seine	35	580,369	16,582	474	35
Round haul seine	90	6,474,214	71,936	1,798	40

TABLE II

Resumé of information on commercial fishing vessels: Years 1948-1952.

Item	1948	1949	1950	1951	1952
Vessels, total number	469	826	893	1,148	1,227
Classified according to kind of gear employed:					
Bag net	168	242	333	502	648
Beach seine	19	16	16	37	45
Beam trawl	94	166	157	131	56
Gill net	4	5	5	2	2
Hook and line	9	2	8	7	3
Long line	—	1	3	2	1
Muro-ami	9	2	2	2	1
Purse seine	9	10	16	26	35
Otter trawl	15	58	129	190	234
Round haul seine	63	213	109	107	90
Miscellaneous 1/					
Fish carrier 2/	53	73	71	70	56
Pearling boat 3/	—	2	4	8	7
Towing vessels 4/	26	31	42	64	49
No. of powered vessels	324	479	651	792	879
No. of non-powered vessels	145	347	242	356	348
Total tonnage (metric tons)	5,790	17,560	20,260	23,438	24,995
Total investment (pesos)	4,601,109	9,970,274	11,715,107	14,618,241	12,561,907
Total Number of licensed fishermen	3,699	12,318	12,171	9,463	11,832
Total production (kilograms)	41,995,461	54,826,595	47,932,881	69,027,384	73,315,041

1/ Licensed as commercial fishing vessels, but used in functions other than catching fish.
2/ Used in pearl fishing.
3/ Used as fish transport.
4/ Used for towing non-powered fishing boats.

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HANDLING AND PROCESSING OF SOME FISHERIES PRODUCTS IN SOUTHERN PHILIPPINES

By JOSE I. SULIT
Bureau of Fisheries, Manila

The tropical warm climate which hastens fish spoilage is one of the immediate problems confronting the handling and processing of fisheries products in this country. In most remote fishing regions where ice is expensive and hardly available, fish is commonly preserved by salting and drying. Icing is profitable only when first class fish is preserved. Less than two percent of trawlers are equipped with mechanical refrigeration. The rest of the fishing fleet preserve most of their catches with crushed ice.

FISH PRESERVATION IN SAMAR

Catbalogan, with a population of approximately 27,000, has a sufficient supply of fish throughout the year. It is the capital of the province of Samar where the principal fishing ground is Maqueda Bay which, including Catbalogan coastal waters, is considered one of the richest fishing grounds in the Philippines. In spite of the general depletion of many surrounding principal fishing grounds, Maqueda Bay still provides profitable fishing for most of the fishing boats operating in this area. The commercial species of fish found in this region are: anchovies (bolinao, dilis), *Stolephorus indicus;* chub mackerels (hasa-hasa), *Rastrelliger brachysomus;* slipmouths (sapsap), *Leignathus equulus;* herrings (haul-haul), *Sardinella* sp. sardines (tamban), *Sardinella longiceps;* cavallas (talakitok), *Caranx sexfaciatus;* crabs (alimasag), *Neptunus pelagicus;* oysters (sisi); shrimps, etc.

FISH CANNING

At Guinsorongan, a progressive fishing village of Catbalogan, Samar, canning and salting of fish are being undertaken profitably as in pre-war days. A fish cannery established three years ago by the Samar Canning Corporation puts up several species of fish at the rate of 200 cases a day. The cannery makes its own cans, importing the tin plates from the United States. Some of the canned products are *"paksiw na dilis" hasa-hasa* in tomato sauce, and *alimasag* in oil.

Paksiw na dilis — The fish is washed as soon as received and packed in cans and steamed for 20 minutes. The water produced

during the steaming process is drained off and is replaced with a pickle solution containing vinegar, spices, tomatoes, and green peppers. The cans are exhausted for 15 minutes, sealed completely, sterilized for 40 minutes at 15 lbs. pressure, then washed in one percent sodium hydroxide solution; finally allowed to cool and labelled.

The same procedure is followed for canning *"pakaw na sapsap."*

Hasa-hasa in tomato sauce — The fish is placed in a weak brine (one part salt to 6 parts water) for 30 minutes. The head, fins, tails, internal organs are removed, washed thoroughly of blood and slime and allowed to drain. The hasa-hasa is then fried in good cooking oil until slightly brown, packed in No. 1 tall cans with one tablespoonful of tomato sauce added; exhausted for 15 minutes, sealed completely and sterilized for 90 minutes at 10 lbs. pressure.

Alimasag in oil — The crabs are steamed in a retort for few minutes, allowed to cool, then flaked. The flaked flesh is put in cans with one teaspoonful of peanut oil added; exhausted for 15 minutes, sealed completely and sterilized for 50 minutes at 10 lbs. pressure.

Brine salting — The cannery also engages in salting and drying various species of fish during the heavy fish season. At this time most of the people in the fishing villages along the mainland and islands around Maqueda Bay also salt and dry such fish as hasa-hasa *(Caranx kalla)*; sap-sap and various species of herring. These fish are cured for two to three hours in concentrated brine solution. Then they are removed and sorted as to kind, washed with clean sea water and allowed to dry in the sun for two to three days, the drying time depending upon the size of the fish and the weather. In the case of hasa-hasa, the gills and viscera are removed as soon as they are taken from the salting vats.

Dilis salted fish paste — These small fish are salted in the proportion of one part salt to three parts fish by volume. The fish and salt are mixed thoroughly in cement tanks by means of shovel or with merely the use of hands and feet. The mixture is allowed to stand overnight, and the raw bagoong is then packed in 5-gallon cans or in 55-gallon drums and shipped to Manila for further aging.

Drying of dilis — Because of its small size and low fat content, dilis is sundried without salting. After washing with clean sea water, the fish is spread in the sun on buri or bamboo mats and allowed to dry for two to three days. The dried product is packed directly in jute sacks and shipped to Manila and other localities.

Salting of sisi — This bi-valve is found in the shallow portions of Maqueda Bay and is gathered during low tide. The sisi is shucked right on the spot where it is gathered. Shucking is done by hand, a very slow process, taking a whole day for a person

to fill a gallon can with sisi meat. The shell meat is salted in the ratio of three parts meat to one part salt, then allowed to ferment for a week before bottling for the market. Three beer bottles of salted sisi retail for one peso.

Fresh sisi meat is also sold in public markets. The people consume it raw with or without vinegar. Fresh sisi meat omelet sandwich is a delicacy in Samar province.

ICING

Temporary preservation of first class fresh fish and shrimps by icing is a very profitable industry in Catbalogan, Samar. Boxes of 100 kilos net capacity are used for transporting them to Manila. First class fresh fish and shrimps cost from ₱0.80 to ₱1.00 per kilo in Samar.

DISTRIBUTION OF FISH

Most of the fish caught and processed in Samar are shipped to Manila, but a sizeable portion finds its way to such populous islands as Cebu, Bohol, Leyte, and to neighboring provinces. Four interisland vessels make regular weekly trips between Manila and Catbalogan. Three boats maintain a weekly schedule between Cebu, Catbalogan and other Samar ports. Daily trips between Catbalogan and Leyte are maintained by small crafts.

For distributing fish products, various packings are used. Salted fish bagoong is packed in 55-gallon drums; dried fish are packed in boxes and baskets; and iced fish and shrimps are packed in boxes of 100 kilos net.

FISH PRESERVATION IN ZAMBOANGA AND SULU

Repacking of bagoong — A new kind of fishery industry is the repacking of bagoong which exists in Zamboanga City. So far as the writer is aware, such practice is not pursued in any part of the Philippines. Because in Zamboanga tin containers and salt cost more than fresh dilis used, the pickle produced in dry salting of dilis is discarded to put in more fish material per unit can of bagoong. As soon as this type of product is received in Zamboanga another one-third of brine solution is added so that the repacking of the product gained an extra one-third in the finished product. Following is a prospectus in repacking bagoong in Zamboanga.

MONTHLY OUTPUT OF REPACKED BAGOONG
(4,000 cans of 5-gallon capacity)

1) Cost of production:

3,000 cans of bagoong at ₱3.80 each	₱11,400.00
1,000 empty cans at ₱0.50 each	500.00

Salt added (₱0.30 per can)	300.00
Fisheries fee, ₱0.10 per can	400.00
Soldering and stevedoring, ₱0.30 per can	1,200.00
Freight to Davao, ₱0.45 per can	1,800.00
Total	₱15,600.00

2) Selling price F.O.B. Davao
4,000 cans of bagoong at ₱3.50 per can ..... ₱22,000.00
3) Net gain 6,400.00

FISH PRESERVATION BY SALTING AND DRYING

(a) **Daeng** — Most of the salted dried fish sold in Zamboanga market come from the Tawi-tawi islands of the Sulu Archipelago. Some species of fish, however, such as *tulúngan* (*Auxis thazard*); *dalagang bukid* (*Caesio* sp.); *talakitok* (*Caranx* sp.), etc. are caught in waters close to Zamboanga and salted and dried in fishing villages near the city. During heavy fishing season fish are dressed right on the city's wharf then distributed to various fish driers in the suburbs.

(b) **Binoro** — This is salted tamban and its preparation is a big business in the tamban-fishing center of Maluso, Basilan City.

The fish is immersed in concentrated brine solution for at least twelve hours or until firm. From the brine the fish is allowed to drain, then packed in bamboo baskets lined with paper or banana leaves. Each layer of fish is covered with salt and more salt is added on the last top layer to protect the fish from flies. The finished product is shipped in 55-kilo baskets to Zamboanga from where it is distributed to different parts of the Philippines.

(c) **Salted fish paste (bagoong)** — Large quantity of bagoong is being prepared in the two municipalities of Sulu, namely, Siasi and Bongao, and neighboring small islands. The capitalists supply the fishermen with prime commodities and in return these fishermen turn over to them the finished product at a low price.

The bagoong is prepared by mixing four 5-gallon cans of dilis with one sack of salt of 45 kilos. After twenty-four hours the pickle produced is removed and discarded and the residue packed in 5-gallon cans for shipment to Siasi bagoong factory. At the factory more salt is added to insure preservation.

The practice of discarding the liquid pickle in bagoong making is highly objectionable since the pickle is rich in food value. This practice, however, is taken advantage of by bagoong repackers in Zamboanga who are able to produce an extra can for every three cans of Siasi bagoong by adding brine solution. This solution is of course a poor substitute for the valuable pickle that is lost. The bagoong repackers are alien capitalists and so long as they make good

profit from the bagoong as it is now produced, they can hardly be expected to take the initiative in improving the product.

(d) **Dry salted fish (daeng)** — A superior method of preparing daeng was started by a Bornean in the municipality of Bongao. Species commonly dry-salted are *mayamaya, pampano, talakitok* and *dalagang bukid.*

After splitting the fish, the gills, viscera and blood are removed with the aid of a hard thick brush. The fish is washed in sea water, drained, dry salted and then arranged with the meat side-up in wooden vats; set aside for six hours or until firm. Then a little brine is added to cover the fish (one part salt to three parts sea water).

The next day the salted fish is removed from the brine, washed thoroughly with sea water, and dried on split bamboo mats for three to four days. The product is a first class daeng of almost golden yellow color with the flesh firm and somewhat resilient. This product differs from those prepared by the Moros which are grayish to dark brown in color signifying inferior quality.

The municipality of Sitangkai — In this town, practically every house has a fish drier. This explains why it produces the greatest quantity of dried fish (daeng) in the whole Sulu Archipelago.

The Moro fishermen deliver the fish already dressed to various fish driers at a price of ₱0.40 to ₱0.50 per kilo When delivered as dried daeng, the fish are sold at ₱0.60 to ₱0.80 per kilo.

During the heavy fishing season no less than 200 boxes of 50 kilos of daeng are shipped weekly from Sitangkai to Zamboanga and are distributed to Davao, Cebu and Manila.

Sitangkai is a very small island of about four hectares and during high tide most of the land is covered with water. About 90 percent of the houses are, therefore, built above water. The sea surrounding Sitangkai is very shallow and during low tide it is exposed, a favorable factor for the growth of seaweeds which are mostly of the genus *Gracilaria, Caulerpa, Laurencia, Eucheuma* and *Sargassum.*

UTILIZATION OF SOME PHILIPPINE FISHERIES PRODUCTS*

By ANTONIO M. DE VERA
M. A. Roxas Memorial School of Fisheries
Daanbantayan, Cebu Province

WINDOW-PANE SHELL, SEA CUCUMBER, SEAWEEDS AND DRIED ANCHOVY

In accordance with the recommendations of the member nations of the Indo-Pacific Fisheries Council to utilize fish and fishery products for the production of more sea foods, the Philippine Bureau of Fisheries has geared its technical know-how and undertaken researches on the standardization of sea food recipes, utilizing the meat of window shell *(kapis)*, sea cucumber *(trepang)* and seaweeds *(gulaman-dagat)*. Periodic testing of developed recipes by the Bureau's testing panel composed of technical men has been made, taking into account the flavor, odor, texture, appearance and amount of ingredients used. The comments and suggestions given were embodied in the final development of the recipes. The following are descriptions of the partial results of studies undertaken at the fish preservation laboratory on the standardization of these sea food products:

WINDOW SHELL

The *Placuna placenta* Linnaeus, commonly called the window shell, window pane shell, window oyster or Chinese window shell, is known locally as *kapis* (Tagalog), *lampirong* (Visayan), *kalampinay* (Bicol), *kalansipay* (Pangasinan) and *kulintipay* (Ilocano).

The uses to which the shell are applied are more extensive than is generally supposed. Because of their transparency and durability, the shells have been utilized in the Philippines in the manufacture of window panes during the past hundred years. The meat which has not been fully utilized due to lack of proper knowledge in its preparation, except in the making of the common paste *(bagoong)*, has been prepared in various ways as food. The following recipes have been developed as a result of experimentation:

SALTED KAPIS MEAT (Paste)

3 parts of kapis meat
1 part salt

Wash the meat thoroughly with fresh water to remove the slime. Then for every 3 parts of kapis meat add 1 part of salt by weight or by volume. Add the salt to the meat in little amounts and stir until the salt is all used up. Leave the mixture to ferment in a container which is well covered to keep off flies. After several weeks or months, the paste is ready for use. **Patis,** the supernatant liquid developed during fermentation, is siphoned out and bottled for use in flavoring food preparations.

KAPIS ADOBO

Kapis meat	1,500 grams
Salt	1-1/3 tablespoons
Black pepper (powdered)	1 teaspoon
Garlic (minced)	100 grams
Vinegar (native)	200 cc.
Pork lard	4 tablespoons

Wash the meat in fresh water to remove the slime. In the meantime that the kapis meat is being drained, prepare the ingredients. Mix the kapis meat with the ingredients except the pork lard. Cook in a sauce pan and stir frequently until the liquid portion has evaporated. Add the pork lard and cook further for 3 minutes. Serve right away or can in a 1/2 lb. enameled tuna can. If canned, exhaust for 10 minutes and process at 10 lbs. pressure for 25 minutes.

KAPIS CHOWDER

Kapis meat	1 quart
Salt pork (cut to small pieces)	6 tablespoons
Onion (minced)	1 large size
Flour	2 tablespoons
Kapis stock	2 cups
Salt	2 tablespoons
Sweet potato (diced)	2 cups
White pepper (powdered)	1/4 teaspoon
Pork lard	4 tablespoons

Wash the kapis meat thoroughly with fresh water to remove the slime. Set it aside to drain. Prepare all ingredients. Place the lard in a pan and saute the salt pork, onion and sweet potato. When done, add the kapis meat. Dissolve the flour in the kapis stock and add to the mxture. Cook and when done, add the salt and white pepper. When serving, add 1/2 cup evaporated milk. If desired, the product may be canned in a 1/2 lb. enameled tuna can without the addition of milk. Exhaust for 10 minutes and process at 10 lbs. pressure for 30 minutes.

KAPIS OMELET

1 cup kapis meat
1 cup evaporated milk
1/2 tablespoon flour
5 eggs
2 tablespoon pork lard
Salt and pepper

* Presented at the 3rd IPFC meeting at Madras, India, 1951.

Beat the eggs and add to the milk, salt, pepper, flour and kapis meat. Place the lard in a skillet to which, when very hot, pour in the mixture and cook slowy in a gentle fire. When about done, make a cut through the center towards the handle of the skillet. The cut must not run thru the bottom. Fold one side over the other, then cook further. Slide it into the place with a turner.

SEA CUCUMBER

The sea cucumber or trepang is an important sea food scarcely known at all in Europe. It is abundantly found in the Pacific and its adjacent seas. Sea cucumber is a general name applied to many species of sea animals belonging to the group of Holothurioides and known in the Philippines as *beche-de-mer, kulatan, bat, balat, mauang, kisam, balate,* or *namaco.* The processed trepang is exported to China and Japan where it is a staple food.

The sea cucumber resembles a pickled cucumber. Its skin may be smooth or covered wtih prickle-like teats arranged in rows or scattered over the body. The color varies from pale flesh to black. However, when processed, the trepang becomes hard and assumes a sausage-like shape. It becomes palatable only when it is cleaned, minched, and made into appetizing soup. There are sixteen principal varieties and forty-seven commercial grades of trepang in the Philippines. They live usually among corals in the sea garden vegetation and are mostly found in the reefs of the Sulu Archipelago, in the vicinities of Jolo, Siasi, Bongao and Sitanki. They are also found in abundance in Davao Gulf where they feed mostly on small sea animals and vegetation.

The commercial varieties with superior qualities are known by the following names in the Sulu and Manila markets: *Bangkolugan, keskesan, talepan, mauang, sapatos China, loclowan, balati blanco, matam, hangenan* and *sapatos grande.* These are graded from the best down as follows: (1) *Oe,* uniformly black in color, perfectly smooth and, when dried, from 120 to 200 millimeters, (2) *Gau Sim,* large and brownish with 2 rows of teats and, when dried, flat and about 120 millimeters. Back is slightly roughened. (3) *Bark Sim,* of six kinds. (4) *Moi Whar Che,* large with the entire back covered with numerous long teats which are black or reddish-brown. (5) *Hong Che,* resembling No. 4 but smaller, with teats pointed and slightly larger in size.

The sea cucumbers are gathered from mud-banks and taken to the processing shed where they are placed in an iron kettle *(kawa)* with enough water and then boiled for 15 to 20 minutes to make them hard and elastic. They are later split open with a sharp-pointed knife, the internal organs removed, and then placed on trays to dry under the sun. When nearly dried, they are smoked for about 24 hours. After smoking, they are further sun-dried

until they become thoroughly hard and free from moisture. As trepang is highly hygroscopic, it is kept dry until shipment.

The following recipes have been prepared using trepang as the principal item:

TREPANG PANCIT[1]

Trepang (sliced)	2-1/2 cups
Garlic (minced)	4 tablespoons
Dried anchovy	1/2 cup
Hibe (dried-shelled shrimp)	1/3 cup
Patola (sliced)	2-1/2 cups
Onion (minced)	1/2 cup
Pechay (cut)	3 cups
Noodle (mike)	2 kilos
Fish sauce (patis)	3 tablespoons

Clean and slice thin the trepang and soak it in water for two days, changing the water several times. Boil the soaked trepang in 1-1/2 liters of water with 2 tablespoons of sodium bicarbonate until it becomes tender. Cut the noodle into pieces. Prepare all vegetables. Wash the dried anchovy and hibe. Saute the garlic, onion, shrimp and anchovy. Add the trepang and patola. Season with the fish sauce. When done, add the noodle and the pechay and cook further. Garnish with sliced hard-boiled eggs and cut raw onion leaves. Dash with powdered white pepper to taste.

TREPANG SOUP

Trepang (sliced)	53.2 grams
Pechay (sliced)	22 grams
Garlic (minced)	5 grams
Onion (minced)	20 grams
Patis (fish sauce)	2 tablespoons
Pork lard	2 tablespoons
Salt	1/2 teaspoons
"Betsin"	1/2 teaspoons
Small hot pepper (native)	1
Water	1-1/2 cups

Clean and soak the sliced trepang in water for about two days, changing the water several times. Boil the sliced trepang in about 1-1/2 liters of water with two tablespoonfuls of sodium bicarbonate until it becomes tender. Drain and set it aside. Saute the garlic, onion, trepang and pechay. Then add the water. When the ingredients are cooked, season the soup with the rest of the ingredients.

SEAWEEDS

In Philippine waters there are more or less twenty species of edible seaweeds, but the most commonly utilized is the one belong-

1 Pancit is a kind of Chinese noodle food preparation which is very popular in the Philippines.

ing to the genus *Gracillaria*, locally called *gulaman-dagat*. During the months of January to June the seaweeds are found along the west coast of the Philippines in the provinces bordering Manila Bay, notably Rizal, Bulacan, Pampanga, and Bataan. They appear as scattered filamentous branches loosely attached to the sandy substrata or some foreign materials such as pieces of shell, wood or grass. After several weeks the growth becomes very thick in nature. The color of the fronds vary from dark green or pale-greenish white to brown purple.

During low tide the fronds of seaweeds are collected by means of the hand and placed in suitable containers or possibly a **kaing**. On shore they are washed with fresh water to remove foreign matters like small pieces of wood, shell or grass and then spread evenly in thin layers on bamboo trays or galvanized iron sheets to dry under the sun. Bleaching is usually accomplished by: (1) treatment with sunlight (2) rice washing or (3) a weak lime solution. In the light of experiments conducted at Navotas, Rizal. No. 1 treatment is recommended for bleaching the seaweed. The process is as follows: When the weeds are already spread out to dry, they are, during the day, sprayed with water several times. At the end of the day they are soaked in water until the next morning when the weeds are rinsed with fresh water at least two times and again spread out to dry. After the first day of drying, the color changes to light purple, and the seaweeds shrink from 1/2 to 1/3 of their original bulk. The procedure is continued until the seaweeds attain a final light cream color, which is usually accomplished within 3, 4 or 7 days time, depending upon the frequency of water spraying and weather conditions.

From time immemorial oriental peoples, especially the Chinese, Japanese, Filipinos, and Hawaiians, utilized seaweeds as food. Since these plants contain a high percentage of protein and large amounts of soluble nitrogenous and organic compounds, they have high food value. Besides they furnish salts and vitamins for the body. In Navotas and Malabon, Rizal Province, during the Japanese occupation, many people were saved from malnutrition by utilizing these seaweeds in their diet in the form of various food preparations.

Seaweeds are employed in industry and agriculture. The agar or agar-agar extract from seaweeds is utilized in the manufacture of confectioneries, laxatives, cosmetics, bread, dental products, bacterial culture media, cordials and condiments, welding fluxes, etc. It is used in meat and fish canning, the clarification of wine and vinegar and the glazing of textile and upper leather. During the last war seaweeds were used in the manufacture of shatter-proof glass for airplanes. Fishpond owners have been utilizing gulaman-dagat as a supplement to the dwindling supply of algae in ponds.

In the past researches on seaweeds were mainly on agar extraction methods, solubility at various temperatures, chemical structure, physio-chemical properties, etc. Only recently has work been undertaken on the standardization of food recipes from agar. The following recipes have been developed at the Philippine Bureau of Fisheries:

S A L A D

2 cups blanched seaweeds
4 regular size ripe tomatoes (sliced)
1 regular size onion (sliced)
1/2 cup native vinegar
1 tablespoonful sugar
1 teaspoonful salt
Powdered black pepper—to taste

Wash the fresly gathered *gulaman-dagat* to remove foreign matters like small pieces of shells, wood, or grass. Cut weeds to about 1 inch long and blanch. Drain. Place in a salad plate and add the vinegar, sugar, salt, black pepper and mix. Place the sliced tomatoes and onion on top.

GULAMAN DESSERT

1 regular size melon or 2 mangoes, (scooped into balls or cubes)
1 cup diced pineapple (canned or fresh)
1 cup sugar
1/2 cup coconut milk or (evaporated cow's milk)
50 grams of dried bleached seaweeds (gulaman-dagat)

Boil the 50 grams of dried bleached seaweeds in 5 cups of water for about 30 minutes. Strain thru unbleached muslin or 5 layers of gauze and add the ingredients. Cool until the agar jells. When firm, unmold into a platter and serve.

JELLIED SHRIMP SALAD

1/2 cup coconut milk or (evaporated cow's milk)
1 medium size red pepper (diced)
1 hard boiled egg (chopped)
1 medium size green pepper (diced)
1 regular size onion (minced)
1 regular size carrot (minced)
50 grams of dried bleached seaweeds (gulaman-dagat)
2 tablespoons lemon juice
1 teaspoon salt
1 teaspoon vinegar

Peel shrimps and boil them in a weak brine solution for 5 minutes. Mix the diced red and green peppers, carrots and minced onions. To five cups of water add the dried bleached seaweeds and boil for 30 minutes. Then strain thru 5 layers of gauze or unbleached muslin. Mix all the ingredients with the strained gulaman or extract and place in a mold. Cool for about 3 to 4 hours, if possible,

in a refrigerator. Unmold the jelly when firm into a platter, garnish with parsley and tomatoes and serve with mayonnaise.

DRIED ANCHOVY

Anchovy, called *dilis, bulinao, monamon, diris* or *talisok,* is found throughout the Philippines but it is especially abundant in northern Luzon, Balayan and Batangas bays, Samar Sea and Maqueda Bay. The flesh of the anchovy is somewhat dry but it is delicate and of good flavor. These characteristics make it ideal for making bagoong. Anchovy can also be made into *kroepoek,* biscuit and toast. Dilis is now used as a supplement in calcium-deficient diets. Dried dilis has been reported to contain 15.4% moisture, 68.1% protein, 3.7% fat, 2.6% calcium and 2.0% phosphorus.

DILIS BISCUIT

1-1/2 cups flour
6 tablespoons dilis powder
4 teaspoons baking powder
2 tablespoons sugar
1/2 cup shortening
2/3 cup milk

Preparation of dilis powder: Remove the stomach portions and head of ordinary dried dilis with one slide stroke of a sharp kitchen knife. Wash thoroughly in fresh water, drain and toast in oven until crisp. Grind fine and keep in airtight containers.

Mix the flour, dilis powder, baking powder and sugar; cut in the shortening until the mixture resembles coarse crumbs. Add the milk all at once and stir just until the dough flows around bowl. Plate the dough on a lightly floured surface, roll to size and then cut with a biscuit cutter. Bake on an ungreased cookie sheet in moderate over (230 deg. F.) for about 8 to 10 minutes. About 50 pieces of 1-1/4 inch square biscuits can be made from the preparation.

DILIS KROEPOEK

2 cups native rice (wagwag)
2 cups water
1-1/2 teaspoons fine salt
6 tablespoons dilis powder
2 teaspoons lime solution (made by dissolving ordinary lime in 1/2 cup water)

Wash and soak the rice in water overnight. Next morning wash thoroughly and drain it well. Add the 2 cups of water and then grind. Stir the ground mixture and add the dilis powder, salt and lime solution. Set it aside. Prepare the steamer. Put 3 tablespoonfuls of the mixture in a pie plate, spread evenly and steam for about 3 to 5 minutes or until the mixture is clear or transparent. Remove from steamer and cool over a basin of water.

Cut into desired shape and size and day in a tray under the son. Fry in deep fat. Drain and serve. For future use keep dried kroepoek in a tight container.

DILIS TOAST

Cut bread into 1/4 inch slices; spread with butter and sprinkle generously with dilis powder. Toast in over at 400 deg. F. until rich golden brown.

ICHTHYOLOGY IN THE PHILIPPINES

By AGUSTIN F. UMALI
National Museum, Manila

The history of ichthyology is said to have begun with Aristotle who studied the fishes of Greece. From available literature it appears that the earliest recorded work on Philippine fishes was that of Bernhard G. E. Lacepede in his "Histoire Naturelle des Poissons" published in five volumes in Paris in 1798-1863, wherein was recorded and described one species of trumpet fish (Family Aulostomidae) from the Philippines. From then on, works of early European scientists such as those of Proce (1822), Heckel (1840), Muller (1843), Richardson (1846), Kaup (1858), Gunther (1859), Bleeker (1862-1877), Kner (1865), Peters (1865-1869), Meyer (1885), and many others recorded and described Philippine forms.

Ichthyology in the Philippines received very little attention during the Spanish regime. In 1895 Fr. Casto de Elera compiled a catalog of the fauna of the Philippines in which was included an enumeration of some Philippine fishes. The museums of the University of Santo Tomas and the Ateneo de Manila were repositories of some of the collections of Spanish naturalists.

During the American regime, ichthyology received a good share of attention. Prominent among the American ichthyologists who did notable work on Philippine fishes, some of whom are still active, could be mentioned Alvin Seale, A. W. Herre, D. S. Jordan, A. L. Day, C. L. Hubbs, G. Myers, L. Radcliff, R. E. Richardson, B. W. Evermann, G. H. Gilbert, H. W. Fowler, and H. M. Smith.

The repository of the collection of the early American workers in the Philippines was the Division of Zoology of the Bureau of Science. In February, 1914, the Manila Aquarium located at the Ravelin de Bagumbayan of the Walled City (Intramuros) was inaugurated. In 1921, the Division of Fisheries of said Bureau was established independent of the Division of Zoology. Included as one of its main functions was the intensification of the collection and study of Philippine fishes. This was the only government entity charged with the study and maintenance of a collection of fishes, although some workers in the Department of Zoology of the University of the Philippines also conducted researches on Philippine fishes. Before World War II, this collection was considered one of the largest in the Orient. Among the valuable materials were many irreplaceable type specimens which were all lost during the battle for the liberation of Manila, together with

the equally priceless ichthyological references in the Scientific Library of the Bureau.

There seemed no definite government policy as to the housing and maintenance of the ichthyological collection before the outbreak of World War II. Evidence of this was the too frequent transfer of said collection from one building to another, and from one office to another. The enormous collection representing 2,000 species and distributed to 200 families was originally housed in the first floor of the right wing of the Bureau of Science Building. With the completion of the left wing of said building, it was transferred to the basement of that wing. Here it was subjected to flooding during every rainy season. In the reorganization of the government in 1934, and with the conversion of the Division of Fisheries into an independent division known as the Fish and Game Administration, said collection was transferred to the National Museum Building at Port Area where a wing was constructed for that purpose. The transfer of the Fish and Game Administration back to the Bureau of Science in 1934 carried said collection back to the basement of the left wing of the Bureau of Science Building. Again, in the organization of the National Government in 1939, it was transferred to the Oriente Building at Binondo with the transfer of the then Fish and Game Administration back to the Office of the Secretary of Agriculture and Commerce as an independent Division of Fisheries. In 1940, when the National Museum was designated as the repository of all natural history specimens of the government, it was returned to the Bureau of Science Building where it occupied a good portion of the second floor of the left wing. Here it was finally burnt and destroyed in the battle for the liberation of Manila in the early part of 1945.

In July, 1945, when the National Museum was organized, the beginnings of the post-war collection was laid. Thanks to the efforts of the Philippine Fishery Program of the U.S. Fish and Wildlife Service, the present collection has gradually taken some semblance of its former shape. What with the enormous collection made on board three motor vessels, the "S. F. Baird", "T. N. Gill", and the "D. S. Jordan" from different and remote places of the Philippines in the course of the survey of Philippine fisheries. A donation of a good lot of pomacentrids by the U.S. National Museum and a sizeable batch of assorted materials from the Australian Museum and the Queensland Museum have augmented the present stock.

To date there are in our present collection no less than two thousand specimens segregated in regular museum bottles belonging to 129 families, with still a good portion of unassorted ones which are being gradually identified and catalogued. With these modest beginnings, there still exists, however, the great task of rehabilitating the collection to the pre-war levels. In this job, the Museum is beset with many difficulties, foremost among which is the lack of sufficient funds for the purchase of needed museum

bottles and jars and for defraying traveling expenses of collectors. The total destruction of the ichthyological references in the Scientific Library is another great handicap which has to be met with by systematist sin the Philippines today.

In spite of the combined efforts of both foreign and Filipino workers in the field of ichthyology for the past several years, still there are many regions which need intensive collection and study. The waters around the Batanes and Babuyanes Group, the lakes and rivers of the Mountain Provinces, Lingayen Gulf, the deep waters of Balayan and Batangas Bay, the rocky shores around Polillo and its vicinities, the equally rich and yet very accessible waters of Manila Bay especially around Corregidor and towards Limbones Cove, Ragay Gulf, Tayabas Bay, the Bicol Regions, the deep coasts of Antique, the picturesque Puerto Galera, the unruly waters around Romblon and Tablas Islands, and many regions in Mindanao and Sulu from Davao Gulf to the distant waters of the territorial limits of the Philippines in Sitangkai and Siluag, still await conscientious efforts of Filipino workers in the line.

OUTSTANDING RESEARCH ON FISH AND FISHERIES IN THE PHILIPPINES

By CLARO MARTIN
Bureau of Fisheries, Manila

Early studies on Philippine ichthyology and fisheries which consisted of the enumeration and description of a few species of fish collected from a few localities may be considered casual in character. These classic taxonomic works on Philippine fishes of noted naturalists appeared in various European scientific journals, memoirs and natural history publications. The earliest publication in which a Philippine fish was recorded and described was the Histoire Naturelle des Poissons of Lacepede, published in Paris, 1798-1803. A species of Aulostomidae from the Philippines was described. In 1822, the first record in a scientific journal of the description of three species of Tetraodontidae from Manila appeared in an article of Proce in the Bulletin des Sciences par la Societe Philomatique de Paris. The voluminous works of Cuvier and Valenciennes, the Histoire Naturelle des Poissons, published in 1828-1843, is perhaps the earliest work which carries records or descriptions of a sizeable number of species reported from Manila. During the 19th century there had been three scientific expeditions that seemed to have gone through or touched Philippine waters. These were the H.M.S. "Erebus and Terror" in 1839-43, the Frigate "Novara" in 1857-58 and the H.M.S. "Challenger" in 1872-76. Accounts on Philippine fishes collected during the voyages of these scientific expeditionary ships have been reported, respectively, by Sir John Richardson, Rudolf Kner and Albert Gunther. Before 1900 the works of Albert Gunther, "Catalogue of the Fishes in the Collection of the British Museum", his three reports on fishes collected during the voyage of the H.M.S. "Challenger" and the "Fische der Sudsee," represented the most extensive work on Philippine fishes collected from various places in Philippine waters, and they comprised the most valuable reference on the taxonomy of fishes in the Philippines thereafter.

Other naturalists who contributed to Philippine ichthyology were Heckel (1840), Muller (1843), Muller and Troschel (1845-49), Kaup (1859), Steindachner (1864), Kner (1865-67), Peters (1865-68), Cartier (1873), Bleeker (1862-77), Sauvage (1878), Gogorza (1885-87), Vaillant (1893), Boulenger (1895), Elera (1895) and Palacky (1895). The works of these naturalists, however, did not contribute very much to the knowledge on the ichthyology

and fisheries of the Philippines. An exception is that of Elera's "Catalogo Sistematico de toda la Fauna de Filipinas," (1895), a list of all the known fauna of the Philippines up to 1895. Many species of fish in the Zoological Museum of the University of Santo Tomas collected from different places in the archipelago were included in this publication which also brought together for the first time, in a single work, all literatures on the taxonomy of Philippine fishes found in many scattered memoirs and journals, etc. In the foreword of the first volume of the same work the author briefly remarked on the zoogeography of the Philippines. The remark apparently was based on records and other information compiled during the progress of the work on the Catalogo Sistematico.

During the early part of the American regime, cognizance of the latent wealth that lay beneath the waters of the Philippine Archipelago made possible the inclusion of the section of fisheries under the Division of Biological Laboratory of the Bureau of Science when it was created out of the old office of the Bureau of Government Laboratories in 1905. Sometime in 1907, the authorities of the Bureau of Science, very likely after consultation with the scientific staff on the U.S. Bureau of Fisheries Steamer "Albatross", then in Manila on the occasion of a scientific exploratory cruise in the Philippine seas and adjacent waters, promulgated the first concrete steps toward the development of the hitherto untapped fisheries resources of these Islands. The section of fisheries was created and placed under the charge of an energetic graduate from Stanford University in the person of Alvin Seale who pioneered the development of fisheries science in the Philippines in almost all its fields, except oceanography and hydrology, thereby laying the foundation of a program for the development and exploitation of the fisheries resources of the Archipelago. He was the fish expert, primarily an ichthyologist, practical fishery economist, fishery technologist, fish culturist, marine fishery biologist and acquarist all at once. He built the collection of fishes with specimens collected from all over the Archipelago during his survey trips and published important taxonomic papers on them. He was assisted in the building of the ichthyological collection by trained Filipino collectors. The first aquarium in the Far East, the former Manila Aquarium, built through the efforts of Mr. Seale, was inaugurated in February, 1914. Since then, this aquarium has been the center of attraction to the public, tourists, students and visiting scientists interested in the observation of living marine and freshwater fishes, both for recreation and for study.

Philippine ichthyology started to flourish at the time of A. Seale. Early works of Philippine fishes by such American ichthyologists as Jordan, Evermann, and Richardson, from the collection of the U.S. Steamer "Albatross", and the work of Seale himself based on the materials in the collection he was gradually building, served as the foundation for the enrichment of this line of

science in this part of the world. The reviews of many families of Philippine fishes, the records and description of new species of Dr. A. W. Herre which were consistently continued even after his separation from service with the Philippine government, with the addition of occasional contributions made by Filipino ichthyologists, H. R. Montalban, H. A. Roxas, D. V. Villadolid, C. Martin, A. F. Umali, J. R. Montilla, P. R. Manacop, A. Agco, G. L. Ablan and G. J. Blanco, have enriched the literature on the taxonomy of Philippine fishes. Herre's work on the distribution of true freshwater fishes of the Philippines which lent further light on the zoogeography of the Philippines, besides other evidences and his "Gobies of the Philippines and the China Sea", are monumental. The works of Smith, Radcliffe, Gilbert, and Hubbs, and Fowler and Bean which appeared in the bulletins of the U.S. Natural Museum and those of Koumans, Frasser-Brunner, Whitley, McCulloch, Bruno and Taning are important contributions to the taxonomy and nomenclature of Philippine fishes.

Herre and Fowler by far have contributed most to Philippine ichthyology. Recent contributions, however, were made by Dr. G. S. Myers and Dr. E. S. Herald of Stanford University and Steinhart Aquarium, respectively.

The pre-war collection of fishes built by Seale, Herre and his successors, including the herpetological and carcinological collection of the Division of Fisheries, was turned over to the National Museum before the outbreak of the Pacific War. This collection was destroyed during the last global war. With the reorganization of the government the collections of the National Museum had to be started "from a scratch." What few number of specimens collected at the start was later augmented by the donation of the U.S. Fish and Wildlife Service at the end of the term of the Philippine Fishery Program in June, 1950. The gradually enlarging collection of fishes is now under the charge of Mr. A. F. Umali, ichthyologist of the Philippine National Museum, who, with the collaboration of I. A. Ronquillo and A. M. Sarenas of the Bureau of Fisheries, is ably pursuing studie salong this line. Meanwhile, Blanco is continuing his studies of juvenile forms of marine and freshwater fishes. The carcinological studies started by Cowles were pursued for sometime by Blanco during the first few years of his service with the Division of Fisheries.

Up to 1925, the technical personnel of the section of fisheries has been extremely limited to one — the imported expert who served as the chief of the section and whose interest is centered on his individual training. When Mr. Seale retired from the service in 1916, E. H. Taylor, herpetologist, took over Mr. Seale's work. He continued to take charge of the routine fishery activities of the section while at the same time he gradually built a herpetological collection. This became the material for his valuable

taxonomic work on Philippine reptiles and batrachians, which later became an indispensable reference for turtle fisheries and the marine snake fisheries.

In the line of marine biology, the former Director of the Bureau of Science, Dr. Alvin J. Cox, in his 12th annual report of the Bureau of Science ending June 30, 1913, stated the following: "A beginning has been made in the important branch of biology which includes the study of marine products; such as pearl oysters, window shell, edible mollusks, and edible fishes. A number of important groups of marine animals are being studied systematically —when a sufficient amount of systematic works has been completed, we shall have a substantial basis for extended economic work and for the development of the fisheries industries." This again was a line pioneered by Alvin Seale resulting in the publication of three serial reports on the fishery resources of the Philippines, and another three serial reports on the sea products of Mindanao and Sulu on food fishes, pearl shells, button shells, sponges, tortoise shells, clams and beche-de-mer. These reports have for many years served as valuable references on Philippine marine products until later information was added by F. Talavera and Dr. L. Faustino in 1930 and 1933, and J. S. Domantay since 1936.

Fish culture, especially the raising of *Chanos chanos* in ponds, has long been practiced in a scale as to make it industrially important in many estuarine localities bordering Manila Bay. However, as late as 1912 this important phase of the fisheries industries was still unnoticed by the Government as shown in the Report of the Director of the Bureau of Science for the year ending August 1, 1912 — "we are in great need of a fish pond, where experiments for improving fish farming and shellfish industries may receive some much needed attention." Later workers like Herre and Mendoza in 1929, and Adams, Montalban and Martin in 1934 wrote detailed description of the cultivation of Chanos chanos. The long-felt need for an experimental fishpond became a reality with the construction in 1936 of the Dagatdagatan Salt-water Fisheries Experimental Station and of the Binakayan Oyster Farm in 1937. The biological phase of the Chanos culture industry and the culture of other estuarine species as the crabs *(Scylla serrata)*, sugpo *(Penaeus monodon)*, oysters *(Ostrea irredalei* and *O. malabonensis)* and the window pane shell *(Placuna placenta)* have since then occupied the attention of the enlarging technical staff of the Division of Fisheries. In this line of study, F. Talavera, F. Arriola, Victoria Smith, D. K. Villaluz, G. L. Ablan and G. J. Blanco contributed in no small measure. Fresh-water fish culture, it may be mentioned, was also begun in the Philippines by A. Seale in 1907 when he introduced the black bass *(Micropterus salmoides)* from California. He also brought the mosquito fish *(Gambusia affinis)* and with it, incidentally, the *Mollienesia latipinna* which multiplied abundantly in the bañgos fishponds around Manila Bay. After Seale's time the

first accounts on freshwater fish culture were those of Dr. D. V. Villadolid and A. F. Umali. Young workers as H. Rabanal, R. Esguerra and P. Acosta, with their assistants, are continuing to enrich the wealth of knowledge on both estuarine and freshwater fish culture.

The study of parasitology of Philippine fishes started with the discovery by the writer in 1933, of an unusual number of ectoparasitic worms in the gills causing unusually great mortality among marine fishes in the Manila Aquarium. Examination of the gills of parasitized species by Dr. M. Tubangui revealed a rich source of material for the description of several new species of piscine ectoparasitic trematode worms. The life-history of *Ancyrocephalus manilensis* Tubangui was subsequently studied by the suthor. Unfortunately, the manuscript of this paper was destroyed during the war before it could be published. Later, Dr. Vazquez-Colet (1938) studied the nematode parasites of certain common Philippine food fishes.

Fisheries biology is a line of study that was introduced by Dr. D. V. Villadolid upon his return to service in the College of Agriculture, University of the Philippines, after his return from Stanford University in 1927. In 1928, the Danish steamer, R.S.S. "Dana II" touched the Philippines on its round the world scientific expedition. Dr. J. Schmidt, head of the expedition and known as the foremost authority of the freshwater eels, in the course of this trip, made a study of the systematics and biology of the Philippine Anguillidae, making use of the specimens in the ichthyological collection of the Division of Fisheries, under the Bureau of Science. In 1929, the first fisheries biology paper on the life history and habits of *Arius* spp. in Laguna de Bay by A. M. Nane, a student of Villadolid, was published. With the transfer of Villadolid from the College of Agriculture of the University of the Philippines to the Division of Fisheries, and the subsequent recruitment of his students in the same office, like A. M. Mane, P. R. Manacop, F. Alonte, F. Arriola and D. M. Buñag, research along the line of fisheries biology gained more impetus and fisheries conservation work was initiated. The literature on Philippine fisheries biology is replete with the articles of Villadolid and the students he had trained. Studies on fisheries biology were made on the migratory habits of species that ascend freshwater rivers and lakes; rate of growth, age and sexual maturity of certain important commercial species; and spawning and breeding season. Years before the outbreak of the Pacific War, sometime in 1935, a good headway was made on the biology and racial study of such commercial species of wide range of migration, as the *Sardinella longiceps* and the *S. fimbriata*, aimed at the conservation of these two important species. This, however, was disrupted by the Pacific War. In the early part of 1932, Dr. R. Woltereck of the University of Leipzig and Dr. Willis L. Tressler of the University of Detroit, made a study of the

biology and chemistry of Philippine lakes. Buñag assisted the two scientists in the work along the chemical and plankton analysis which took them to various parts of the former Dutch East Indies.

The survey of important and interesting fisheries all over the archipelago for record purposes as well for the solution of conservation problems of the more important ones have attracted the attention of the members of the technical staff during the early years of the 1930's after the creation of the fishery districts. A close study of the condition and extent of the different fisheries and detailed observation of methods of fish capture have been made possible by the creanization of the district fishery offices and field stations as well. Of late studies and observations on the technology of fish capture in which G. Ferrer, P. Manacop and S. B. Rasalan have been actively engaged have been centered on the improvement and mechanization of the gears in order to increase efficiency and to save labor. This tendency came about in the fishing industry because of the need for increased production, keen competition and high cost of labor.

In the field of fish processing and fish preservation, the first attempt to study the problems of salting and smoking fish, and the possibility of canning certain commercial species in the Philippines was again made by A. Seale. In 1911 one hundred tins of sardines and anchovies were experimentally packed by him for exhibit purposes and some were distributed to commercial firms in Manila and certain canning establishments in the U.S. to apprise them of this yet unexploited fishery assets. In 1927, in a temporarily built station in Estancia, Iloilo Province, H. R. Montalban conducted experiments on various methods of salting, drying, pickling and smoking fish aimed at the improvement of the prevailing local methods. Ten years later a permanent station equipped with machinery for a one-ton pilot fish cannery was established in the same town. Further studies on the problems of fish preservation under Philippine conditions were conducted in this station by Montalban and later by the writer until the activity was cut short by the outbreak of the Pacific War.

The chemistry and bacteriology of fishery products were first investigated in connection with medical studies during the early stages of the research activities in the Bureau of Science. Further studies on the chemistry of food fishes were undertaken later at the University of the Philippines by Dr. F. O. Santos and his students at the College of Agriculture, University of the Philippines, and Dr. D. M. Birosel and his assistants in the College of Liberal Arts, U.P., and in the Bureau of Science by Dr. A. J. Hermano and his assistants. These studies came about with the growing nutrition-mindedness of certain quarters in the government particularly the Department of Health.

Studies of bacteriological nature on fisheries food products were made in 1924 by Dr. Ana Vazquez-Colet on *bagoong* and *patis*. The investigation, however, had nothing to do with the mechanics of their preparation but it was more on the sanitation of these foodstuffs.

The first studies on the preservation of gear were by Dr. J. A. Clague and B. Datingaling during the period when the Philippine Fishery Program was in operation, in 1947-1950. Investigation of problems along this line are being pursued in the Bureau of Fisheries at the moment by J. I. Sulit, B. Datingaling and P. Pañganiban.

The different research activities of the Division of Fisheries suffered a great set-back as a result of the Pacific War. Rehabilitation of the offices, laboratories and field stations and the fisheries industries occupied the attention of the administration during the reorganization of the Commonwealth Government in 1945. On April 30, 1946 the U.S. Congress passed the Philippine Rehabilitation Act (Public Law 370), authorizing the U.S. Fish and Wildlife Service to cooperate with the Government of the Philippines in the rehabilitation and development of the fishing industry and in the investigation and conservation of the fishery resources of the Philippines and adjacent waters. In accordance with the provisions of the Act and after the execution of an agreement by the respective nations on March 14, 1947, the American Mission known as the Philippine Fishery Program was established in Manila. It may be mentioned in passing that the agreement was executed by the Division of Fisheries which later became a Bureau on July 1, 1947. To effect the purpose of the Act the Program pursued its work along the following studies and activities: oceanography, fisheries biology, fish culture, technology, engineering, statistical economic and market development, demonstrations and fishery explorations. Also included in its activities was a Training Program to provide one year practical instruction and training in the fishery sciences and techniques to 152 young Filipinos in the methods of fish capture, fish culture, and fish processing and preservation. Several members of the technical staff of the present Bureau of Fisheries were sent to pursue higher studies in different universities in the United States under this Program. The results of the studies and surveys conducted by the technical staff of the Philippine Fishery Program during its three-year tenure ending on June 30, 1950 have been published by the U.S. Fish and Wildlife Service in the form of investigational reports and mimeographed leaflets. Most of the laboratory apparatus and equipment of the Program including one research vessel were turned over to the Bureau of Fisheries, thus reinforcing the research facilities of this Office and placing it in a better position to take over the work either started or revitalized by this American Mission. A very significant result of this rehabilitation program is the appraisal of the produc-

tive capacity of the fisheries of the Philippine territorial waters. This finding led to the reorientation of the Philippine fisheries development program — a shifting from intensive offshore demersal fishing to development of pelagic fishing and extention of fishing operations, and improvement of fish cultural techniques and expansion of hectarage.

Dr. H. A. Roxas who made some study of marine plankton, on a commentary on the status of oceanography in the Philippines stated in 1936 that outside of Dr. Faustino's work on coral reefs, the work of Father Selga with his associates has never been reported. According to Megia (1952), deep-sea oceanography work conducted in Philippine waters by many of the research ships that visited the Philippines, from H.M.S. "Challenger" in 1875, to the "Galathea" in 1951, were concentrated on the Mindanao Deep. He also declared that oceanographic investigations of practical economic and scientific value commenced only with the intensive exploration of the Philippines and adjacent seas which was made by the U.S. MV "Spencer F. Baird" from 1947-50 as part of the Philippine Fishery Program to obtain information basic to the authentic logical appraisal of the fishery resources of the Philippines. The investigations on oceanography and hydrology are now being pursued by the Bureau of Fisheries with the facilities and equipment obtained from the U.S. Fish and Wildlife Service at the termination of the Philippine Fishery Program in 1950. Assigned in this line of work are capable young oceanographers as T. Megia and A. Sebastian, with the assistance of M. Llorca and R. LaO.

The membership of the Philippines in the Indo-Pacific Fisheries Council which made possible collaborative work in fisheries with other member countries in the area has greatly boosted fisheries research activities and developmental work in the Philippines. Once again Philippine fisheries scientists are contributing their efforts not only to the enrichment of the science of fisheries but also to the strengthening of the global movement to raise the standard of nutrition of all people of the world.

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To stimulate and encourage research in fisheries.

To foster comradeship among the members, promote collaborative research in fisheries and coordinate these with the economic needs of the nation.

To cooperate with the government of the Philippines in the execution of fishery laws and in the formulation of policies dealing with the conservation and development of fisheries.

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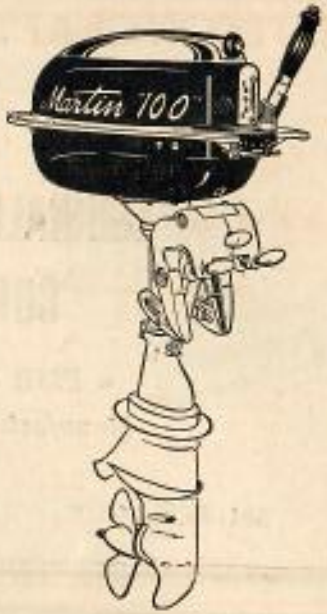

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