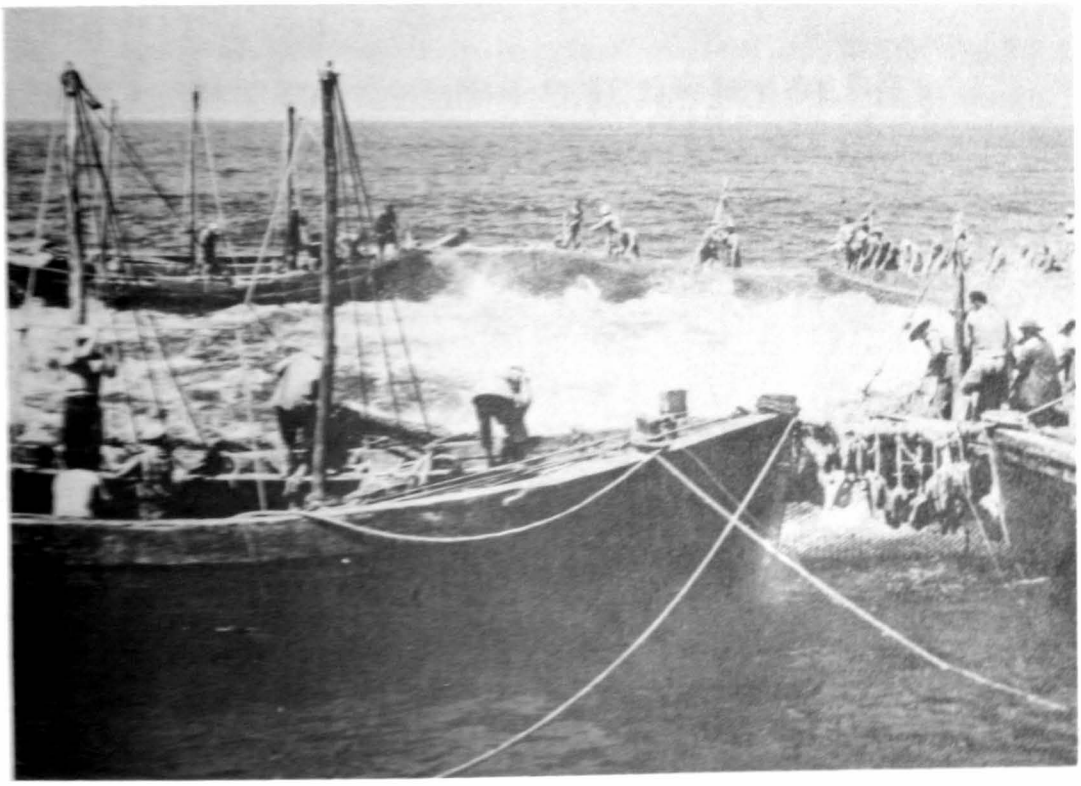
THE BLUEFIN TUNA-TRAP FISHERY OF THE WESTERN MEDITERRANEAN SEA



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THE BLUEFIN TUNA-TRAP FISHERY OF THE WESTERN MEDITERRANEAN SEA

by

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COVER: Raising the webbing of the bag of the trap to concentrate the tuna prior to capture. Photo supplied by Dr. Alonzo Palau, Genova, Italy.

Figure

INTRODUCTION

The history of permanently anchored traps for capturing bluefin tuna has been obliterated in the passage of centuries, and we know neither the place nor the time of origin of this gear. But the importance of tuna to the economy of early civilizations is indirectly recorded by the existence of ancient Grecian coins bearing the facsimile of tuna, and by brief but essentially accurate descriptions of the habits of bluefin tuna provided by writers of early historic times including Aristotle and Pliny (Gruvel 1923, Loture 1946, USF&WS 1951). We can only conjecture that traps became an important gear in this fishery at an early date, for simple traps require little or no highly technical skill or special equipment and can be worked with the most primitive type of vessels. Further substantiation for the conjecture is afforded by the observation of Santamaria (1923) that the earliest traceable records of trap gear describe structures similar in all essentials with those in use today. This implies that the untold but almost certainly lengthy period of trap evolution that culminated in gear of the present level of complexity was undergone countless centuries ago.

Today, traps designed for capturing bluefin tuna are found in operation in coastal waters off most of the countries bordering the Mediterranean and adjoining seas during the prespawning migration which takes place from late May through early July, or during both prespawning and postspawning migrations (late May through September), and the trap structures are often left in the water the year round.

This leaflet, describing the fishery for bluefin tuna in the western half of the Mediterranean, was prepared to help answer inquiries concerning construction and use of tuna traps, and is the result of a survey and translation of the pertinent available literature of those countries bordering the Western Mediterranean where the traps are used extensively. For persons interested in further detail, most of the references listed also contain descriptions of trap fisheries in other areas and for other species.

THE RESOURCE: BLUEFIN TUNA

Centuries of observations by fishermen in the Mediterranean have resulted in a detailed knowledge of migration routes taken by bluefin tuna (Thunnus thynnus). Traps situated most favorably for capturing bluefin tuna in the western Mediterranean are now, or recently have been, placed along these observed migration routes off the shores of Spain, France, Sicily, and northern Tunisia. Traps off several other western Mediterranean countries, notably Morocco, Algeria, Libya, Italy, and the area surrounding the Balearic Islands take bluefin, but not ordinarily as a major constituent of the catch.

The largest and most valuable catches are made as the bluefin pass along the coasts in tightly-formed schools on their way to the spawning grounds in May, June, and early July. These prespawning tuna are in prime condition, having spent the winter on the rich feeding grounds of the western Mediterranean. Most of the Mediterranean population of bluefin spawn within an area bounded by the islands of Sardinia and Sicily and the coast of northern Tunisia (fig. 1). Smaller spawning areas are found off the coast of Spain near Cartagena and Valencia, and an indeterminate number of tuna from the eastern Mediterranean migrate through the Straits of Bosphorus to join the resident population of the Black Sea on the spawning grounds of that area. Wherever the areas of spawning activity may be, they are marked by definite characteristics -- a water temperature, just below the surface, of 60 to 70 degrees F., and a salinity of 36 to 38 parts-per-thousand.

Spawning takes only a short time, and by the first of July some of the tuna have started the return migration -- back to the feeding grounds -- over the same routes travelled in the prespawning journey. The fish are in poor condition at this time because they have not fed since the prespawning migration began; and they are more thinly grouped. For those reasons, fewer traps are operated during the return migration, which continues through August and into September, and those operated are far less profitable in this portion of the fishery.

Following their migration, the tuna winter on "banks" where there is available an abundance of food material. One such area, of considerable importance to the fishery of the western Mediterranean, is located in the vicinity of the Gulf of Lions (fig. 1) on the southern coast of France where the wintering fish form the basis for a profitable troll fishery.

Young bluefin spend the early part of their lives in the deepwater basins of the Sea and are carried about by the currents. This causes some of them to be swept through the Straits of Gibralter with the outgoing submarine currents, and those fish add to the recruitment of the Atlantic population. Most of the young bluefin spawned in the Mediterranean, however, remain there, and the Mediterranean and Atlantic stocks appear to be essentially distinct (Loture 1946).

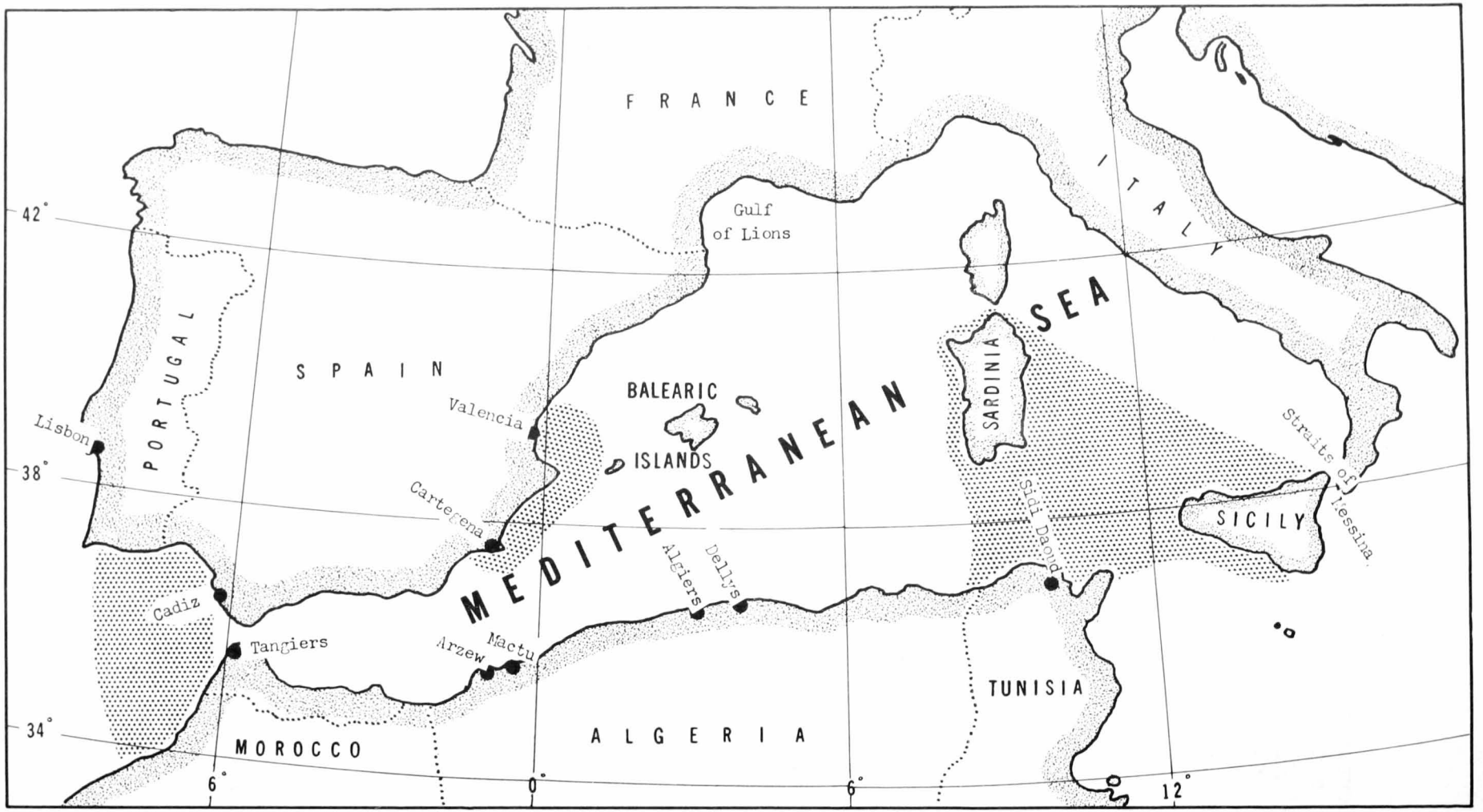

Figure 1.--Map of the western Mediterranean and adjoining portion of the eastern Atlantic. Areas of bluefin tuna spawning stippled.

Bluefin tuna captured in the traps of the Mediterranean coastal waters commonly range from 35 to 225 pounds in weight although larger fish are taken occasionally. The majority of the fish captured during the pre-spawning migration weigh between 150 and 175 pounds.

TRAP CATCHES

Trap catches naturally vary with the size and location of the trap. Loture (1946) states that in the western Mediterranean, daily catches of from 700 to 800 bluefin weighing individually from 150 to 175 pounds are not uncommonly the result of trap operation, but that catches fluctuate from day to day and from year to year. He cites a few production figures for the trap at Sidi Daoud off northern Tunisia -- one of the oldest and most advantageously situated traps in the Mediterranean -- where records are available for a long period of operation. Records for the period 1863 through 1923 show an average yearly catch of 700 tons of tuna representing approximately 8,000 individual fish. Production in the best year of this period was 1,300 tons and in the poorest year it was roughly 190 tons.

Trap catches on the Algerian coast contain an admixture of bluefin, smaller tunas, and mackerel in which the relative importance of bluefin to the trap fishery of that area is markedly diminished from its position in the fishery of Tunisia or the fisheries of other, more northern, portions of the Mediterranean. Auffret (1931) cites figures for several traps along the Algerian coast. Of the traps that were in active operation during any part of the period 1919-30, and for which figures were available, only one (a trap at Mactu) shows a catch of bluefin that approaches the figures cited by Loture for Tunisia. Traps at Dellys and at Arzew (fig. 1) averaged 60 and 30 bluefin a year, and several traps at other locations along the coast showed catches completely devoid of bluefin. The catches from traps off the Mediterranean coast of Morocco are similar in composition to those of the Algerian coast.

THE TRAP GEAR

Placement

The trap gear is placed on the migration route of the bluefin tuna with the major portion of it situated at some distance from the shore at the outer edge of the route in 10 to 35 fathoms of water. This offshore portion of the trap is connected to shore by a long wall or "leader" of webbing that cuts across the tuna path at approximately a right angle. The length of this shoreward leader varies, depending upon the distance from shore at which the tuna pass. In extreme cases it may be from a minimum of 35 or 40 feet to a maximum of 6 miles in length, but it is usually a few hundred yards in length. The nature of the bottom is a second important factor in trap-site selection, because the traps are held in position by means of anchors which require satisfactory holding ground. The traps should be located far from

the mouths of large rivers, for these often dilute and muddy the sea for long distances following storms, and the tuna actively avoid such areas. Where possible, areas little used as navigation routes or for other types of fishing activity are selected.

Description and Construction Details (fig. 2 and 3)

Tuna traps consist of three principal components, all constructed of webbing: The leaders which divert the fish into the remaining trap sections; the enclosure which serves as an assembly and concentration area for the tuna; and the bag which represents the actual site of capture (fig. 2). The entire structure is held in position by means of anchors at the ends of long cables running from trap floatlines (fig. 3). The upper edge of the trap is maintained at the surface of the water by a plentiful supply of floats and buoys, and the lower edge of the leaders and walls of the enclosure is held on the bottom by means of weights so that the webbing comprising these structures completely traverses the water column. In this way the leaders completely cut across the normal migration route of the tuna from surface to bottom, and the floor of the enclosure is formed by the sea bottom. The bag, supplied with a bottom of netting, requires no weights.

All of the webbing used in construction of the leaders and the outer and partition walls of the enclosure is made from 3/16-inch esparto twine which is knit into 12-to-16-inch mesh (stretched measure). Esparto twine is derived from a native Mediterranean grass of that name. It is cheap, relatively strong, and apparently possesses the faculty of retaining much of its original strength after continuous immersion for periods of nearly one year in duration. Cotton and hemp twines recently have been substituted in some cases, but even when suitably treated with refined coal-tar preservatives (also necessary with esparto), these twines are not long-lasting.

The webbing of the leaders and enclosure is hung between 2-inch manila floatline and smaller-diameter manila or galvanized leadline. Details of hanging are lacking, but are determined to a great extent by the strength of current and severity of wave action. Sufficient slack is left in the webbing that a slight pocketing effect is produced and the webbing offers minimum resistance to the current. In hanging the leaders, a minimum slack of approximately 10 to 15 feet is allowed for every 100 to 120 feet of line (Auffret 1931). All sections of webbing are made slightly deeper than the water in which they are to be positioned in order to allow vertical pocketing. Riblines of small-diameter manila are laced to the webbing at frequent intervals between the floatline and the leadline to give added strength. Usually these are placed at the points where the anchor cables leave the floatline.

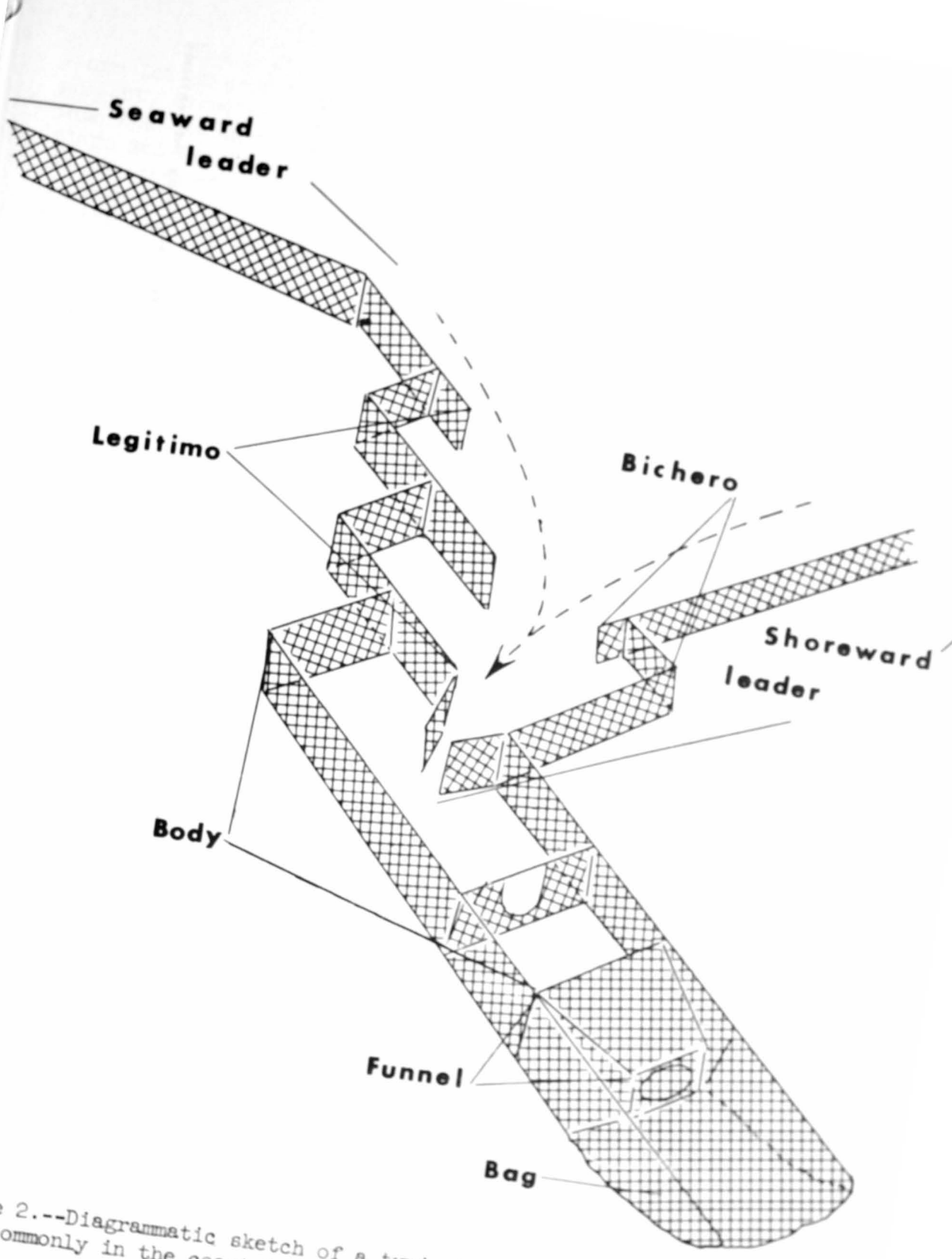

Figure 2.--Diagrammatic sketch of a typical bluefin tuna trap used commonly in the coastal waters of the Mediterranean Sea.

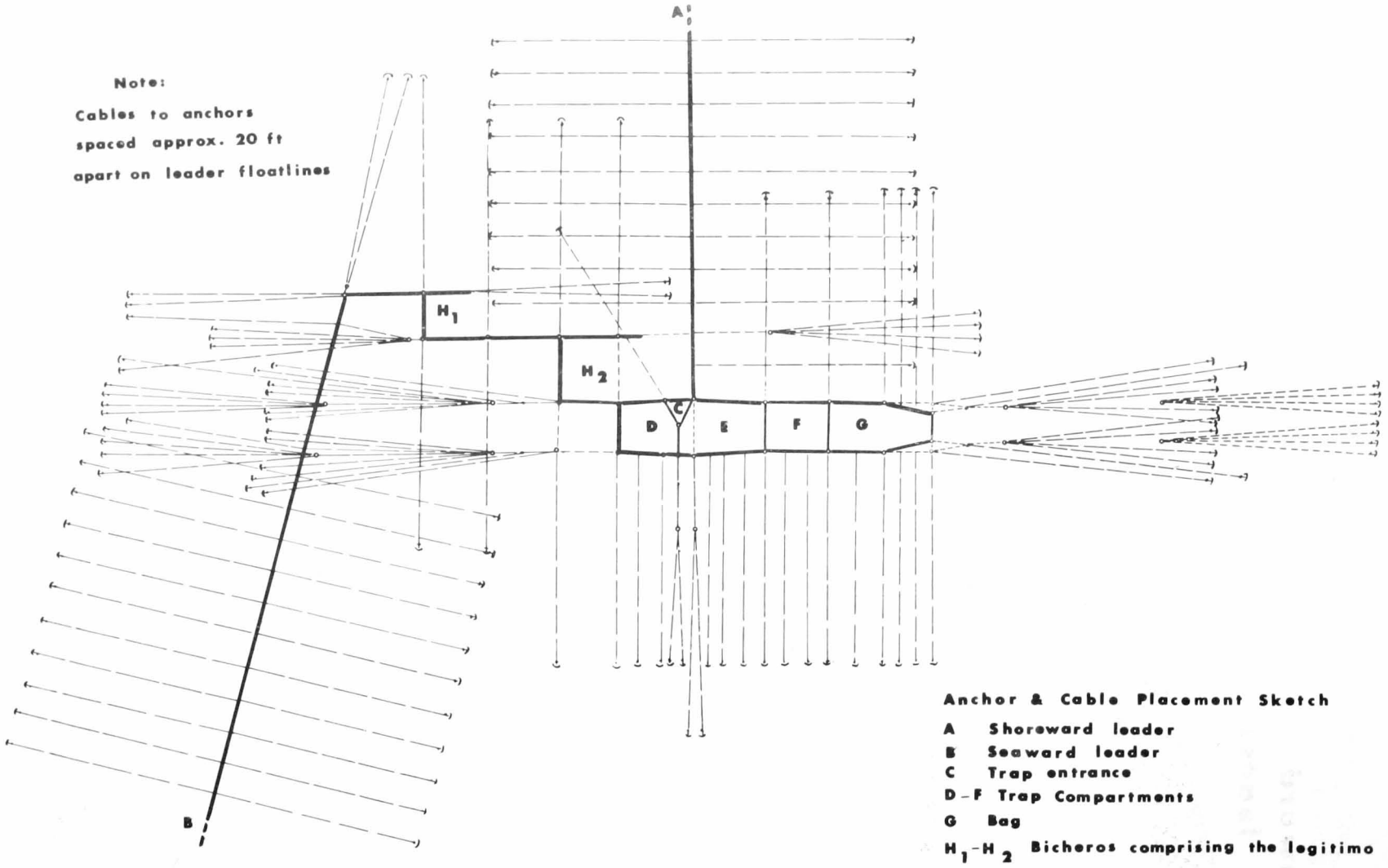

Figure 3.--Tuna-trap diagram showing placement of anchors and relation of parts.

The leaders cut across the normal path of the migrating fish -- one leader connecting the enclosure with the shore and the other, when present, directed seaward--and, by diverting this path, funnel the tuna into the enclosure through a single opening which is guarded by V-shaped flaps and is situated between the points of attachment of the leaders. As the shoreward leader runs from the shore to a depth of from 10 to 35 fathoms, it is tapered along the bottom edge to follow roughly the contour of the sea bottom.

On encountering the leader, the tuna invariably turn and follow the leader webbing either toward or away from the enclosure. A postulate that schoolfish in the northern hemisphere tend to turn to the left when meeting an obstacle has been advanced, but has not been proven and certainly is not absolute. By adding offset baffles of webbing (bicheros) to the distal ends of the leaders, those fish which have turned away from the enclosure are led round in a semi-circle and are, thus, oriented in the desired direction. A series of these three-sided baffles, arranged in step-like fashion on the enclosure end of the seaward leader and known collectively as the "legitimo", serves not only to direct the fish, but also as an antechamber about the entrance to the trap (fig. 2, 3).

Both the leaders and the enclosure are constructed of webbing adequately large that all but the largest tuna captured could escape readily if they were to struggle sufficiently, and thus these components are not actually concerned with capture per se, but only in preliminary collection and concentration of the fish. The success of these trap components depends upon the fact that the tuna are seldom alarmed, but swim peacefully in the enclosure, until they are herded into the bag.

The partitions which divide the trap enclosure into a variable number of compartments are made from the same webbing as the rest of the enclosure. Each partition is provided with an opening approximately 4 to $4\frac{1}{2}$ feet square. To the bottom of each opening is attached a flap which can be raised to cover the opening and prevent the escape of the fish contained in the compartment. The number of compartments varies with the ideas of the individual trap designer. Usually there are from two to four compartments between that bearing the entrance opening and the bag, and often one compartment on the end of the enclosure opposite the bag. The principal function of the compartments is to ease the task of driving the tuna toward the bag in the preliminary stages of capture. Compartments of bluefin traps are usually at least 50 feet square. Dimensions of the trap enclosure vary within wide limits. Most bluefin trap enclosures are from 200 to 600 feet long, 50 to 150 feet wide, and from 10 to 35 fathoms deep, depending upon the depth of water at the trap site, but trap enclosures as large as 1,300 feet and as wide as 325 feet are known.

The bag is made of manila which is stronger than esparto, but more expensive in the Mediterranean. Manila, or "canamo", is also less durable. The canamo fibers are made into 4-strand, 1/4-inch twine. The bag is the only section of the trap that possesses a floor of webbing, and is made from a single piece of webbing of varying mesh size. Beginning at the rim of the bag, along the floatline, the meshes measure 4 inches on a side (8-inch stretched mesh). The meshes then graduate down in size until, at the bottom of the bag sides, the meshes are only about 2-1/2 to 2-7/8-inch bar, and the bottom meshes are from 3/4-to-1-inch bar. The bag also is hung on a 2-inch manila floatline. Like the rest of the trap webbing, the bag is treated with a coal-tar preservative before use. In addition, it must be brought ashore every 20 to 30 days, dried, and retreated. This makes it necessary to have a spare bag always ready for use.

The floatline of all trap sections is heavily buoyed with cork floats of diverse size and shape, depending upon the country in which the trap is used, and with barrel buoys. Some of the latter are provided with flags to warn vessels away from the trap area in the daytime, and with lanterns for the same purpose in nighttime.

Weights used on the leadline of leaders and enclosure may be conventional net leads, chain links, bars of pig iron, bags of gravel, or in some places, large stones. Small grapples are occasionally tied to the leadline to supplement the weights (Santamaria 1923, Auffret 1931, Bas 1955).

The number and size of floats and weights is determined largely by trial and error and is dependent upon the strength of the current and weight of the webbing.

From the floatline of the ends of the trap, near the corners, two 1-inch galvanized cables run out to connect with several diverging 3/4-inch anchor cables. The latter terminate individually in widely separated anchors which weigh up to 2,500 pounds. From the sides of the trap, 1/2-inch cables run directly to single anchors weighing 1,000 to 1,500 pounds. The leaders also are held in place by means of anchors attached to 1/2-inch cables. The cables extend out from either side of the leader every 15-20 feet (fig. 3).

Length of the anchor cables is an important factor. If the cables are too short the angle between the cable and the wall of netting will be too sharp, and the downward force exerted by the cable on the floatline will counteract the buoyant effect of the floats and drag the netting down. Sixty-foot cables appear to be minimal in length, but this is partly a function of depth. The cables are tarred and wrapped with esparto fiber to prevent chafing wherever they come in contact with the webbing.

TRAP OPERATION

Operation of the bluefin tuna traps generally requires a labor force of from 30 to 50 men and up to 12 boats including 2 rigged with winches and booms and ten 6-man boats propelled by oars.

The fishing operation is usually carried out daily. To start the operation, one of the 6-man boats is rowed out to the trap, and the trap entrance is closed. This boat is then joined by a second, and by dragging a movable piece of webbing between them or by splashing, the two boats chase the tuna into successive compartments toward the bag of the trap. When all of the tuna are in one compartment, the flap of webbing attached to the compartment partition is raised preventing the fish from escaping toward the entrance. This procedure is continued until all of the tuna are in the bag. Up to the point where the tuna actually enter the bag, they are relatively peaceful, show little sign of alarm, and may be kept for relatively long periods without damage. This absence of alarm on the part of the fish is an essential feature of the trap operation, because--as stated previously--the 12-to-16-inch mesh walls of the trap enclosure and leaders would allow all but the largest tuna to escape if the fish seriously charged these walls.

Once the tuna are in the bag, the final steps of the operation commence. Two vessels, rigged with winches and booms, or tackles on the mast heads, are maneuvered over the ends of the bag, just outside the webbing. Men aboard these vessels seize the webbing, break the floatline over the gunwale, and attach the floatline to lines running through blocks on the booms or masts to the winches. At the same time, the rim of the bag has been surrounded by the 6-man boats, and as the winches haul in on the net, the men in the smaller boats take in the slack webbing. This procedure, known as the "levantada", raises the bottom of the bag and concentrates the tuna in a smaller space (cover illustration). When the floor of the net is from 4 to 6 feet from the surface the fish feel their living space becoming cramped and begin to thrash about so violently that they often kill one another during the struggles, and in many cases become so aroused that the floatline and webbing must be dropped again. When the fish calm down, it is raised once more, and so on, until the fish are sufficiently tired that the operation can proceed without danger of damage to gear or personnel or loss of fish. Each time the net is lifted, it is raised to within 4 to 6 feet of the surface. On the final lift, the live tuna are clubbed or harpooned, and all are pulled aboard the boats. The catch is then taken ashore either in the 6-man boats or in barges. The entrance to the net enclosure is opened, the flaps barring the partition openings are dropped, and the trap is ready for the next operation. The large vessels remain on the trap site and the 6-man boats are hauled up on the beaches until the following day.

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