Instituto Panamericano de Ingeniería Naval
Instituto Pan-americano de Ensenharia Naval
Pan-american Institute of Naval Engineering

XI CONGRESO PANAMERICANO DE INGENIERIA NAVAL,
TRANSPORTE MARITIMO E INGENIERIA PORTUARIA.

EVOLUTION OF THE CHILEAN FISHING FLEET
PRESENT AND FUTURE

CONFERENCIA N° 3

PETER G. SCHMIDT
PRESIDENT
MARCO SEATTLE, U.S.A.
ASTILLEROS MARCO CHILENA LTDA.

ABSTRACT

In the 30 years since 1959, the Chilean Industrial Fisheries, producing product primarily for export, has grown from an insignificant level to where Chile now ranks fifth in the world in total fish production. Today a large fleet of modern purse seine fishing vessels provides product to the fishmeal plants located in the north from Arica to Caldera and in the south central zone from Coronel to Quintero. This paper describes the evolution of the Chilean purse seine vessel from 1959 until the present. The designs and systems used by the vessels were initially derived from the purse seiners of the West Coast of North America with machinery, accommodations, and command forward. Recently, however, a strong Norwegian influence has entered the fishery, particularly in the south central zone, where there is now a mixture of North American and Scandinavian concepts.

Arrangement plans and a detailed table of dimensions, coefficients, and ratios are included in the appendix for 14 vessels, indicating the evolution of the Chilean purse seiner. Additionally, information is given on current designs.

There is no clear pattern of evolution in trawlers and longliners. Most of the few trawlers that are operating have been of European origin. The longline industry is currently undergoing Spanish and North American influence in the few new vessels presently fishing. Current and pending regulations not only affect the size of the vessels but limit operations on board.

It is concluded that in the past 30 years, the Chilean Industrial Fishery has gone through extensive evolution and that today's purse seine vessels serving the industry are modern and well-suited for the task. The fishermen and management are highly skilled and production is extremely efficient. The purse seine fishing vessels in the north may have reached a temporary plateau in size and development, while the vessels of the south central zone, fishing in stormier water, are still in a rapid state of development. Both the trawl and longline fisheries are poised for significant growth, but it is difficult to project the most efficient type and size of vessel because of existing and pending regulations.

HISTORY

During the 1950s, the rapid development of the Peruvian fishmeal industry occurred, based on its vast anchovy resource.

Peruvian fisheries In 1958, I travelled to Peru to introduce the Puretic Power Block, a device for hauling purse seine nets aboard the anchovy seiners. Coincidentally, a license agreement was developed between my company, MARCO Seattle, and a Peruvian steel fabricator to produce some of the first steel fishing vessels in that country. As a result of that agreement, nearly 500 vessels were built during the 1960s based on four designs -- from 20 to 30 meters (65'-99') in length overall. The technology that was transferred to Peru, including vessel design and fishing systems and equipment, was purely from the West Coast of the United States and Canada, with the exception of the snap purse ring, which I brought from Iceland and Norway.

First visit to Chile During the 1958 trip to Peru, I made my first visit to Chile at the invitation of Sr. Miguel Yoma, who had constructed at Coronel one of the four initial modern fishmeal plants in Chile dedicated solely to the production of fishmeal.

During this initial trip, I visited Talcahuano and the areas surrounding, from Coronel to Dichato: San Antonio, Antofagasta, Iquique, and Arica. All of the newly-installed fishmeal plants, which were of Danish/Norwegian origin, suffered from a lack of raw material, which resulted from several factors: [1] the owners believed that the existing artisanal fishermen could supply larger quantities than was realistic; [2] the owners acquired unsatisfactory fishing vessels that were not properly designed for the use intended, or [3] the latter coupled with management inexperience and a lack of sufficient fishing culture to operate the necessary vessels.

Evolution begins From this, the long process of evolution began, resulting in the current situation. Today, some 30 years later, Chile is number 5 in the world in fish production, with a magnificent fleet of large, modern purse seine fishing vessels with experienced fishermen, and sophisticated management of the companies. In the last 30 years, the Chilean fishmeal industry has developed its own culture of management, fishermen, and supporting industries, including suppliers and ship construction and repair yards.

Currently, the number and fishhold capacity of purse seiners delivering to the fishmeal plants are as follows:

	NORTH	SOUTH
Total number of vessels	146	108
Total fishhold capacity (m^3)	39,370	48,770
Average fishhold capacity (m^3)	270	452

Fisheries development legislation During my 1958 trip, I learned that there was a proposed fisheries development law which appeared certain of enactment, designed to stimulate the development of the fishery through tax and other incentives. Because of this, I returned to Chile four times during 1959 to study the possibility of our becoming involved in what appeared to be a growth opportunity in the fisheries.

STATUS OF THE CHILEAN FISHING VESSEL - 1959

Artisanal fishing vessels Up and down the coast of Chile there were hundreds of artisanal fishing vessels, from row boats to motorized vessels up to approximately 10 meters in length. Also in some areas, notably Antofagasta, many of the vessels were propelled by sail.

These artisanal vessels fished with hand lines, small driftnets, and, in some areas, small seine nets pursed and hauled by hand.

In the Port of San Vicente one could see boats like the one shown in Photo 1 loaded with sardine or anchovy. These scenes excited me about the potential for modern purse seine nets and vessels. Thirty years later, the artisanal fleet continues little changed, separate and apart from the industrialization of the Chilean fisheries. This fleet produces such table fish as white sea bass (corvina), congrio, smelt, and other species.

Trawlers In 1959, a few trawlers operated, primarily in the Talcahuano/San Vicente area, where they fished for hake (merluza). Several of these vessels were small cutters brought from Germany during the late 50s and early 60s ostensibly as a transfer of capital from that war-ravaged country. A small group of German fishermen operated these vessels, with Chilean crews, delivering the bulk of their catch to the newly-installed fishmeal plants in the Talcahuano area, with some of the product going to the fresh market. These side trawlers were 16 to 20 meters in length overall and worked quite well in the sometimes rough waters of that area. In addition to these trawlers, there was a

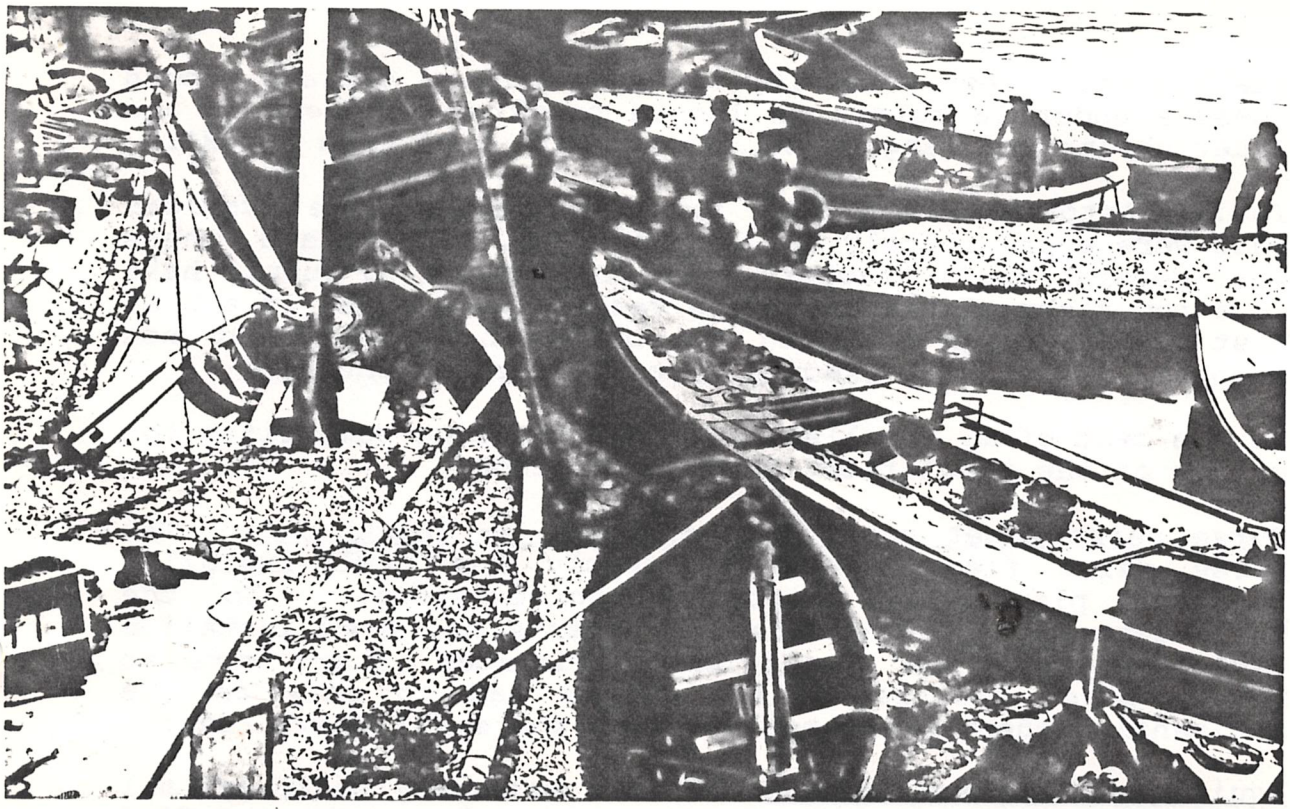


PHOTO 1: Small launches with sardines at Talcahuano, circa 1958.

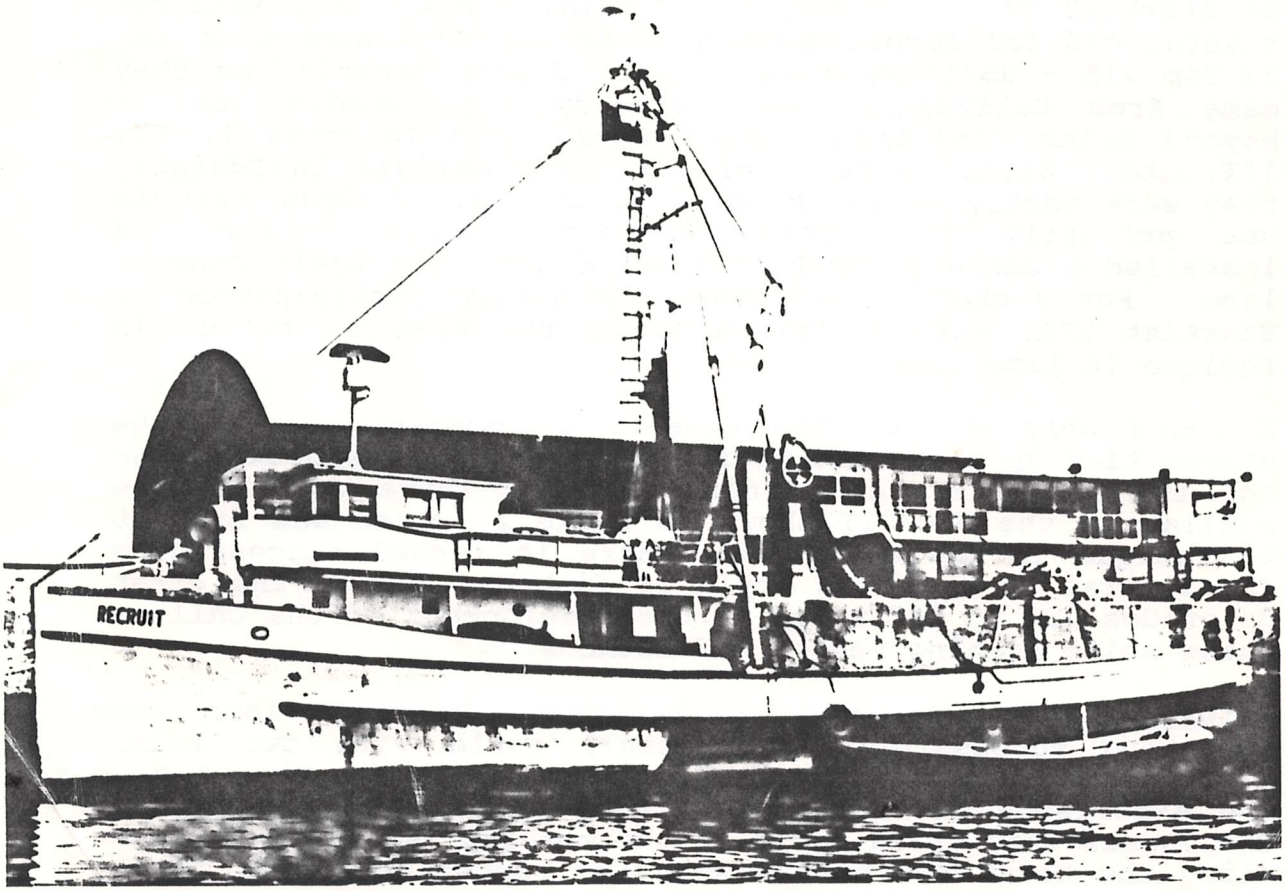


PHOTO 2: RECRUIT - California-style seiner, vintage 1940; first seiners of Pesquera Iquique in the mid-1950s were similar to this type.

small number (fewer than 10) of miscellaneous Chilean wooden vessels under 18 meters in length trawling for merluza and later shrimp and langostino, mostly with less than 200 HP.

In San Antonio, there were two old Spanish side trawlers that were approximately 38m long overall. In Dichato, there were several small trawlers built in Denmark to supply hake to a new fishmeal plant. These vessels were based on a U.S. West Coast design modified and built in Denmark, but not properly designed or executed for the purpose intended.

To the best of my recollection, the foregoing summarizes the extent of the trawl fleet in Chile in 1959.

Purse seine fleet nearly non-existent -- Talcahuano The purse seine fleet needed to supply the newly-installed fishmeal plants was virtually non-existent. In the Talcahuano area, where three new plants had been installed exclusively for the production of fishmeal, there were no modern purse seiners -- the plants had to rely on the artisanal fishermen and merluza from the small trawl fleet.

Iquique -- Pesquera Iquique It was necessary to travel all the way to Iquique, some 1,900km (1,200 mi.) north, to find purse seiners. Here, Pesquera Iquique, through investment by Starkist of San Pedro, California, U.S.A., had acquired several old California sardine/mackerel/tuna seiners in the 23-26m (75 - 85') LOA size. These wooden vessels, as they came from California, were already old, wooden vessels beyond prime condition. They were named Colorado I, II, III, etc. Within a few years of their arrival in Iquique, they were mostly broken down. The purpose of these vessels was primarily to supply Pesquera Iquique, which had installed a cannery, with bonito and tuna for their canning line. For a short time, there was active participation by Starkist USA, but it had waned by the time I arrived in Iquique in late 1958.

I found only one of the vessels in operation, with the others tied up along the pier with their engines broken down and in various states of disassembly. These vessels were similar to the RECRUIT shown in Photo 2, which was brought to Iquique in the early 60s, where it fished successfully for several years. The style of fishing used on the first Colorados had an influence on the development of the Chilean purse seine fishing vessel and methods.

Arica -- Pesquera Indo In Arica, Pesquera Indo was operating successfully on a small scale with two local creations, the VERONICA and ELIZABETH (see Photo 3). I had the experience of making a fishing trip on the VERONICA. The vessel left Arica early in the morning, sailed northwest along the beach toward the Peruvian border for about 20-30 minutes, shot its net, pursed, and loaded up with a complete

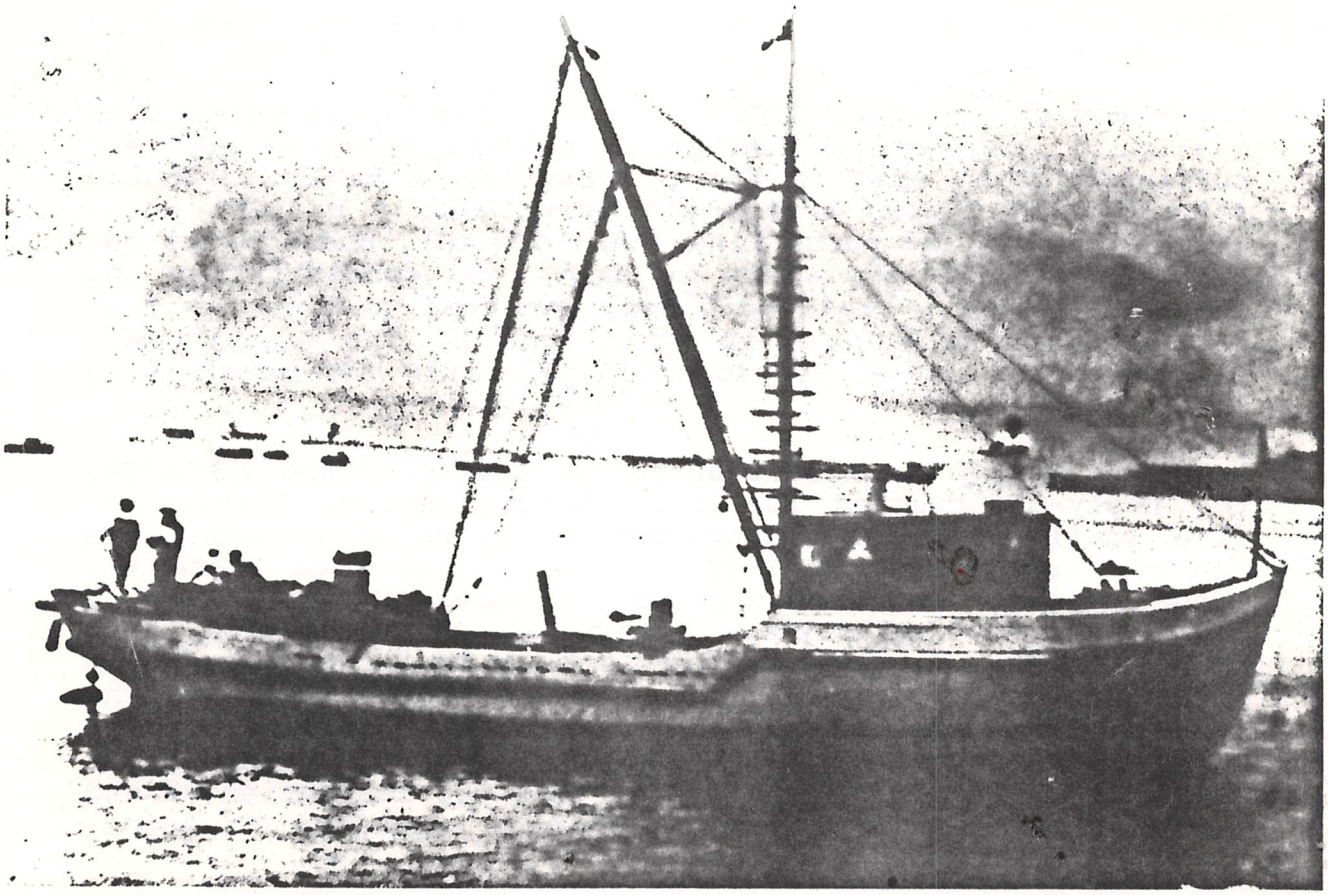


PHOTO 3: ELIZABETH - One of the two original seiners of Pesquera Indo, late 1950s.

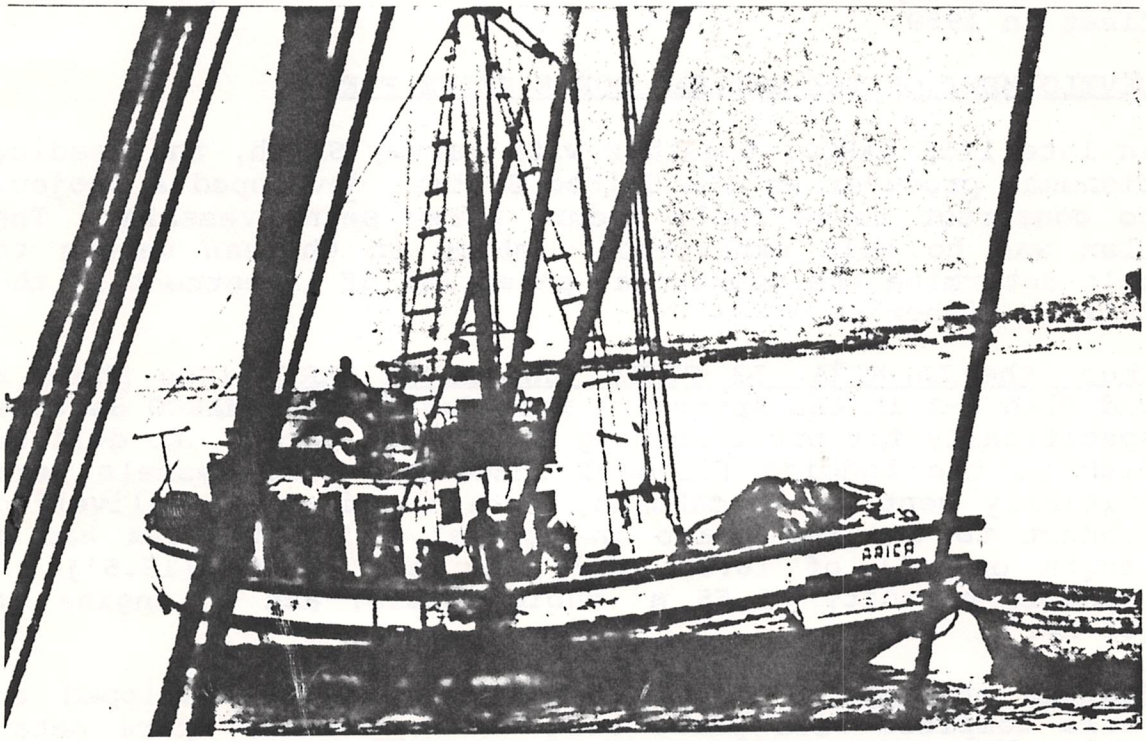


PHOTO 4: EPERVA 1-5 - The first vessels of Pesquera Eperva, these small wooden seiners built in Norway were unsatisfactory imitations of U.S. West Coast type.

cargo, returning to port to be unloaded by 10:00 that same morning.

The VERONICA and ELIZABETH were as simple purse seiners as one could imagine and similar in concept to what was then currently being used in Peru. They had a small deckhouse forward with flying bridge with controls, a minimal purse winch for "manila" purse line (hand coiled), and the net was pulled aboard on the stern by hand. On concentrating the fish alongside, a brail (dip net) was used to transfer fish from the bunt of the net to the fishhold. The vessel had a minimal radio and an echosounder, primarily for determining depth of water.

Arica -- Eperva In addition to the ELIZABETH and VERONICA, the newly-constructed 10-ton-per-hour plant of Eperva had five small Norwegian-constructed purse seiners which were not very successful in supplying the plant (see Photo 4). These vessels were constructed in Norway based on North American West Coast style. Unfortunately, in copying these vessels, the Norwegians did not understand the North American purse seining technique or the requirements of the fishery. The vessels therefore were not adequate either as purse seiners or for the fishery of the north of Chile. This was coupled with management that was inexperienced and had difficulty in managing the fishing operation to supply adequate product to the plant.

The foregoing was the extent of the Chilean purse seine fleet in 1959.

DEVELOPMENT OF THE CHILEAN PURSE SEINE FLEET

In late 1959 MARCO, together with Harvey Smith, the leading fishmeal producer in the United States, developed a project to construct three small modern purse seine vessels. The plan was to gain experience fishing in Chilean waters to help determine the commercial potential of investment in the Chilean fisheries.

Thus, the LA NIÑA, LA PINTA, and SANTA MARIA (See photo 5 and Plan B-1 in the Appendix) were designed by MARCO Seattle specifically for purse seining in Chilean waters, to deliver fish to the budding fishmeal industry. The vessels were initially sent to Talcahuano, with the idea of delivering product to the new plant in Coronel. The vessels had a length overall of 16.5m (54'); a beam of 5m (16.5'); a fishhold capacity of 55 m^3 cubic meters; and an engine of 165 HP.

Vessels shipped to Chile These vessels were shipped to Chile complete with purse seine nets; trawls; spare nets; complete spare parts, including spare main engine; tools and equipment for maintenance; two Scandinavian-American fishing

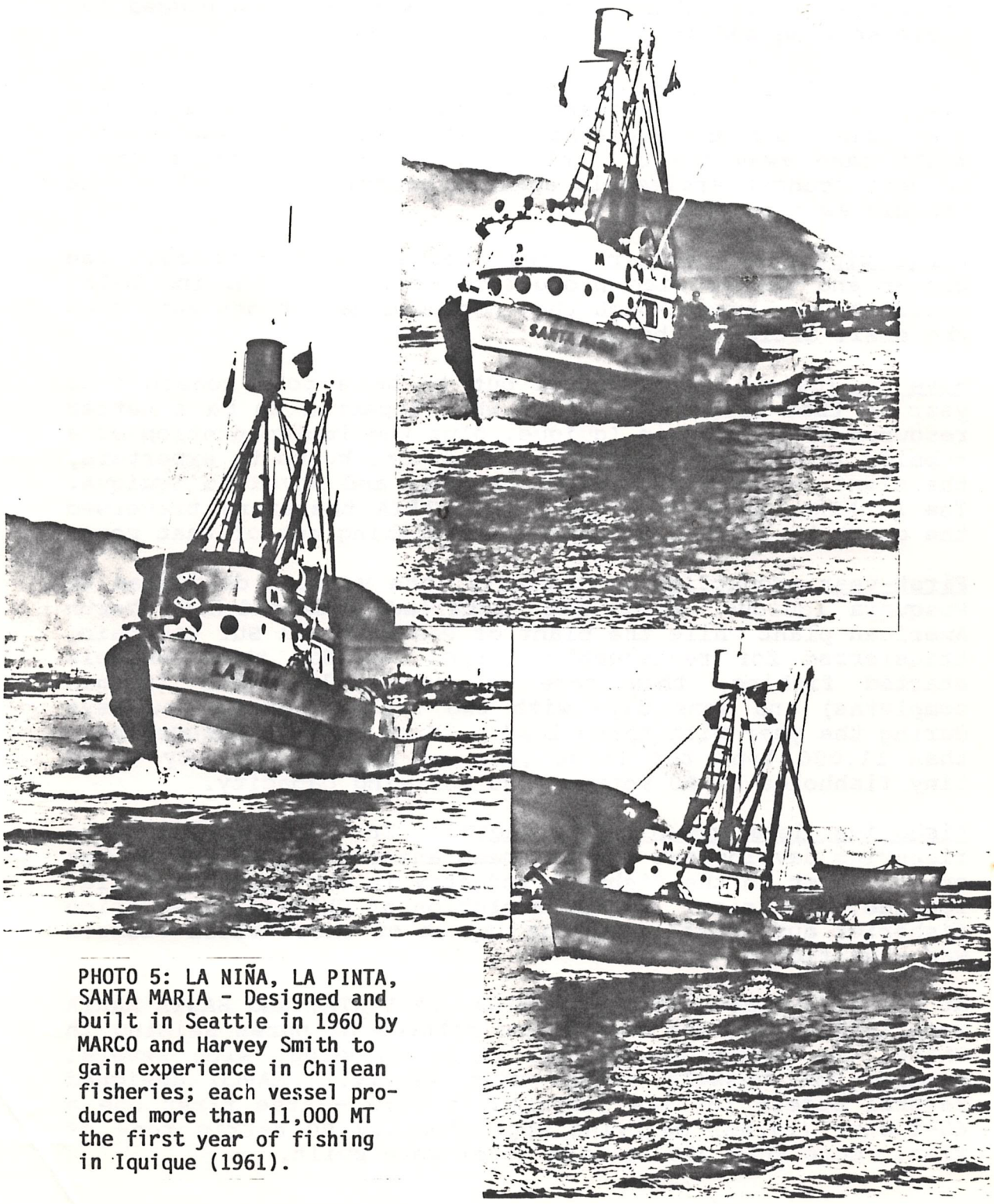


PHOTO 5: LA NIÑA, LA PINTA, SANTA MARIA - Designed and built in Seattle in 1960 by MARCO and Harvey Smith to gain experience in Chilean fisheries; each vessel produced more than 11,000 MT the first year of fishing in Iquique (1961).

captains; and a port engineer. In addition, because of the exploratory nature of this project, one of the vessels was furnished with convertible trawl equipment, and all of the vessels had what is known as a "combination" winch that could be used for either seining or trawling.

On arrival in Talcahuano, two of the vessels were rigged for purse seining and one for trawling for hake.

Apprehension by artisanal fishermen Since these were the first modern purse seiners in the area, there was much skepticism, and the artisanal fishermen feared these vessels might take away their livelihood. Therefore, there was a boycott amongst artisanals against becoming involved on the vessels as crew members.

First winter and summer These vessels fished through one winter and summer with production from purse seining below expectations, even though they produced many times more than the small artisanal boats.

Move to Iquique It turned out to be a poor season that year in that area. Fueled by what appeared to be a better resource of anchovy in Iquique, plus the implementation of a subsidy in Iquique granting a 25% export bonus to exporters, the plant in Coronel was disassembled and moved to Iquique. The LA NIÑA, LA PINTA, and SANTA MARIA therefore traversed the coast to Iquique and commenced fishing out of that port.

First-year production Initially, the vessels delivered to Pesquera Iquique, which had installed a second-hand North American plant while the plant of Pesquera del Sur was being transferred for re-assembly. From the day these vessels started fishing, they came in with full loads (cargas completas) and some days with two loads - and a few days during the year with three loads. Each vessel produced more than 11,000 tons the first year -- limited only by their tiny fishholds of 50 metric tons carrying capacity.

Fisheries development law enacted In the meantime, the fisheries development law had been enacted and the fever was on to invest in the fishmeal industry in the north of Chile, Iquique, and Arica. In the evolution of Chilean purse seine fisheries during the 60s, the impact of these small vessels was significant.

At the same time that the LA NIÑA, LA PINTA, and SANTA MARIA were influencing the design and methods of purse seining in Chile, the fisheries of Peru were exploding, with several hundred new vessels being built yearly. MARCO designed several models for its licensee in Peru -- the first one a 65-footer (19.8m) carrying approximately 90 metric tons of fish. More than 200 of this model were built.

Demand for larger vessels It became apparent that the vessels had to be bigger, as their monthly and annual production depended on being able to carry what they could capture in a day's fishing. As is so often the case, it is impossible in the beginning to anticipate how large the vessels should be and so the evolution of size thus commenced. Little by little, the courageous owners increased the size from previous vessels. At the time the 90-tonners were being built in Peru, they were replacing wooden vessels of about 60-80 tons carrying capacity.

Thus, for the new purse seine fishery in the north of Chile, we and the other Chilean shipyards that had rushed into existence became aware shortly after the success of the LA NIÑA, LA PINTA, and SANTA MARIA that the vessels should be larger.

First MARCO design for construction in Chile The first MARCO design in Chile was for a 20m (66') vessel with 5.9m (19.5') of beam, 280 HP, and a carrying capacity of 100 metric tons (see Plan B-2 in the Appendix). The other shipyards in Chile soon followed. After the construction of the first few vessels by MARCO Chilena in Iquique, a new design was developed which carried 140 metric tons and was 22.3m (73') LOA by 6.7m (22') molded beam, with a main engine rated at 350 continuous HP (see Photo 6 and Plan B-3 in the Appendix). MARCO and three other shipyards, namely IMMAR, SOCONAVE, Arancibia Altamirano, and FORAM, all started seriously building vessels in the 120 to 150 metric-ton carrying capacity range. A total of 85 MARCO 140-tonners were constructed, with the other shipyards together contributing a similar number. All of the vessels were, in effect, expanded clones of the LA NIÑA, LA PINTA, and SANTA MARIA, except for the vessels of FORAM from Antofagasta that had some originality in the form of a partially-raised focsle deck. This design was by John Brandlmayr of Vancouver, Canada.

During the initial period of this accelerated construction in the early 60s, a few more wooden purse seiners were built, but they were too small, too late, and in some cases too poorly designed to compete with the larger steel vessels (see EPERVA 14 in Photo 7).

Arrangement of the vessels All of the vessels had engines and deck houses forward, with rudimentary accommodations for approximately 11-12 fishermen, plus a wide stern to provide buoyancy, stability, and working space for the large seine net. They also included hydraulic purse and anchor winches, and the Puretic Power Block.

Capsulpump By 1964, MARCO had introduced the Capsulpump and shortly thereafter the entire fleet converted over to pumping fish from the bunt of a net into the fishhold.

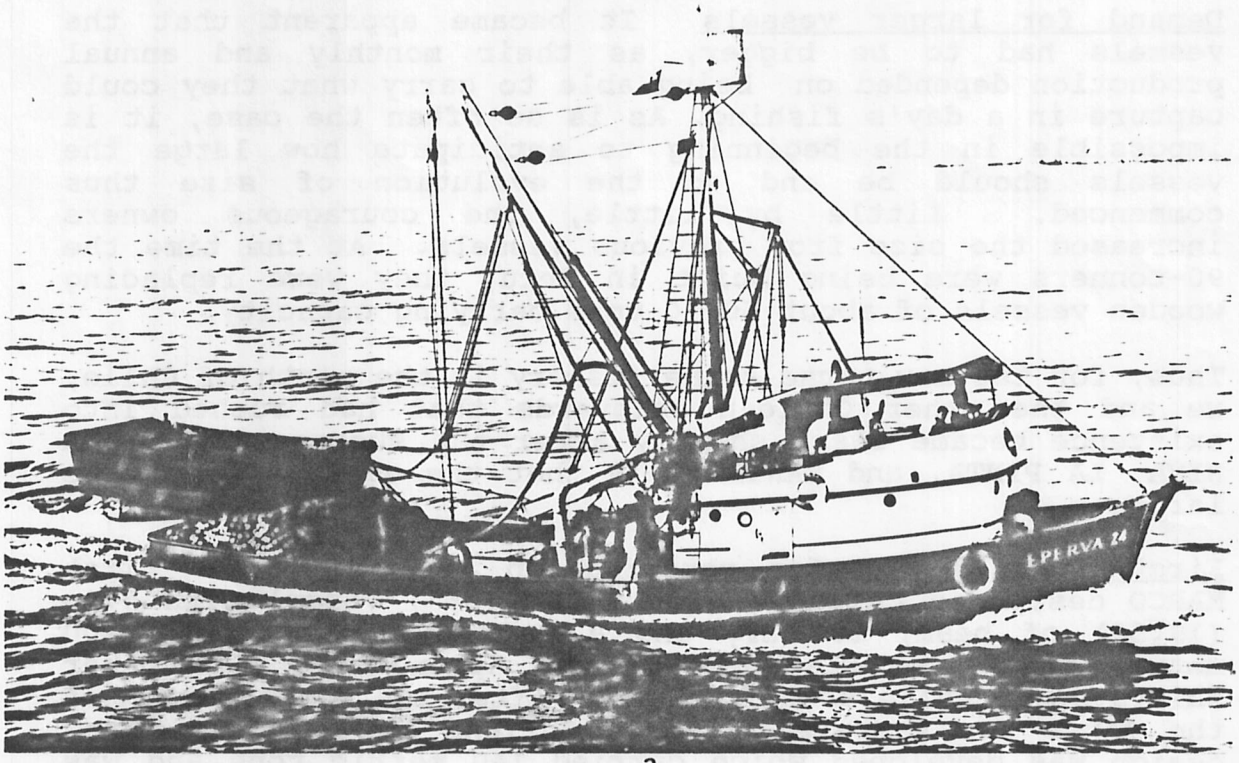
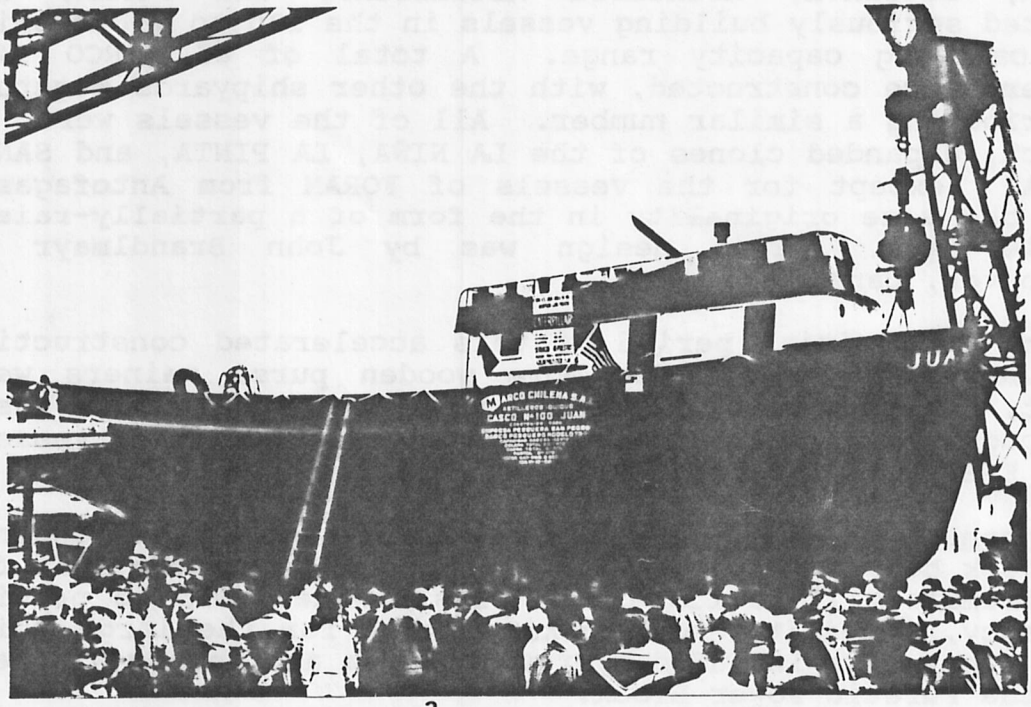


PHOTO 6: EPERVA 24 - 22.3m x 6.7m x 140m^3 seiner; 80 built between 1962 and 1964, with 4 more at a later date. These small, efficient seiners were the most successful seiners in the northern Chilean anchovy fisheries during the 1960s.



JUAN - 22.3m x 6.7m x 140m^3 seiner; photo shows the launching of the 100th seiner built by Astilleros MARCO Chilena at Iquique between 1961 and 1964.

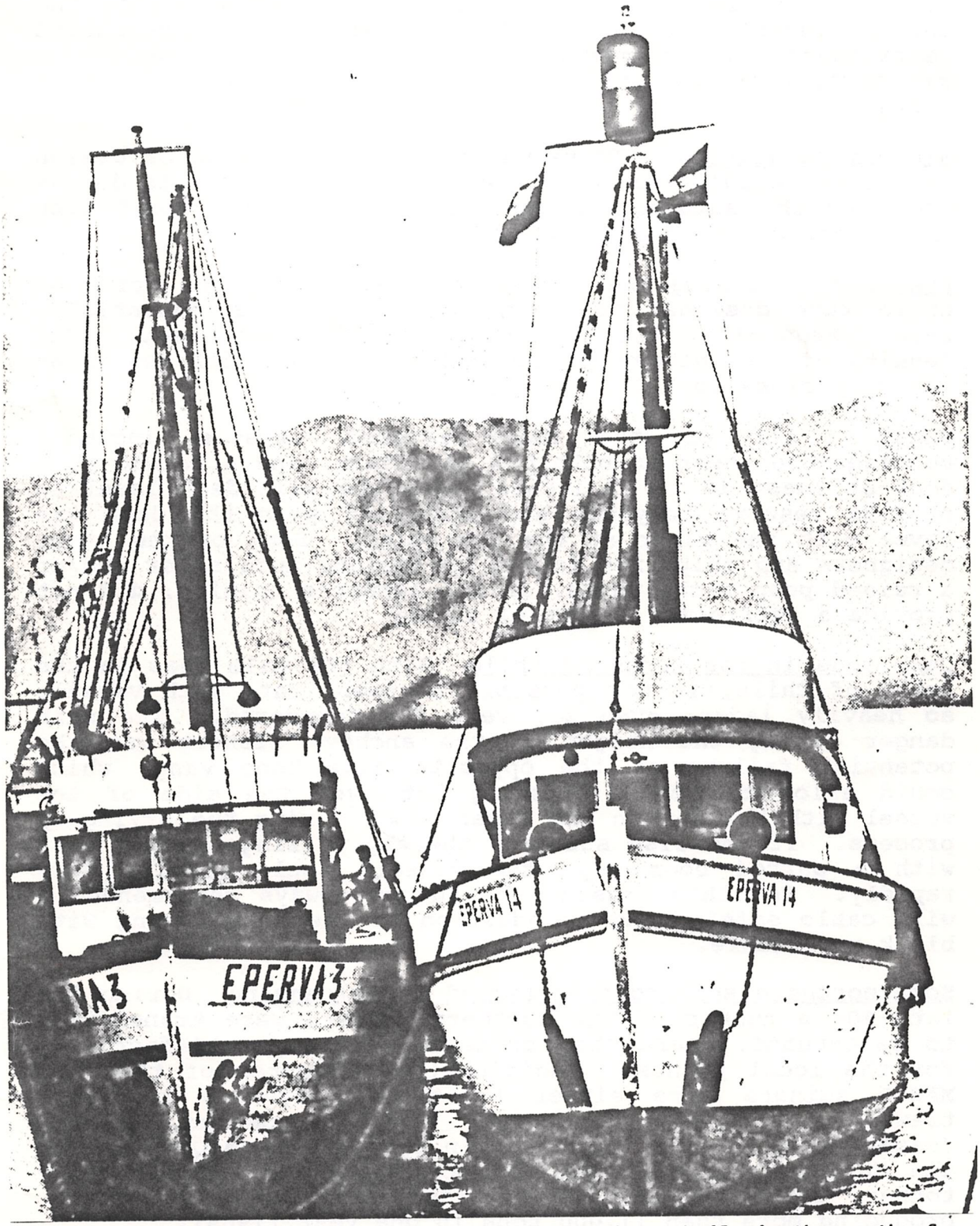


PHOTO 7: EPERVA 14 - Last of the wooden purse seiners built in the north of Chile, circa 1960, in Valdivia. Ten of these vessels were built between 1959 and 1961. They were too small, too late, and too poorly designed to compete with the larger steel vessels.

Prior to the introduction of the Capsulpump, a few of the Chilean vessels and many in Peru had installed deck-mounted centrifugal suction pumps. The success of the Capsulpump was instantaneous, and no further deck-mounted pumps were installed.

Minimum regulation There was minimal regulation of design and construction, and about the only thing one had to do was prove to the authorities that the vessel would float with the fishhold filled with sea water.

Freeboard During the 1960s, the vessels for the north of Chile were designed to carry their load with essentially zero freeboard at the low point of main deck sheer. The density of the anchovy in the fish hold mixed with sea water was very close to 1.0.

Sheer All of the MARCO-designed vessels included considerable sheer in both bow and stern, and a raised poop deck at least 10 to 12 inches above the main deck level to provide reserve buoyancy and stability when the deck was level with the water at the low point. Some of the other designers and shipyards failed to include much sheer and/or a raised poop deck, which, in the author's opinion, did not provide a sufficient margin of safety.

Calm seas in the north of Chile With the calm seas in the north of Chile, it was possible to tempt fate with vessels so heavily laden; even so, very few foundered. The main danger during the height of the anchovy fishery was the potential failure of the opposite side boom vang, which could allow the boom to swing out over the side of the vessel with the net in the Power Block during the drying-up process. If the fish sounded, thereby pulling the net down with a parted boom guy, the vessels would capsize very rapidly. For this reason, the author always recommended a wire cable safety vang in addition to the normal vang with block and tackle.

Some northern seiners transferred to Talcahuano During the late 60s a number of the northern seiners were transferred to Talcahuano, where they commenced fishing satisfactorily for the local plants. Additionally, a number of the 140T MARCO seiners were either built or converted to stern trawlers, fishing very well for langostino, shrimp (camarones), or hake (merluza) in the zone from Quintero to the Gulf of Arauco. The GRINGO, which was a MARCO 140-tonner, set hake trawling records in the Gulf of Arauco, producing more than 11,000 tons in one year (1965).

Trend to larger vessels The trend to larger vessels continued during the 60s, and MARCO produced the 25.6m (84') LOA model designed to carry 200 metric tons. Harvey Smith brought into Chile eight 25.3m (83') LOA vessels of MARCO

design that carried about 180-190 tons (see Plans B-4 and B-5 in the Appendix). Several larger vessels were constructed in Norway, with carrying capacities of 240 MT.

Towards the end of the 60s, because of the failure of the anchovy resource in the north, the demand for vessels slowed. During this period MARCO designed and put into production a 30.5m (100') LOA model (see Plan B-6 in the Appendix) which was intended to carry 300 metric tons. Due to increases in the weight of the nets and fishing machinery, the vessels never quite carried their designed load. At that time, however, zero freeboard was still considered an adequate criterion.

Refinements during the 60s Thus, during the 60s, with the rapid growth of the fleet, the evolution was more towards an increase in size than a change in the basic concept of vessel design and fishing methods. Of course, there were many refinements of methods and vessels throughout the 60s, including:

[1] Introduction of wire purse cable

[2] Introduction of snap purse rings

[3] Introduction of chain instead of customary leadline on the bottom of nets

[4] Introduction of the Puretic Power Block

[5] Introduction of the Capsulpump (mid-60s)

[6] Introduction of vertical fishfinders

[7] First experimentation with sonar (not altogether satisfactory during the 60s)

[8] Introduction of the steel power skiff

It was not until the 80s that significant further evolution of the purse seiner occurred in Chile. During this period, through the present, much has changed.

Development of trawlers In the meantime, during the 60s, Harling brought from Germany several very fine side trawlers to fish for his plant in San Antonio. These trawlers were up to 57m (187') LOA. For one reason or another, however, even with their much larger size they did not out-produce the smaller 22.3m (73') LOA GRINGO. In the meantime, in the last few years there have been various small to medium-size trawlers brought into Chile to supply plants in the southern zone, in the Puerto Montt/Chiloé area. Large foreign factory trawlers are also fishing in the open sea in the far south, primarily with a large number of foreign crew.

In the last few years, longline fishing has been developing up and down the coast -- with the most significant developments from Puerto Montt south to the Straits of Magellan.

Longline fishing is of four types:

(1) Artisanal

(2) Modern vessels under 18 meters LOA

(3) Larger vessels over 18 meters LOA, fishing interior and exterior waters from Puerto Montt south to the Straits of Magellan

(4) Larger vessels that freeze the catch on board either headed and gutted (H&G) or in the round

No clear pattern of evolution in trawlers and longliners Both the trawl industry and the longline industry have, to this date, not shown any clear pattern of evolution. Most of the trawlers have been of European origin designed for other fisheries. The new longline fishery is currently undergoing Spanish and North American influence in the few new vessels presently fishing.

Difficult to predict development of longliners and trawlers It is extremely difficult to predict the future development of trawlers and longliners due to current and pending regulations that affect not only the size of the vessels but limit the operations on board, such as on a factory ship.

Currently, there are complicated length and fishing zone restrictions, all of which will have a major impact on the future development of the trawl and longline industries, as well as the design of the fishing vessels. The rectification of this current situation, where the regulations are in limbo, is extremely important for the development of these industries. Furthermore, it is important that whatever regulations are enacted and implemented be of a constant long-range nature so as to minimize the possibility of creating freak fishing vessels.

The evolution of the Chilean purse seiner The text that follows, therefore, is confined solely to the evolution of the Chilean purse seine fishing vessel which delivers its product to the many large, modern fishmeal plants in the northern and south central zones. As discussed herein, the northern zone encompasses Arica to Caldera, and the south central zone encompasses Coronel to Quintero, with the bulk of the activity in Coronel/San Vicente/Talcahuano, and San Antonio.

So far, the regulation of purse seine fishing vessels has been primarily a limitation of licenses. On the other hand, a few vessels have been built smaller than might be considered optimum because of restrictions on the tonnage available to the license holder. The fisheries authorities should be encouraged by the fishing and shipbuilding industries to give thoughtful consideration to the regulations that affect the free design of fishing vessels for optimum productivity.

THE PRESENT-DAY CHILEAN PURSE SEINER

Typical characteristics of 14 Chilean purse seine fishing vessels are shown in the Table in the Appendix covering vessels from the LA NIÑA, LA PINTA, and SANTA MARIA in the 1960s through today's vessels. Certain ratios are indicated which show the evolution of the designs.

Arrangement plans for 14 of the typical designs of Chilean purse seine fishing vessels are also included in the Appendix, including examples of some of the latest designs.

Initial seiner development ended in late 60s - early 70s The initial development of the Chilean purse seiner ended with the MARCO 100 (100' LOA) in the late 60s - early 70s. From 1959 until this time, the primary purse seine fishing industry was in the north of Chile for anchovy for the fishmeal plants. During the 70s there was a stagnation of the industry, with very little new construction.

Change from anchovies to sardines Commencing in the 80s, the emphasis shifted from the capture of anchovy in the north towards sardina española, which put new demands on boats, equipment, and nets. It was found that the most productive periods of fishing for the sardine resource were during dark hours of the night. With the advent of night fishing, new, larger nets, and more experience gained by the fishermen, production zoomed.

Collapse of Peruvian fishery By this time, the gigantic Peruvian anchovy fishery was near collapse, and the government had nationalized both plants and boats. The Peruvian boats were put on the used market and Chilean fishmeal company owners flocked to Peru to pick off the best bargains. Initially, most of the better MARCO-designed 99-footers (30.2m) built by Fabricaciones Metálicas were purchased and reconditioned; then the larger boats of PICSA, with 350-ton carrying capacities, were purchased in large numbers (see Plan B-7 in the Appendix). The PICSA boat was well-suited to the new Chilean fishery with its bigger capacity, safe load-carrying capability, and adequate stability. The only disadvantage of these boats was that their exceedingly full hull form limited their speed capability and fuel economy. On the other hand, they have been very successful workhorses in the Chilean fishery.

Traditional North American West Coast style Both the FABRIMET 99-footer and the PICSA 350-tonner embody the traditional North American West Coast style, with engine, deck house, and command forward, with a big, wide, clear afterdeck for conducting the fishing operation.

Norwegian influence During the 80s a Norwegian influence came to the purse seine fishery in the south central zone, with the first used vessel imported from Norway in 1983, by the name of TOPOCALMA, of 36M LOA, and 435m^3 carrying capacity. Since that time, approximately 34 Norwegian-style seiners have been imported into Chile, most of them fishing in the south central zone. These vessels included, among other things, bow and stern thrusters, which eliminated the necessity for using a skiff (panga). Because of this and their design for North Sea operation, they were able to fish in the rougher, stormier winter weather of the south central zone, with some of these vessels becoming top producers.

Description of Norwegian-style vessels The Norwegian style, in general, comprises a two-deck vessel with the main propulsion machinery, deck house, and living quarters in the stern of the vessel, with the net bin behind the deck house, and purse winches forward. These vessels arrived in Chile either with an ABAS or Triplex-type net hauling system, rather than the customary single Puretic Power Block.

Net hauling equipment The "ABAS-style" net hauling equipment had become, until recently, the most popular system of net hauling during the 80s. Some vessels utilized the Triplex net winch, and that system is becoming more popular in the south central zone; it appears that a similar system is now spreading to the northern fishing zone as well.

The Norwegian-style vessels in the sizes brought into Chile are from 600 to 1,000-tons carrying capacity. They are two-deck vessels, with fishing conducted from the upper deck. The vessels in general have a somewhat narrower beam than is usual in either North or South America, and so in most cases require extensive ballasting in the light condition.

Because of the combination of Norwegian and West Coast of America systems, new vessels are being built in Chile of four different types:

[1] Two-deck vessels that in general follow the Norwegian concept.

[2] Two-deck vessels that follow the American concept with living quarters and command forward, with ABAS or Triplex-type (Petrel) net hauling systems with machinery aft.

[3] Single deck with raised focsle; machinery aft with stack and access to engine room on starboard side, and living quarters and deck house forward.

[4] Single deck with raised focsle; machinery, living quarters, deck house, and command forward.

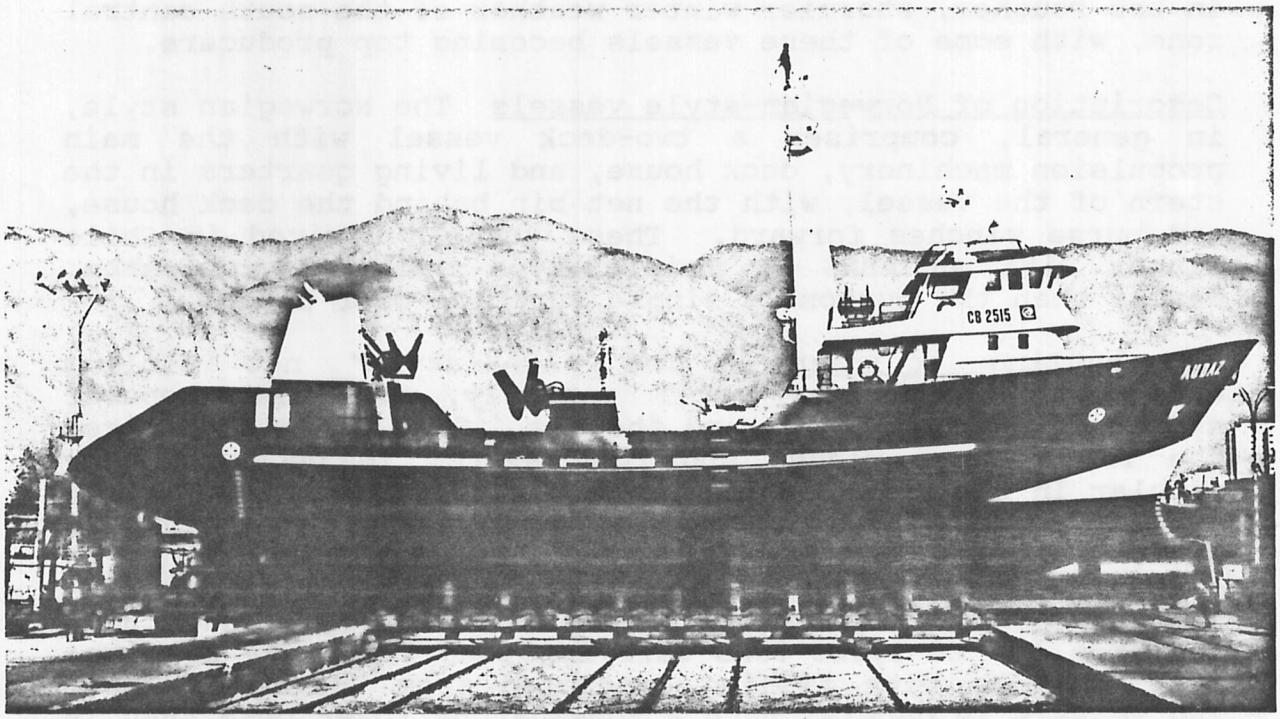


PHOTO 8: AUDAZ - 44m x 10.1m x 550m^3; second vessel of the INTREPIDO Class built by Astilleros MARCO Chilena for Pesquera Coloso. This is the latest and most successful model purse seiner fishing in the north. Five have been built for Pesquera Coloso, with 4 more of generally similar arrangement under construction for Pesquera Iquique.

Split in vessel types used in northern and south central zone A split has occurred in the types of vessels used in the north of Chile and in the more stormy waters of the south central zone.

Current vessels of the northern zone In the north of Chile, the new vessels that have been added since the PICSA 350-tonners have been similar to the MARCO INTREPIDO Class (see Photo 8 and Plan B-11 in the Appendix), which are single-deck vessels with raised focsle and machinery aft. In the north, the size of the new vessels is about 44 meters (145') LOA, with carrying capacities of 500-650 metric tons. These vessels have been designed to get to and return from the fishing grounds more rapidly, and therefore finer prismatic coefficients have been used, coupled with bulbous bows. The vessels have been designed to minimize stern transom immersion in the fully-loaded condition to achieve more speed on the return trip home. Most of the vessels have utilized an ABAS-type (Petrel) net hauling system and a 14" Capsulpump, with 18" Capsulpumps now being introduced.

Initial stability, as well as a strong righting moment characteristic in the heeled condition, must be observed because of the large quantity of fish that can be captured in a set and the heeling moment that can occur from the weight of sounding fish.

Astilleros Arica Astilleros Arica, however, is producing a somewhat smaller vessel for some of its affiliated companies, of 400 metric tons carrying capacity, and 31.7m (104') LOA (see Photo 9 and Plan B-8 in the Appendix).

Current vessels of the south central zone In the south central zone a new fishery has developed during the last five years for mackerel (jurel), a resource which now appears to exist in enormous quantities at various depths. Because of night fishing and deeper and deeper nets, mackerel production seems to increase each year. Due to the stormy winter weather and large quantities of fish available (sometimes at considerable distances from the plant), bigger and bigger vessels are proving to be economically advantageous.

Several years ago the largest vessels were the PICSA 350-tonners. With the advent of the Norwegian vessels, the size increased to 600, 700, and now even 1,000 tons carrying capacity -- with the number-one producer in the south today being a vessel of 1,000 metric tons carrying capacity.

Chilean shipyards have responded The Chilean shipyards ASENAV, ASMAR, ASTILLEROS ARICA, and MARCO have responded with new Chilean designs, for vessels from 400 to 700 metric tons carrying capacity, and larger vessels are being contemplated. Typical designs from these builders are shown

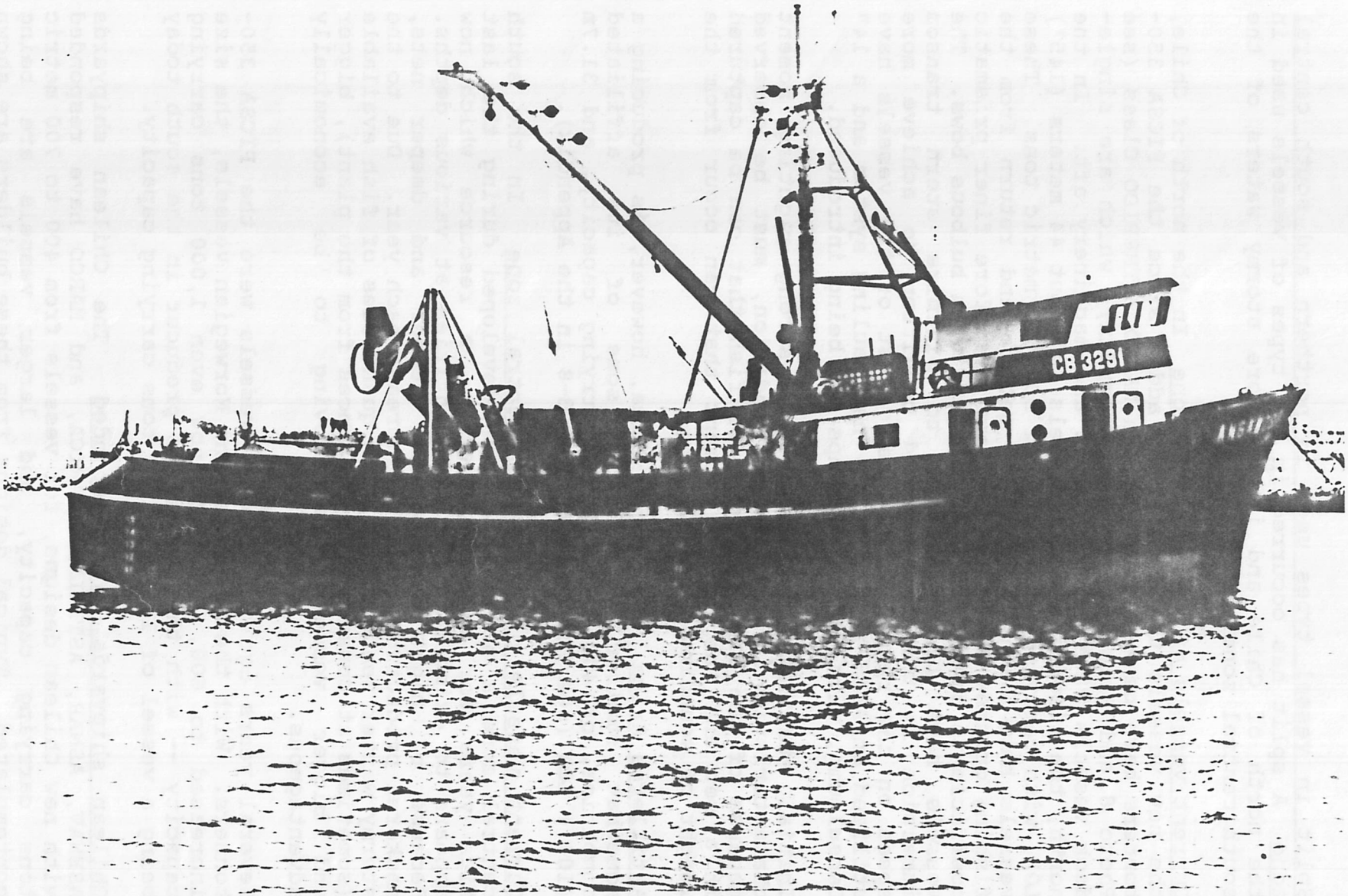


PHOTO 9: ANGAMOS 2 - 107' x 400m^3 traditional Pacific-style seiner of type being built by Astilleros Arica.

with their characteristics in the Appendix. Currently, this is a fast-moving industry with a number of new designs -- mostly larger -- appearing each year.

Two-deck vessels The general consensus is that the purse seiner of the south should have two decks, but there is not much agreement as to whether the deck house, living quarters, and command should be forward or aft. Some of the vessels built by ASENAV and ASMAR are virtual clones of the Norwegian-style vessels (see Photos 10 and 11 and Plans B-12 and B-14 in the Appendix), while others of ASENAV maintain command and living quarters forward (see Photo 12 and Plan B-9). Photo 13, CLAUDIA ALEJANDRA, shows a MARCO single-deck seiner for the south central fishing zone with raised focsle and poop deck; deck house, living quarters, and command forward, with machinery aft. The vessel was designed with high freeboard in the loaded condition for operation in the south. The two deck SOUTHPORT (see Plan B-10b in Appendix) is a sister vessel to the CLAUDIA ALEJANDRA with engines aft and crew quarters and command forward, providing even greater freeboard to the working deck. MARCO has since designed a new model called the Arauco type (tipo Arauco), which also is basically derived from the Norwegian style, but with certain modifications to take local conditions into account (see Plan B-13 in the Appendix). Particular attention has been placed on providing a large working deck aft to store and repair the ever-larger nets being used in the Chilean fishery. The location of the fishhold has also received considerable attention, so as to avoid excessive trim by the bow in the loaded condition, as occurs in many of the Scandinavian vessels.

Each of these Chilean shipyards is producing boats at near capacity, while additional boats are still coming in from Scandinavia.

FACTORS AFFECTING PURSE SEINE VESSEL DESIGN

The following are some of the more important factors influencing purse seiner design:

- Type of fishing method to be used
- Size of catch to be carried
- Weather and sea conditions to be encountered
- Stability requirements
- Speed requirements
- Crew -- number required and livability standards of the industry

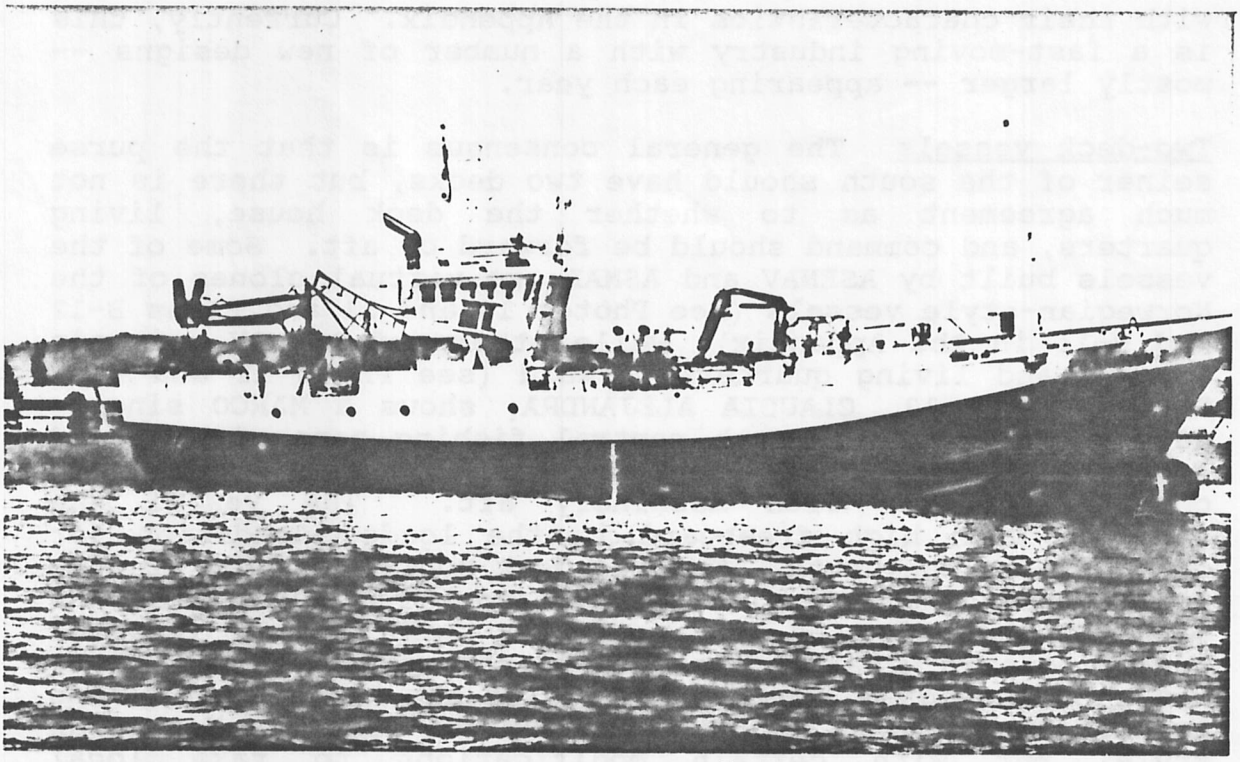


PHOTO 10: PILMAIQUEN I - 43.4m x 8.6m x 650m^3 seiner constructed by ASENAV; a Norwegian-style vessel built in Chile for Pesquera Itata.

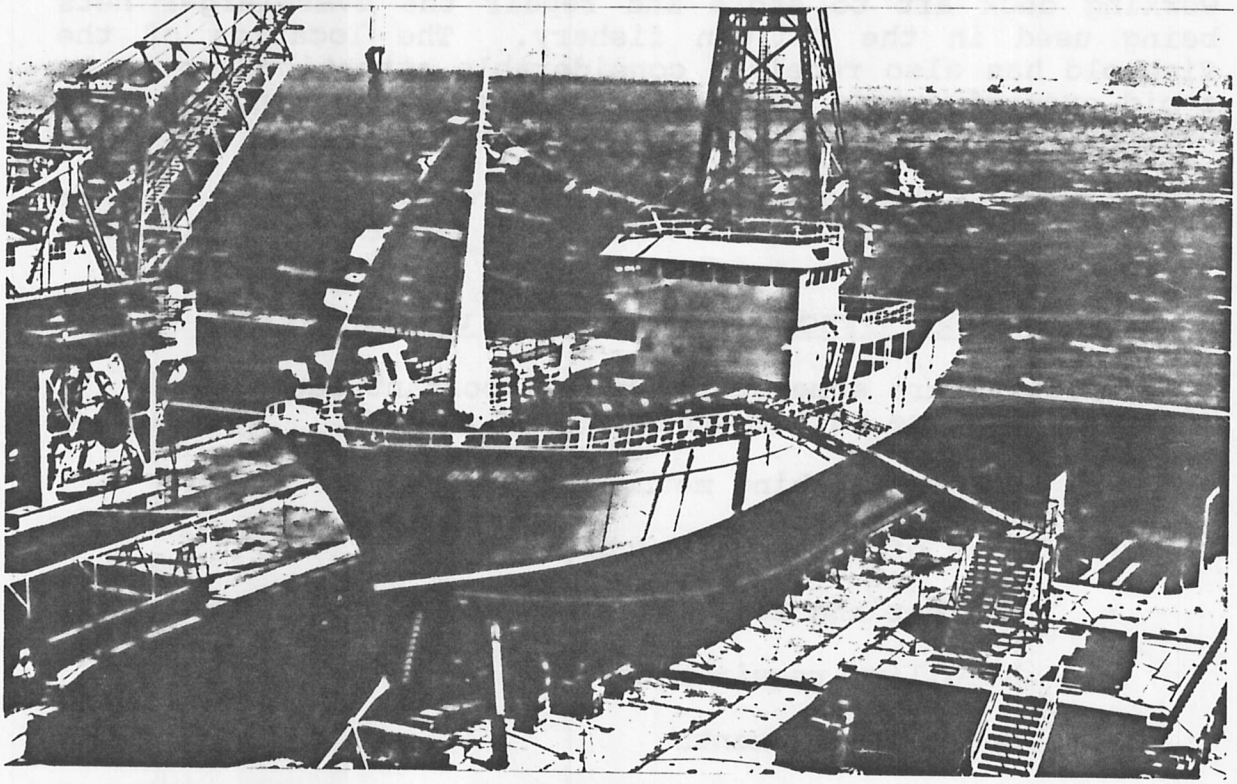


PHOTO 11: DON PEDRO - 48.4m x 10.2m x 750m^3 Norwegian-style seiner constructed by ASMAR for Pesquera Albatros. 1986

Fishing method to be used determines the deck arrangement This has an important effect on size and location of superstructures.

Size of catch to be carried To date in the Chilean fishmeal industry, refrigeration is not being used on board the vessels. The catch preferably should not be on board more than 24 hours, but in certain cases -- particularly in the south -- it could be as long as two or three days, with some losses occurring. Thus, the most efficient fishing vessel size is one that can carry what it can catch in one day during periods of better-than-average fishing. It is probably foolish to build a boat so large that it can only return with a full load a few times a year. The exact point, however, is hard to determine, but the best fishermen usually end up with the largest vessels and produce the most fish.

The exact break-even point on size tends to evolve and is difficult to predict. It appears, however, that in the north of Chile the boats of more than 500 metric tons carrying capacity not only are producing the most fish, but are also producing it at the lowest cost. The current boats of 500-600 metric tons carrying capacity are significantly larger than the previous 350-ton boats, which is a big step. It would appear that, under current conditions in the north, vessels much larger than those currently being built are not warranted.

In the south of Chile, vessel size is continuing to grow, with one of the 1,000-ton carrying capacity vessels being the top producer. It is not at all clear, however, that if one were to build a new 1,000-ton vessel that it would produce a higher return on investment than one of perhaps 700 metric tons carrying capacity. In any case, this fishery and its techniques are developing so rapidly it is difficult to predict at this moment where the economical size barrier is.

This author has seen American tuna industry vessels go from 600 to 1,000 tons, then to 1,200, 1,700, and 2,000 tons; and then drop back to a 1,200-ton capacity as being the standard of the fleet. Recently, however, because of a change of fishing area from along the coast of the Americas to the Western Pacific, larger boats are again indicated and new vessels are under construction with 1,500-ton carrying capacities. So there are instances from which a conclusion can be drawn that the industry has competed itself into larger and larger vessels, only to retract to smaller than peak size.

Weather and sea conditions Obviously, the type of weather and sea conditions materially affect the design of the vessel, as witness the difference in requirements in the

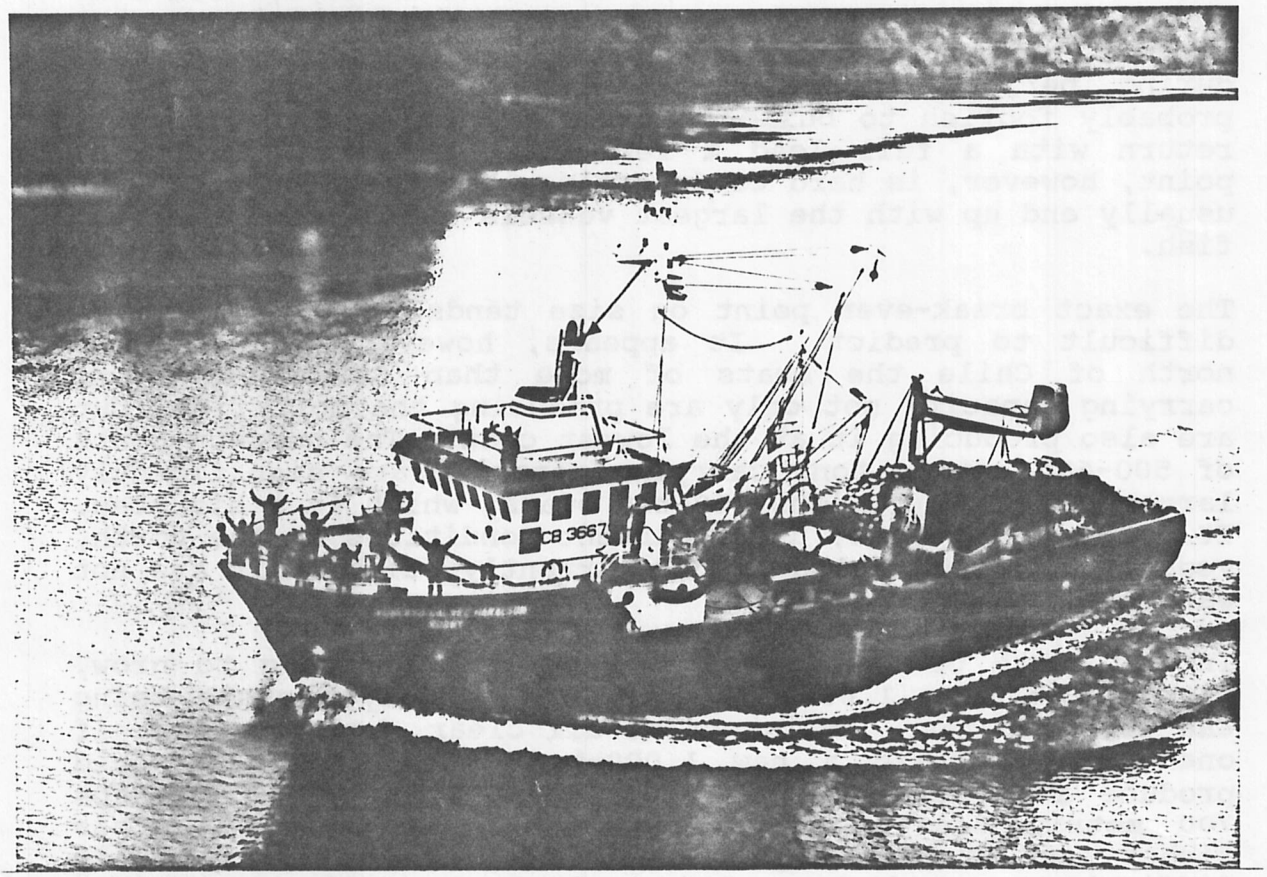


PHOTO 12: BOBBY - 35.7m x 8.6m x 435m^3 Pacific-style seiner with house, machinery, accommodations, and command forward. Constructed by ASENAV for Pesquera Atitlán.

northern fishing zone of Chile and that of the south central zone. In the north, single-deck vessels with relatively low freeboard requirements are indicated, whereas in the south higher freeboard is essential to maintain the working deck clear of breaking water on deck. Likewise, fuller bows on the vessels for the south are indicated to provide more lift when bucking into head seas.

Stability Chilean purse seine vessels require both good initial stability, 76cm (2.5') G.M. or more, and a good reserve righting moment as the vessel heels. As criteria, the author's company utilizes IMO heeling moment standards for fishing vessels with an augmented G.M., as indicated above. Wider rather than narrower vessels of the same cube are indicated to reduce the amount of ballasting required in the initial fishing condition without fish on board.

Freeboard Currently, Chilean authorities require a minimum of 5 to 15cm freeboard in the loaded condition for all large fishing vessels, depending on hatch details. While this is a step in increasing the safety of the vessels, it is suggested that this is not an effective criterion, as freeboard alone is not a good indication of safety or stability of a vessel. This type of criteria does not take into account the amount of sheer, raised focsle and poop decks, nor structures on the deck, all of which influence stability and add reserve buoyancy.

The author believes that criteria based on area under the righting moment curve, as established in the IMO fishing vessel stability criteria, coupled with a minimum G.M. as an indication of initial stability, are suitable.

The criterion of the area under the righting moment curve takes into account the sheer and partial decks as well as structures on deck which effect stability and reserve buoyancy.

For purse seine fishing vessels in Chile, the suitable minimum G.M. should be greater than that required by IMO because of the external heeling forces exerted by the action of fish in the net alongside. A minimum G.M. of 76cm (2.5') is recommended.

Thus, minimum freeboard requirements only relate to seas breaking over working decks, and experience indicates that vessels for the south require significantly higher freeboard than current requirements. Minimal freeboard is satisfactory for the north, provided the vessels meet the IMO standards with the recommended augmentation in G.M.

PHOTO 13: CLAUDIA ALEJANDRA - 41m x 9.3m x 450m^3 single-deck seiner with raised focsle and raised poop deck and machinery aft; built by Astilleros MARCO Chilena for fishing in the north.

Speed Although speed is a relative thing, faster vessels are being designed that use less horsepower, both as an economy move and to allow the vessels to reach the fishing grounds and return to the plant faster.

In the INTREPIDO design, by lengthening the vessel and designing it with a lower prismatic coefficient, two knots greater speed in the loaded condition was achieved, despite increasing the cargo-carrying capacity over the PICSA 350-ton vessels to 550 tons.

Crew requirements The Chilean purse seine fishing crew of 12 to 17 men is being provided with living quarters on the new vessels nearly up to European and North American standards. In the early 60s, crew quarters were spartan and minimal. In many of today's Chilean-built vessels the accommodations are spacious and even somewhat elegant. All of the newer, larger Chilean purse seiners are capable of housing the crew at sea for extended periods, which is important when they are fishing far away from their base plant or delivering to plants in other ports or zones. They are capable of traversing the coast of Chile from north to south as a routine matter.

Higher painting standards Increased emphasis has been placed on painting and corrosion resistance on new Chilean fishing vessels. The steel of all vessels is sandblasted either first or during construction. Mostly, the vessels are coated with inorganic or epoxy zinc, followed by epoxy coatings of various types. In some cases, urethane top coatings are utilized. The anti-fouling paints that have been developed for use in Chilean waters in the last few years have shown excellent results.

Hull form The larger MARCO-designed vessels are now being made finer, with lower prismatic coefficients than before. Attention in design should be placed on transom immersion in the loaded condition, as a deeply-loaded transom creates undue resistance on the return trip. On the other hand, it is disadvantageous for the counter to be far out of the water in the light condition, as the corkline of the net will go underneath the counter and will tend to get caught in the rudder.

In this regard, it is always best in a purse seiner to have the rudder and propeller tucked further forward than in other designs so as to minimize this problem with the net.

Hydraulics The hydraulic systems on all of the newer Chilean purse seiners have become quite complicated and extensive. Up to 500 HP are being withdrawn from main or auxiliary engines at times during the pursing operation. Main purse winches are of two types: either a multi-drum

winch, or what is known as split winches, with the three drums mounted separately on deck. There is a trend towards split winches. The author has seen this trend occur before and usually it cycles back to a main winch frame with several drums to conserve deck space. The deck arrangements on many of the current Chilean fishing vessels is far from ideal because of the placement of winches.

Capsulpump All Chilean purse seiners pump fish aboard with a submersible pump. Pumping rates of up to 600-800 tons of fish per hour can be achieved. Large dewatering screens are utilized as shown on the various deck arrangement examples in the Appendix.

Steering It is very important that a purse seine fishing vessel have a short turning radius. As a result, very large rudders are used. Most of the vessels are designed with a considerable drag of the keel, as can be seen from the outboard profiles of the vessels. With large drag, the vessels maintain course much better, and yawing tendencies in following seas are reduced.

THE FUTURE CHILEAN PURSE SEINE FISHING VESSEL

The Chilean purse seine fishing vessel to date has not been affected much by regulation. If greater regulation occurs, it will undoubtedly have an influence on the size and other characteristics of these vessels.

Vessel size In the north, considering the current fishery and competition on grounds, etc., it would appear that a size range for the newer vessels of 500 to 650 cubic meters fishhold capacity is about adequate; the vessels will not grow unless there is a change in regulations. In the south, it is difficult to ascertain at this moment whether the vessels will grow larger than the largest current vessels (which are of 1,000 metric tons carrying capacity) or even if the most economical and popular size will be slightly smaller, perhaps in the 700 MT carrying capacity size.

Nets Nets are continuously changing, particularly in the south. There, they are getting deeper and deeper, and this could have some effect on the evolution of improved net hauling and pursing equipment, which could influence the deck arrangement of the vessels.

Controllable-pitch propellers Most of the Scandinavian-built vessels that have arrived in Chile have controllable-pitch propellers. Some of the purse seine vessels constructed in the Chilean shipyards the last few years are also equipped with them. One cannot make a case for the utilization of a C.P. propeller in a purse seine fishing vessel based on increased propulsive efficiency. As a matter of fact, there will usually be a decrease in efficiency vs. a fixed-pitch propeller, unless the controllable-pitch propeller is operated at its optimum setting, which in many cases it is not. Contrary to popular opinion in these days when fuel efficiency is a concern because of high fuel prices, one of the items mentioned in increasing fishing vessel efficiency is utilization of fixed rather than controllable-pitch propellers.

A case may be made for the use of CP propellers on purse seine vessels that are (1) fishing without power skiffs; (2) utilizing side thrusters to position the boat during fishing operations; and (3) drawing hydraulic power for the thrusters from the main engine. To be able to use the propeller during fishing operations and to allow the main engine to operate at the necessary speeds to power the side thrusters, a controllable-pitch propeller is useful. On larger vessels, it becomes advantageous to power the side thrusters from an independent power source, in which case the advantage of the CP propeller is diminished.

Z Drive ASENAV of Valdivia has introduced twin Z Drive propulsion (Schottel) to the purse seine fleet. Several vessels have been built with this propulsion configuration. Other than some mechanical problems, this system appears to have advantages for the purse seiner. Obviously, it provides increased maneuverability. By using the Z Drive unit away from the side of the vessel on which the net is being hauled, full power of one propulsion engine can be applied for side thrusting during the fishing operation. At the same time, it also allows thrusting the vessel forward or astern to give good positioning for hauling the fish net. The use of the twin Z Drive also provides the safety of two independent propulsion units in case of breakdown.

Thrusters Most of the new large Chilean purse seine fishing vessels have both bow and stern thrusters. Initially, these were in the 200-250 HP range, but today they are 300-350 HP. This trend will continue and there will be some tendency to increase these horsepowers further, limited only by the driving mechanisms, which are currently primarily hydraulic motors. A fishing captain would always like more horsepower in his thrusters, as in rough and windy weather response is not rapid when moving the boat sideways. It would appear, however, that the current size of about 350 HP in the stern and 300 HP in the bow is adequate.

Refrigeration A big change in the fishery would be the introduction of refrigeration in the larger boats, which could allow vessels in the south central zone, for instance, to make up to four or five-day trips, bringing in the fish in first-class condition. This would maximize the recovery ratio of the fish and the quality of product. The economics of this are not completely developed, and investigations should be made. It is possible that boats of 1,000 tons or more could become even more economical with complete refrigeration similar to that used in some of the Scandinavian vessels and the American tuna industry. By this means, the vessel could stay on the grounds for several days until it was completely loaded, coming in with 1,000 or more tons of fish in prime condition.

During the times of the year when the fish are farther away from the home base factory, the vessel could still sustain good production, and even more importantly, keep the factory working at higher capacity more days of the year.

Fish discharge One additional possibility on the larger boats would be to install pumping equipment to make them self-unloaders. It would be advantageous if they could unload through more than one hose at a time. This would mean installing two pumps and suction hoses to be utilized for each vessel on the pumping barges. Or, perhaps even better, couple the larger vessels up to the submarine pipes

at the pumping barge and have them discharge themselves with shipboard pumps through one or more submarine pipes.

Electronics Continuously improved sonar is available and fishermen are learning more of its possibilities than ever before.

Another big advancement will be the introduction of the Global Positioning System of navigation (GPS) based on 12 satellites which will continuously indicate the ship's position as close as 25 meters from its exact location. This, coupled with radar, will allow all Chilean purse seiners to fish comfortably outside the sight of land up and down the coast, particularly in the stormy waters of the south. By the end of 1992, the GPS system will provide continuous 24-hour-a-day position fixing.

CONCLUSION

In the 30 years since 1959, the Chilean industrial fishery, producing fish meal for the world market, has gone through extensive evolution. Today, the purse seine vessels serving this industry are modern and well-suited for the task. The fishermen and management are highly skilled, and production is extremely efficient.

Whereas the purse seine fishing vessel of the north has possibly reached a temporary plateau in its size and development, the vessel of the south central zone, fishing in stormier waters for mackerel (jurel), is still in a rapid state of development. The limitation of the mackerel resource is not yet known.

Although the longline fishery of the south appears to be poised for significant growth, it is difficult to project the most efficient type and size of vessels because of existing and pending regulations.

It also appears that the trawl industry could undergo a new phase of development, but this again is currently hindered by the restriction on licenses as well as on how regulations will affect the operation of catcher vessels and factory ships.

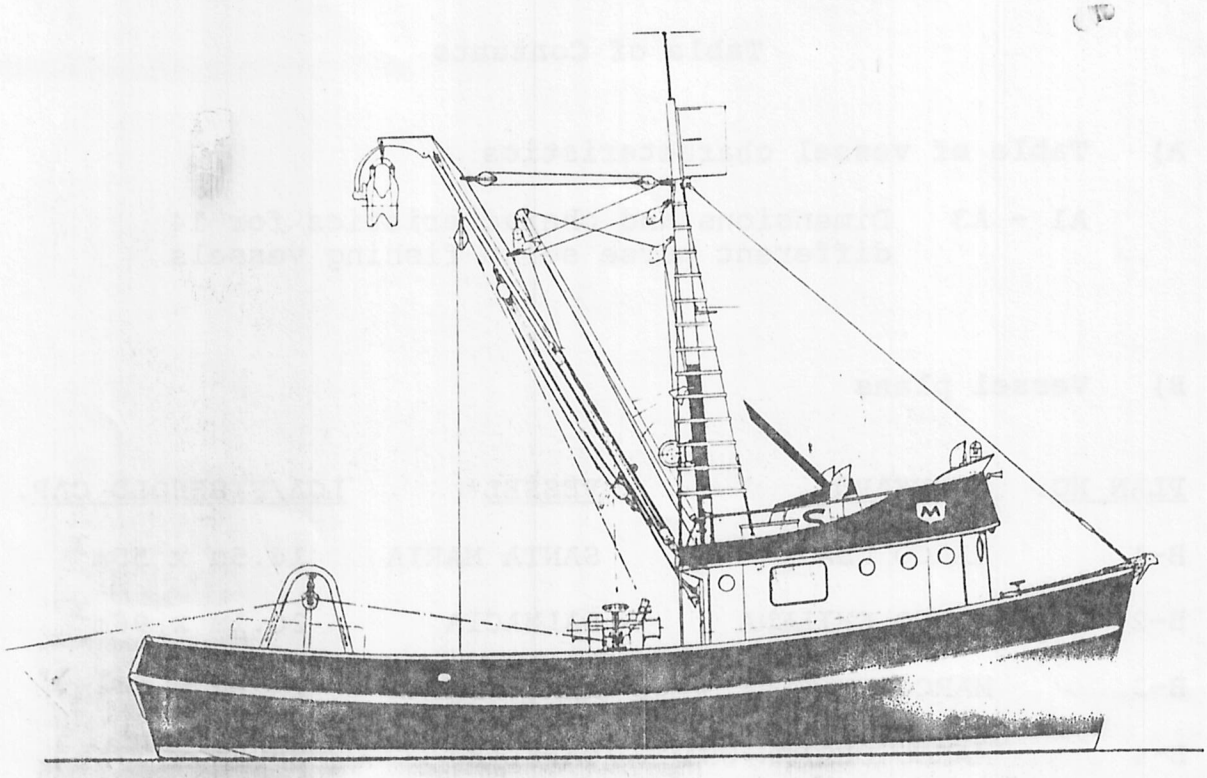
Hopefully, in a few years a success story will be able to be written about the development of the southern longline and trawl industry to parallel that of the phenomenally successful purse seine fishery.

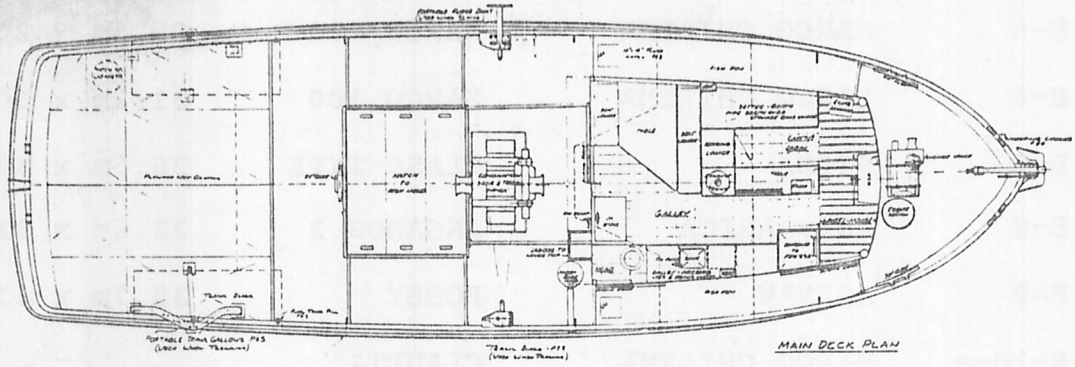
APPENDIX

Table of Contents

PLAN NO.	SHIPYARD	VESSEL*	LOA/FISHHOLD CAP.
B-1	MARCO USA	SANTA MARIA	16.5m x 55m^3
B-2	MARCO CHILENA	DALMACIA	20.1m x 96m^3
B-3	MARCO CHILENA	MARCO 140	22.5m x 144m^3
B-4	MARCO DESIGN/USA	CAPELLA	25.5m x 175m^3
B-5	MARCO CHILENA	MARCO 200	25.6m x 200m^3
B-6	MARCO CHILENA	MARCO 100	31.1m x 300m^3
B-7	PICSA	CLASS TYPE	36.6m x 375m^3
B-8	AST. ARICA	ANGAMOS 2	32.6m x 390m^3
B-9	ASENAV	BOBBY	35.7m x 435m^3
B-10-a	MARCO CHILENA	CLAUDIA ALEJANDRA	41m x 450m^3
B-10-b	MARCO CHILENA	SOUTHPORT	41.2m x 450m^3
B-11	MARCO CHILENA	INTREPIDO	44m x 550m^3
B-12	ASENAV	PILMAIQUEN I	43.4m x 650m^3
B-13	MARCO CHILENA	TIPO ARAUCO	45m x 650m^3
B-14	ASMAR	DON PEDRO	48m x 750m^3

* First vessel in class



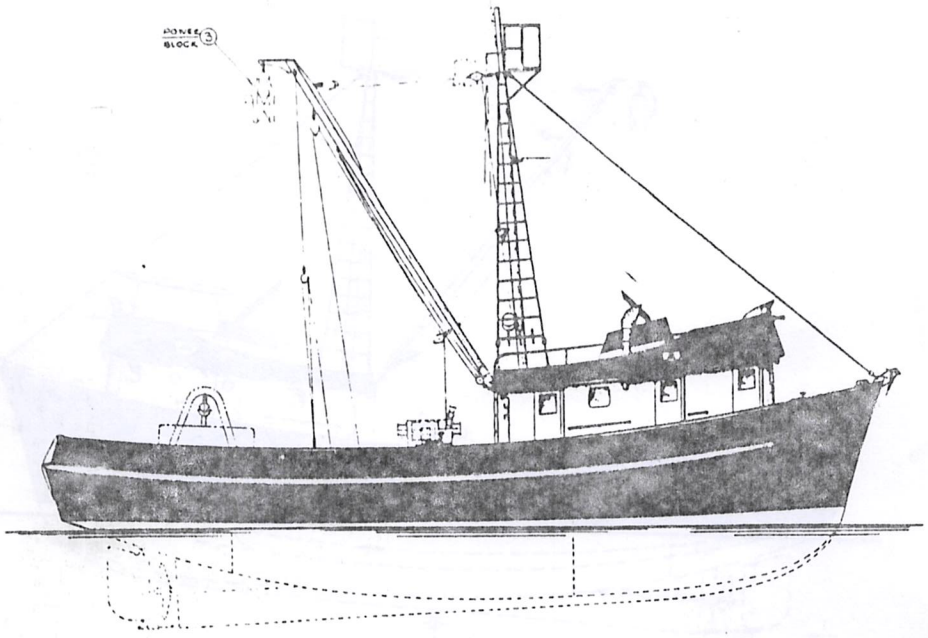


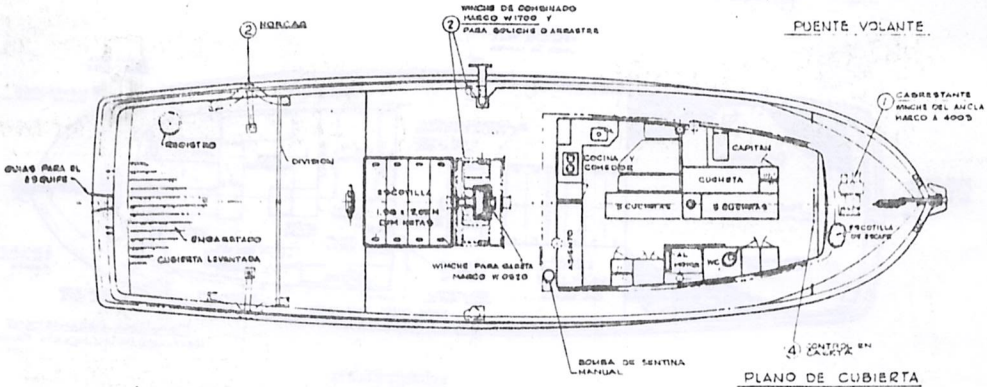
MAIN DECK PLAN

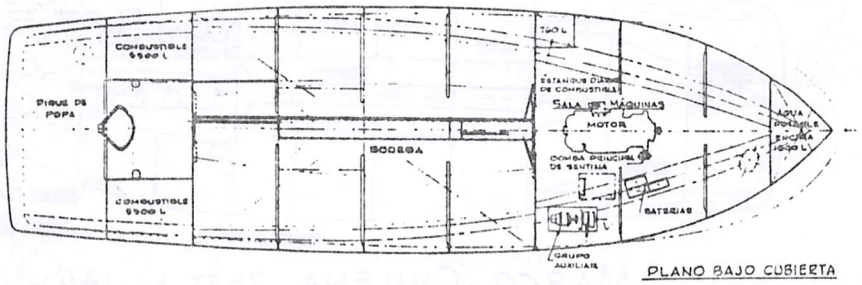
MARCO SEATTLE 54 FT by 55 M³
SINGLE DECK SEINER / TRAWLER

LENGTH OVERALL	16.5 M	HOLD VOLUME	55 M³
BEAM - MOLDED	5.0 M	POWER	165 HP.
DEPTH	2.5 M		

PLAN B-1



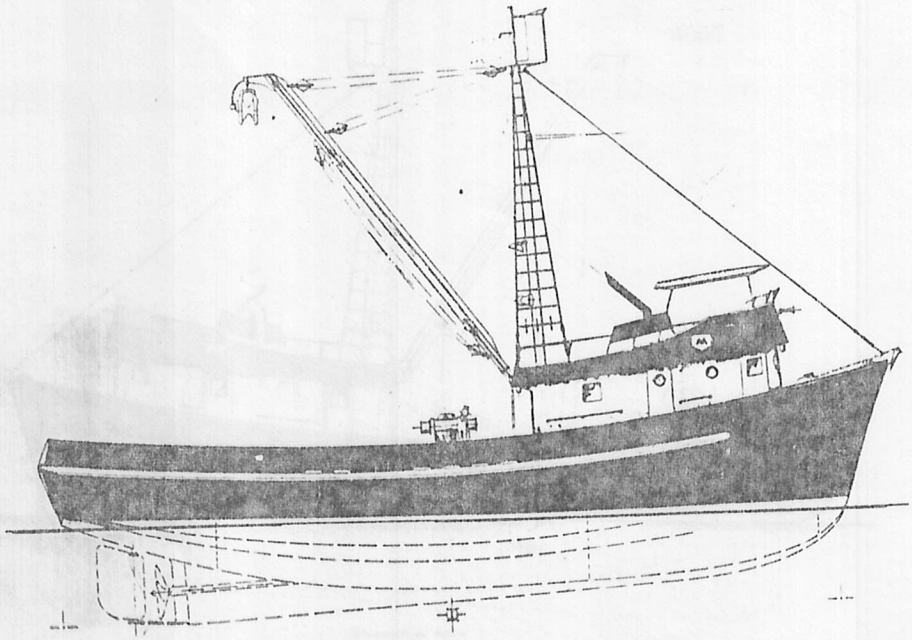


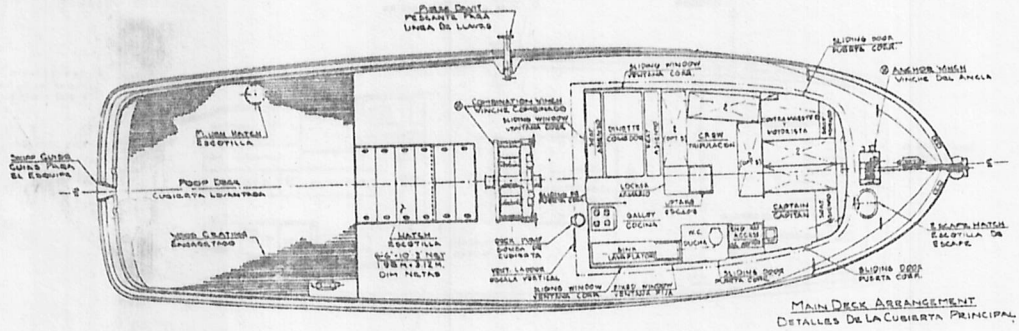


MARCO CHILENA 66FT by 96M³
SINGLE DECK SEINER

LENGTH OVERALL	20.1 M	HOLD VOLUME	96 M³
BEAM · MOLDED	6.0 M	POWER	220 HP
DEPTH	2.9 M		

PLAN B-2





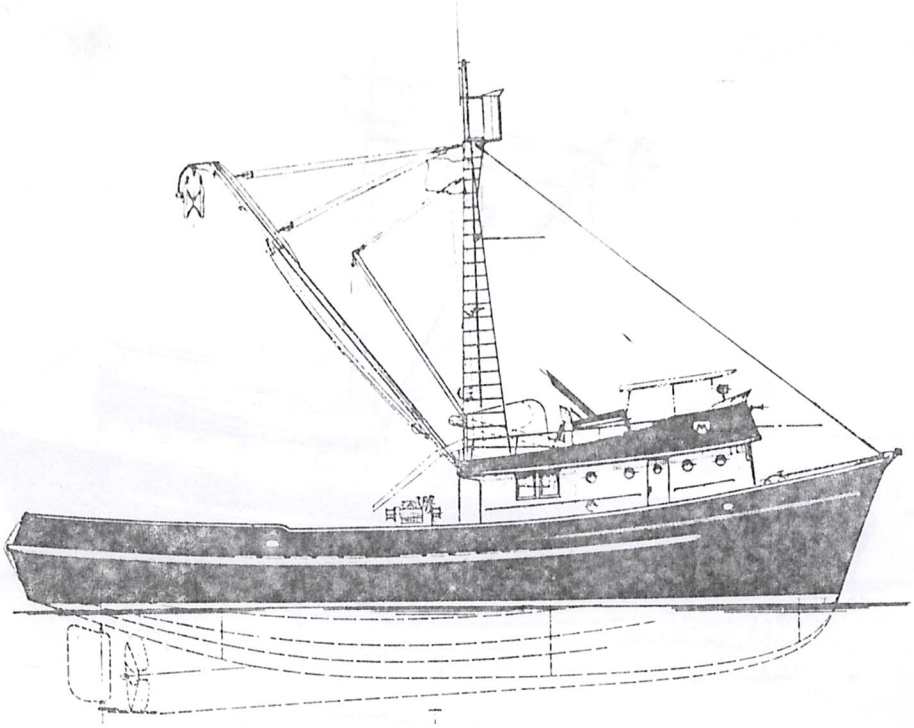
MAIN DECK ARRANGEMENT
DETALLES DE LA CUBIERTA PRINCIPAL

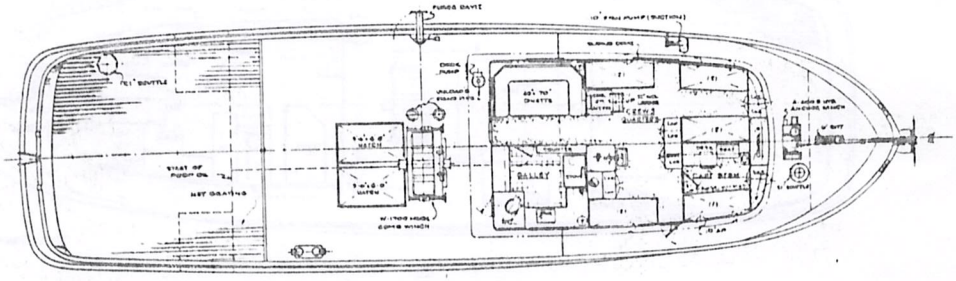
HOLD ARRANGEMENT
DETALLES DEL PLANO INTERIOR

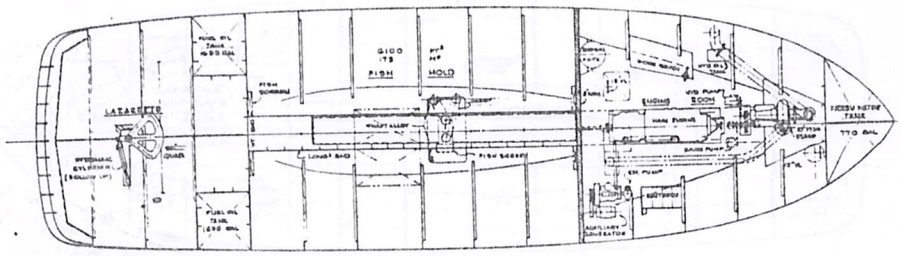
MARCO CHILENA 73 FT by 140 M³
SINGLE DECK SEINER

LENGTH OVERALL	22.5M	HOLD VOLUME	144 M³
BEAM - MOLDED	6.7M	POWER	340 HP
DEPTH	3.2M		

PLAN B-3



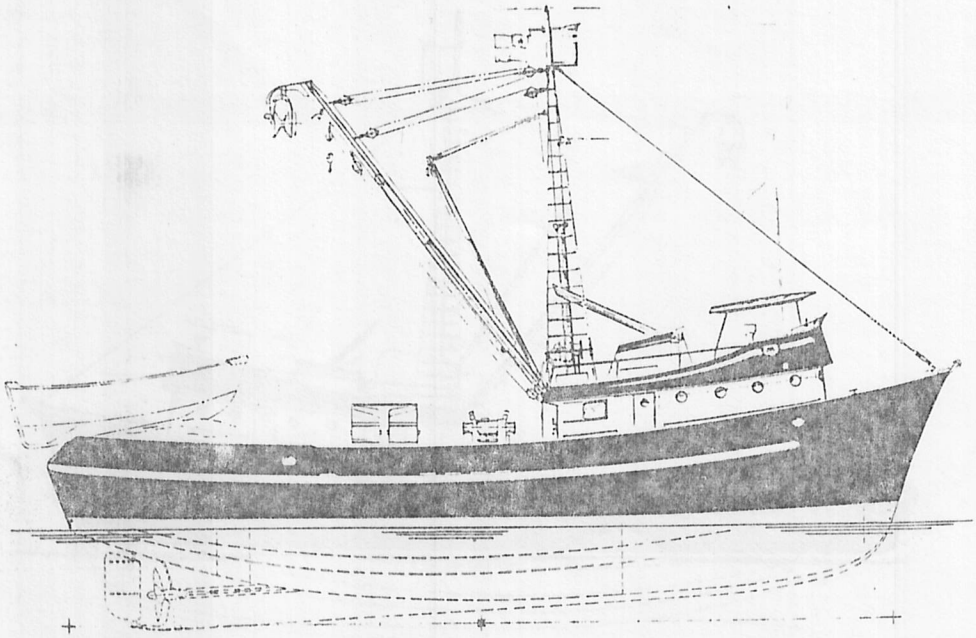


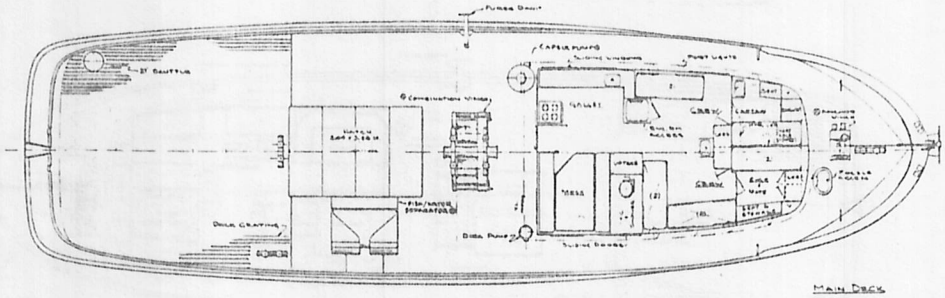


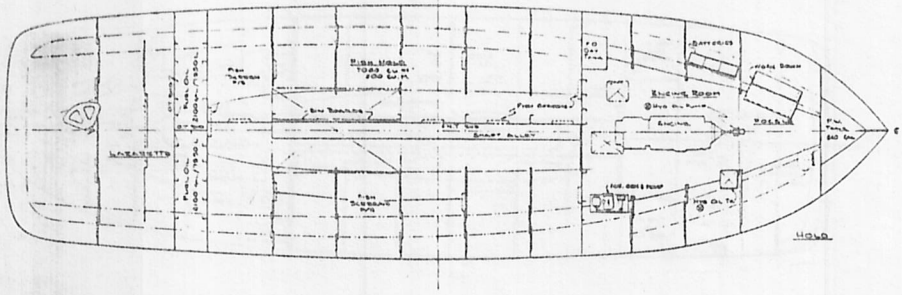
MARCO DESIGNED / USA BUILT "CAPELLA"
83 FT by 175 M³ SINGLE DECK SEINER

LENGTH OVERALL	25.5 M	HOLD VOLUME	175 M³
BEAM - MOLDED	7.0 M	POWER	380 HP
DEPTH	3.5 M		

PLAN B-4



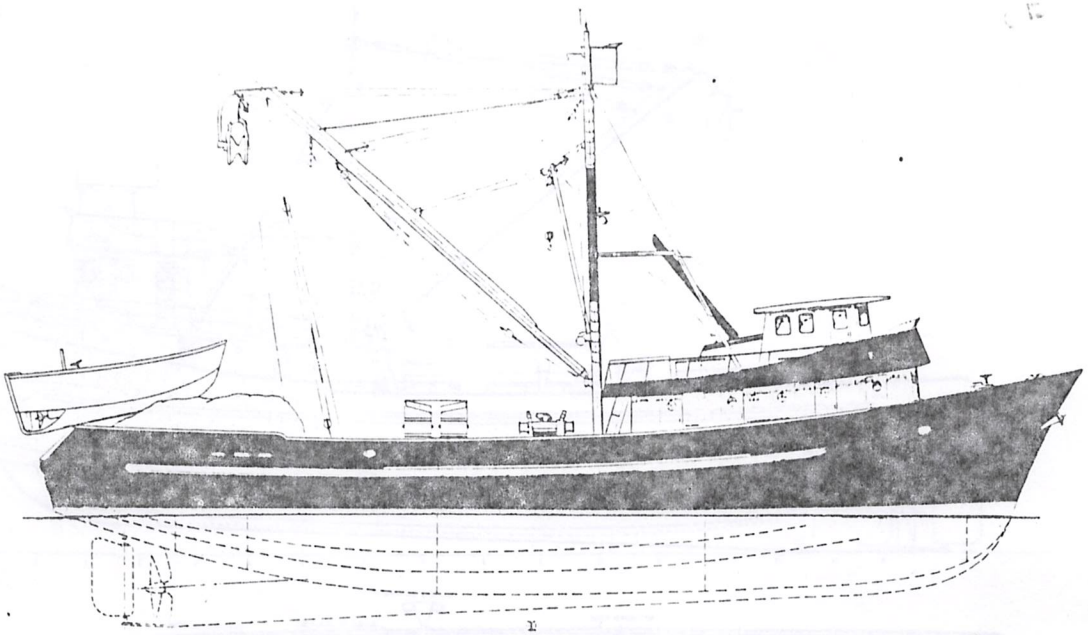


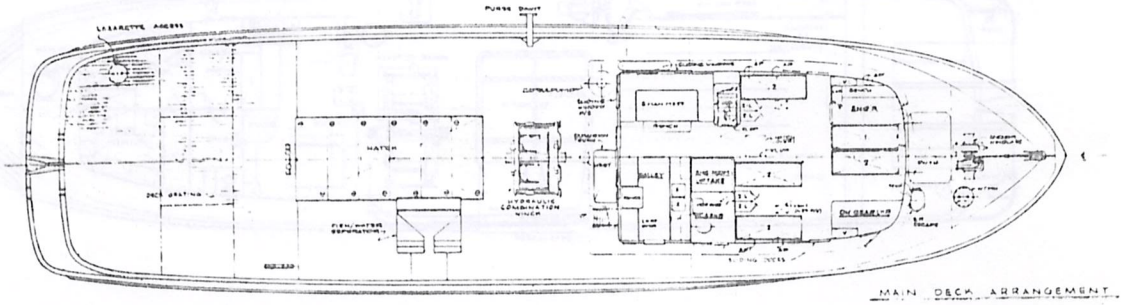


MARCO CHILENA 84 FT by 200 M³
SINGLE DECK SEINER

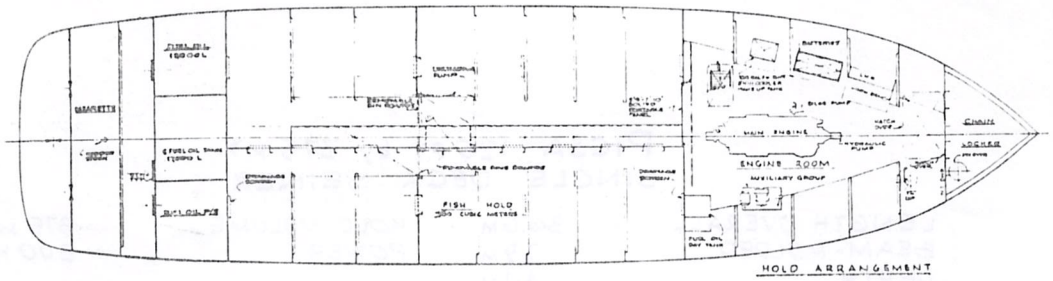
LENGTH OVERALL	25.6 M	HOLD VOLUME	200 M³
BEAM - MOLDED	7.3 M	POWER	450 HP
DEPTH	3.5 M		

PLAN B-5





MAIN DECK ARRANGEMENT

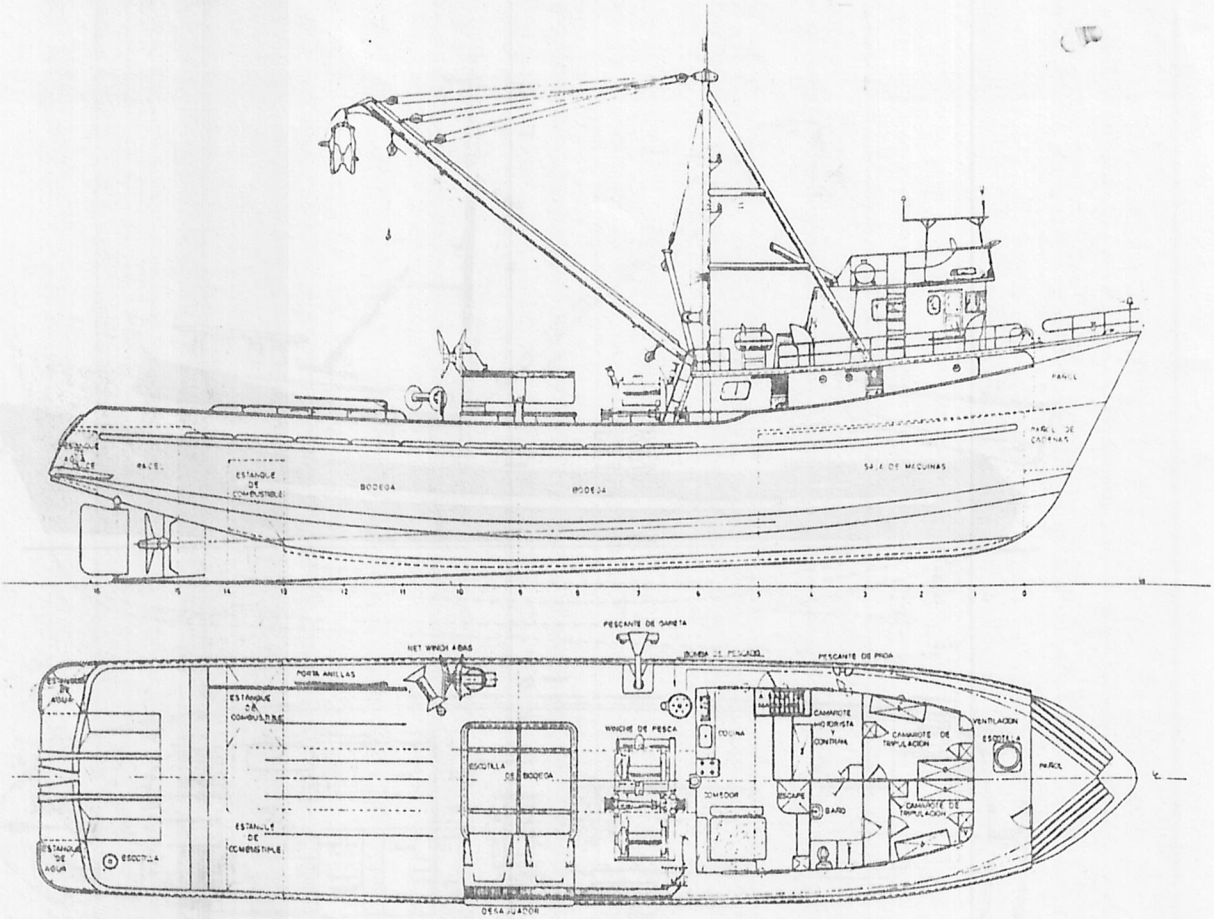


HOLD ARRANGEMENT

MARCO CHILENA 100 FT by 300 M³
SINGLE DECK SEINER

LENGTH OVERALL	31.1 M	HOLD VOLUME	300 M³
BEAM - MOLDED	7.62 M	POWER	750 HP
DEPTH	3.91 M		

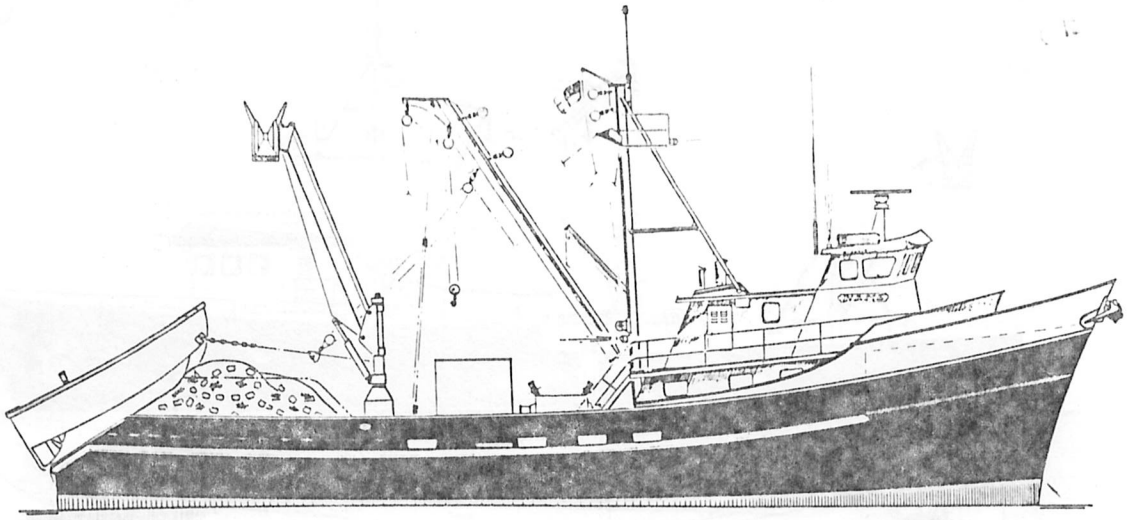
PLAN B-6

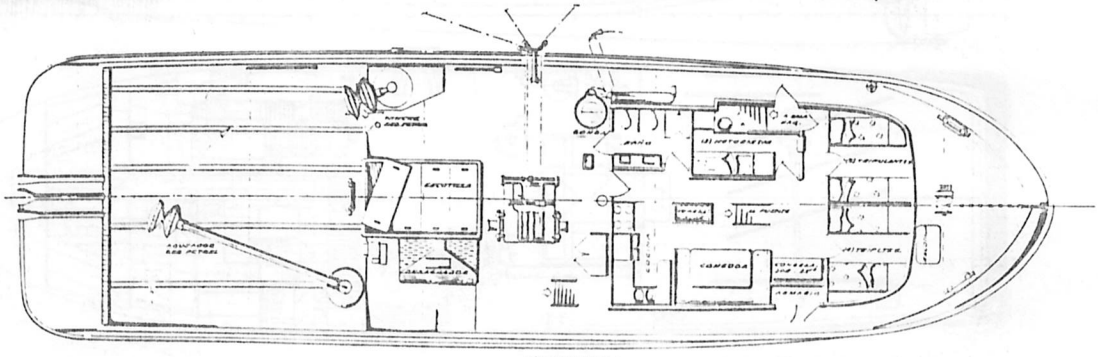


PICSA 120 FT by 375 M³
SINGLE DECK SEINER

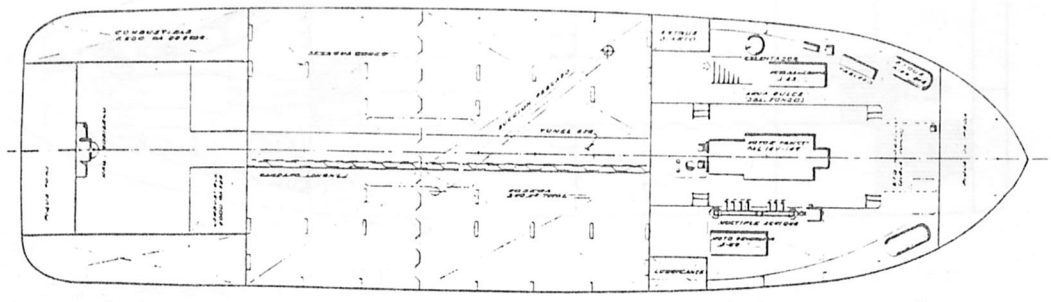
LENGTH OVERALL	36.6 M	HOLD VOLUME	375 M³
BEAM - MOLDED	7.9 M	POWER	~ 800 HP
DEPTH	4.1 M		

PLAN B-7





CUBIERTA

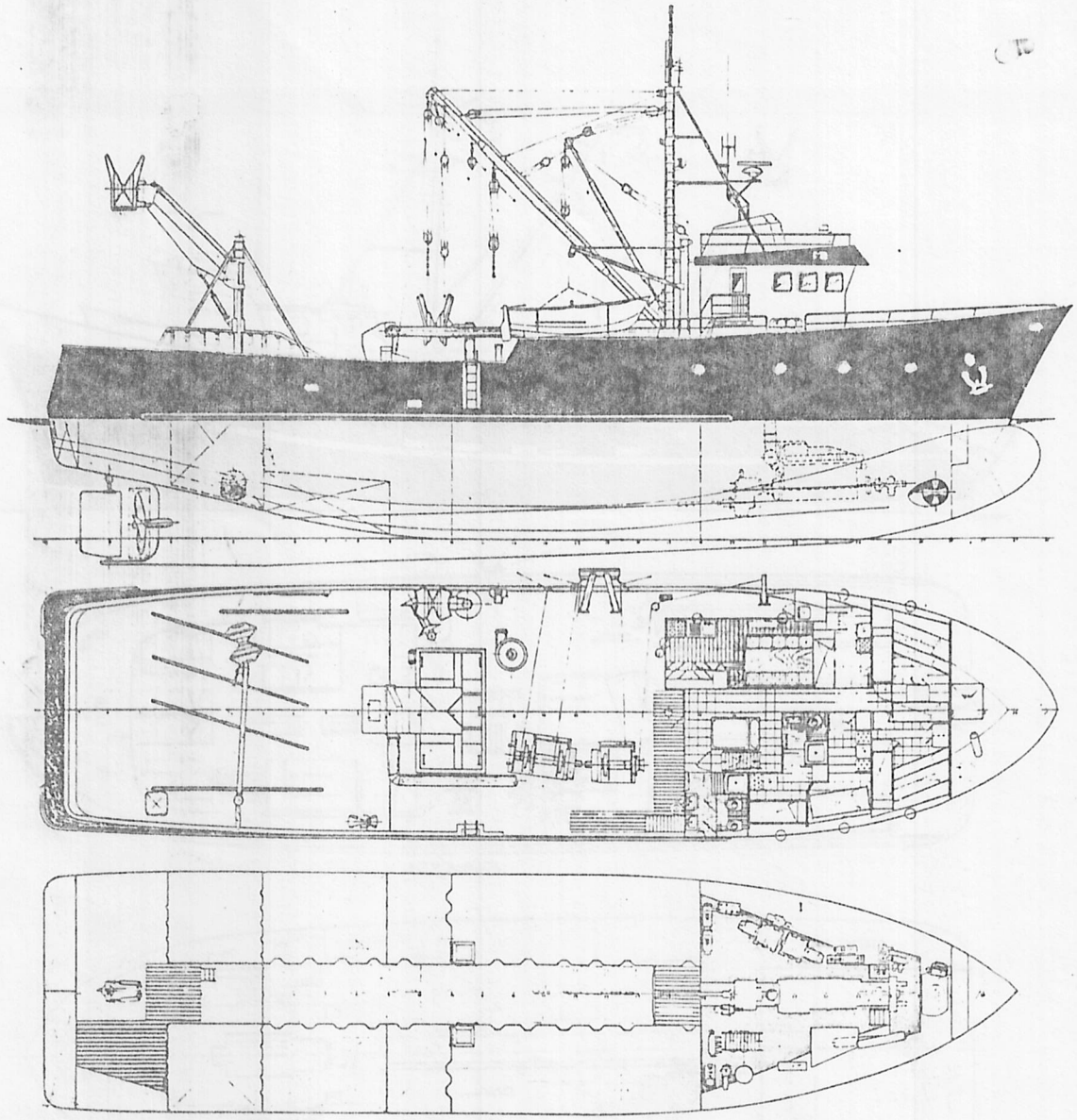


BODEGA

ASTILLEROS ARICA 107 FT by 390 M³
SINGLE DECK SEINER

LENGTH OVERALL	32.6M	HOLD VOLUME	390 M³
BEAM - MOLDED	9.0M	POWER	900 HP
DEPTH	4.0M		

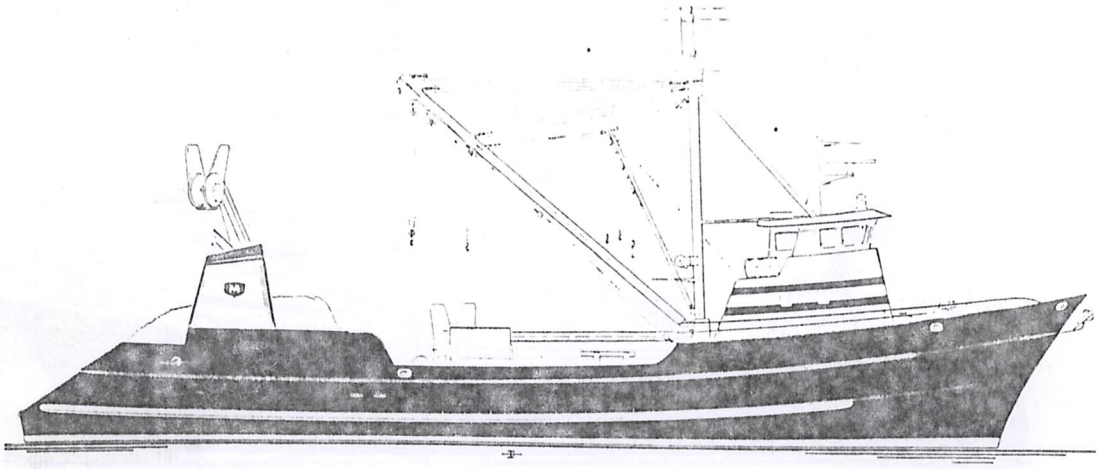
PLAN B-8

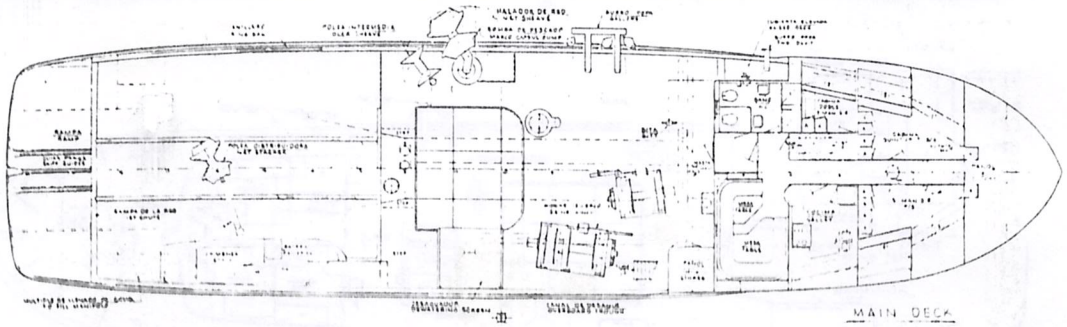


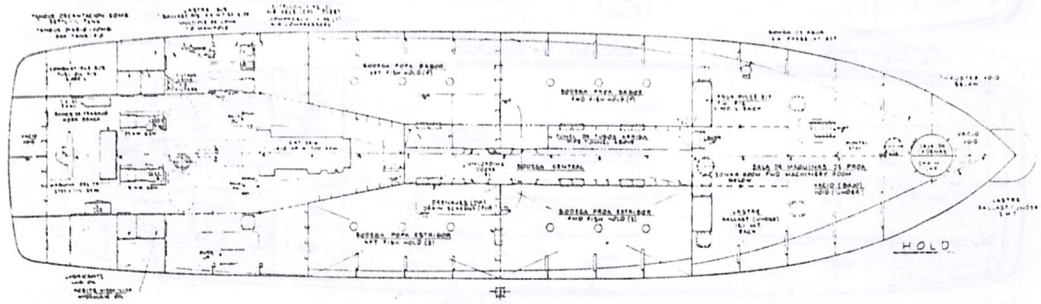
ASENAV 36M by 435M³
RAISED FOCSLE SEINER "BOBBY I"

LENGTH OVERALL	35.7 M	HOLD VOLUME	435 M³
BEAM - MOLDED	8.6 M	POWER	1250 HP
DEPTH	4.3 M		

PLAN B-9



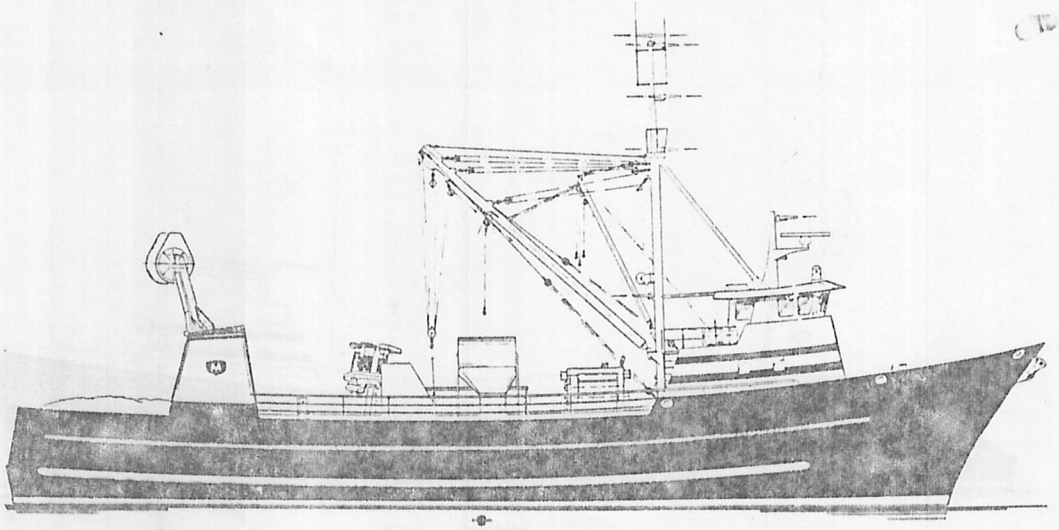


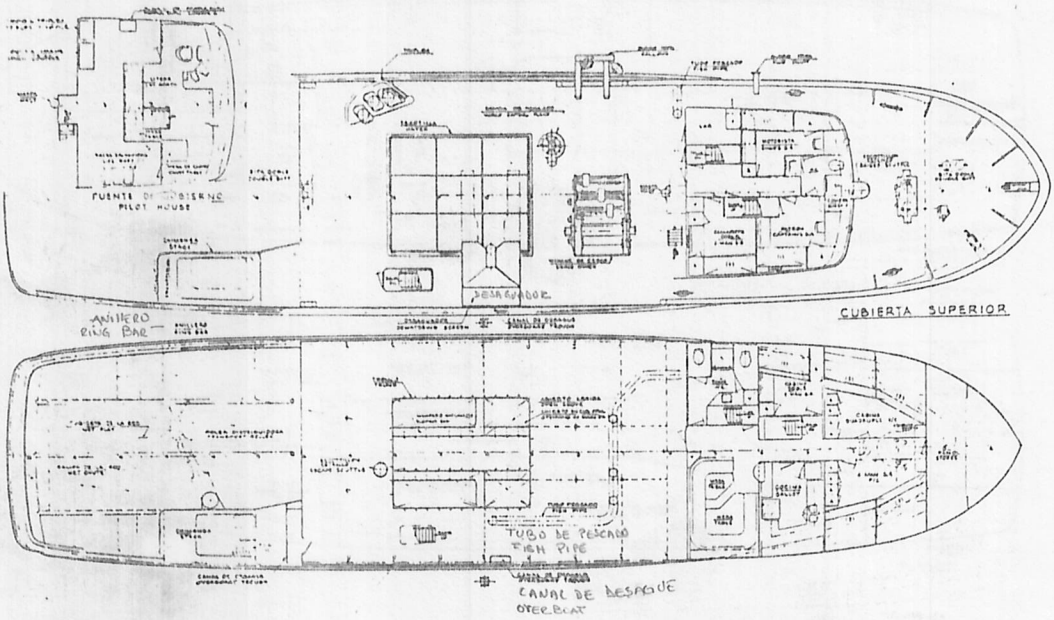


MARCO CHILENA 41m by 450 m³
RAISED FOCSLE SEINER "CLAUDIA ALEJANDRA"

LENGTH OVERALL	41.0M	HOLD VOLUME	450 M³
BEAM-MOLDED	9.3M	POWER	1410 HP
DEPTH	4.6M		

PLAN B-10a

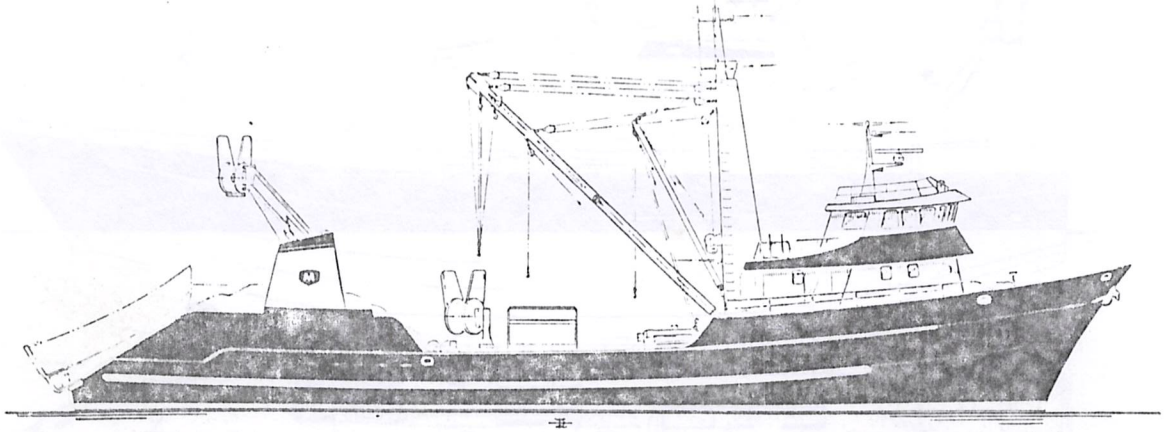


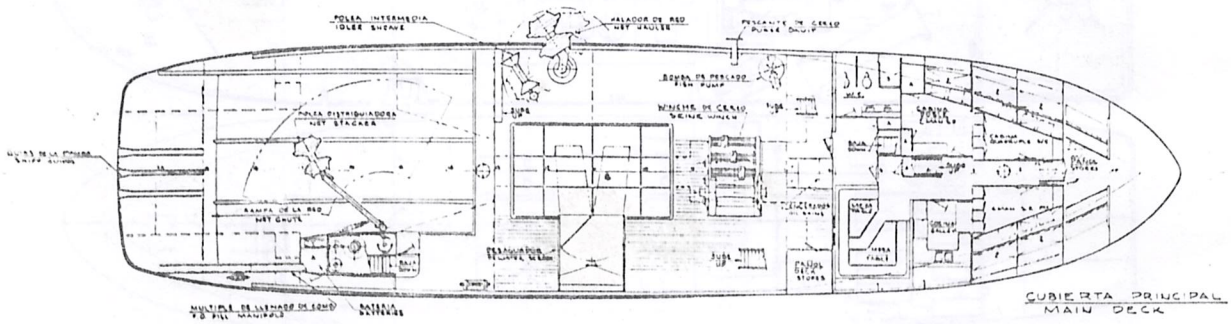


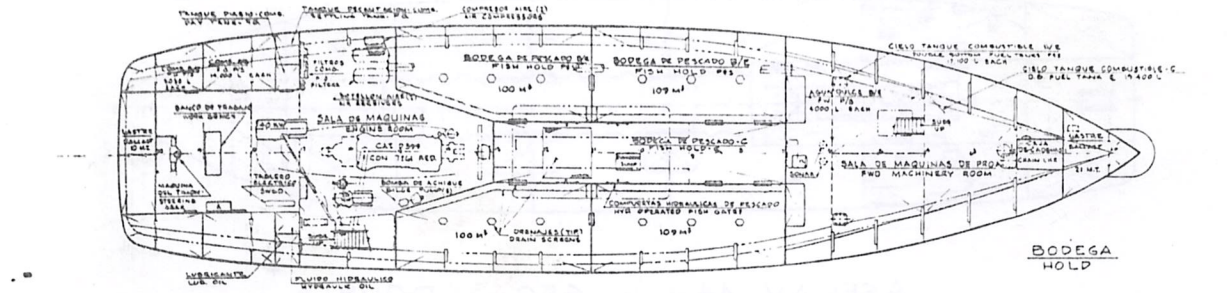
MARCO CHILENA 41M by 450M³
DOUBLE DECK SEINER

LENGTH OVERALL	41.2 M	DEPTH-UPPER DECK	6.9 M
BEAM-MOLDED	9.3 M	HOLD VOLUME	450 M³
DEPTH-MAIN DECK	4.6 M	POWER	1410 HP

PLAN B-10b



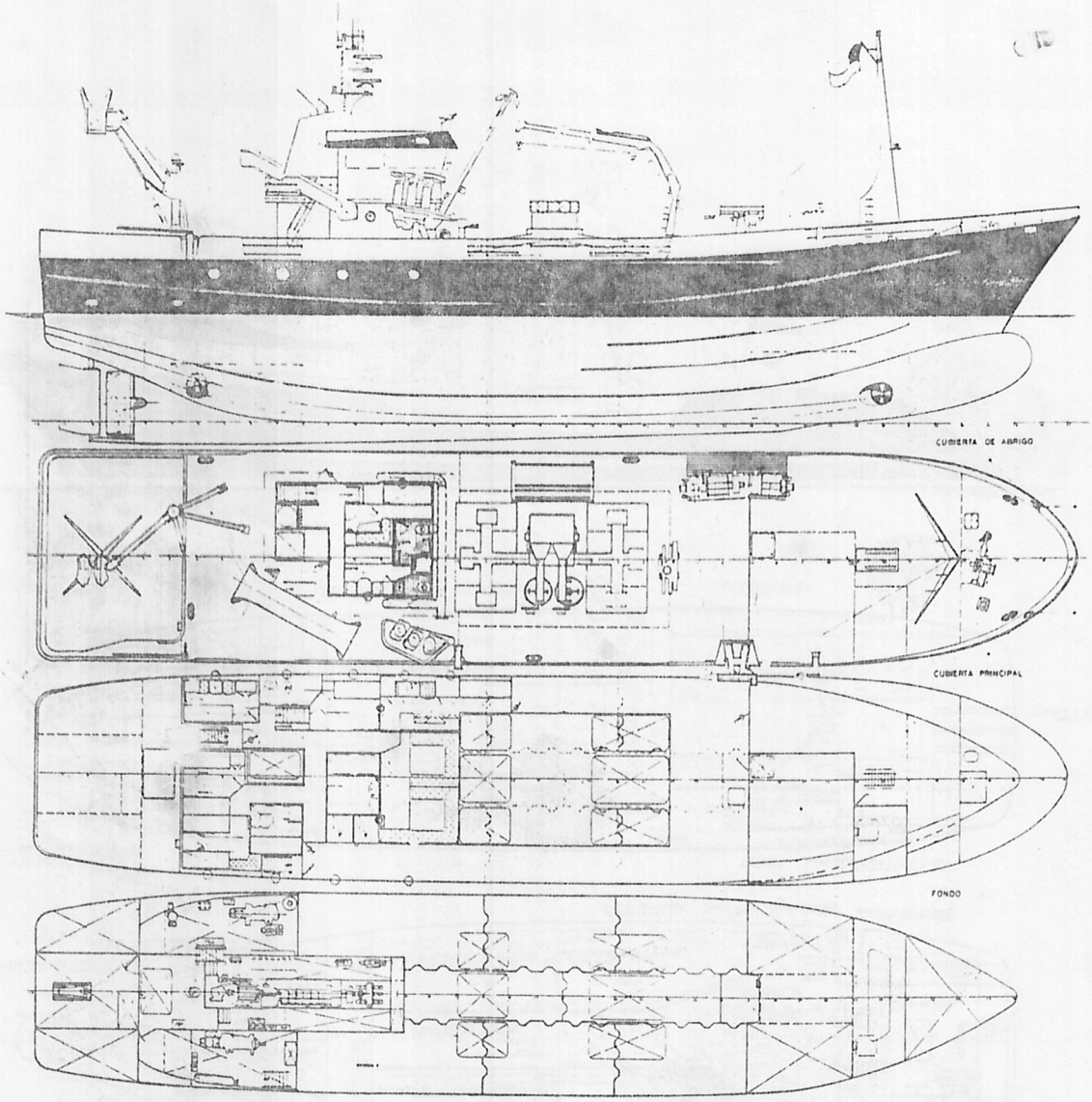




MARCO CHILENA 44M by 550M³
RAISED FOCSLE SEINER "INTREPIDO"

LENGTH OVERALL	44.0M	HOLD VOLUME	550 M³
BEAM - MOLDED	10.1M	POWER	1125 HP
DEPTH	5.0M	(LATER VESSELS	1410 HP)

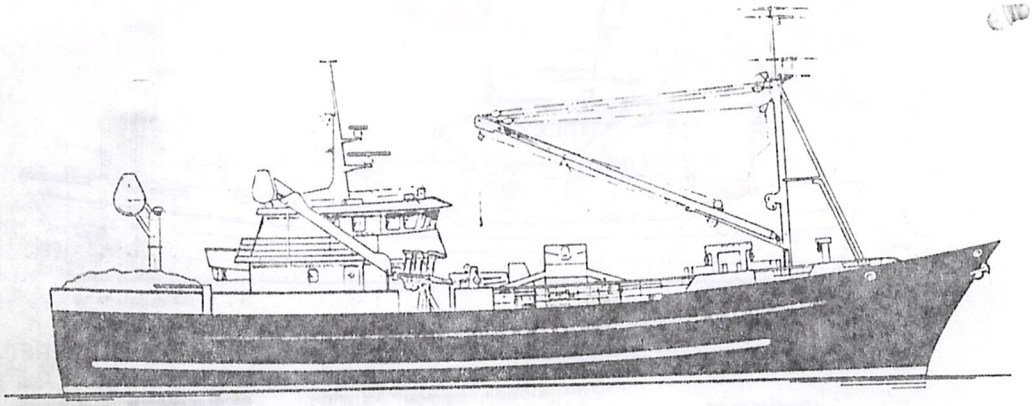
PLAN B-11

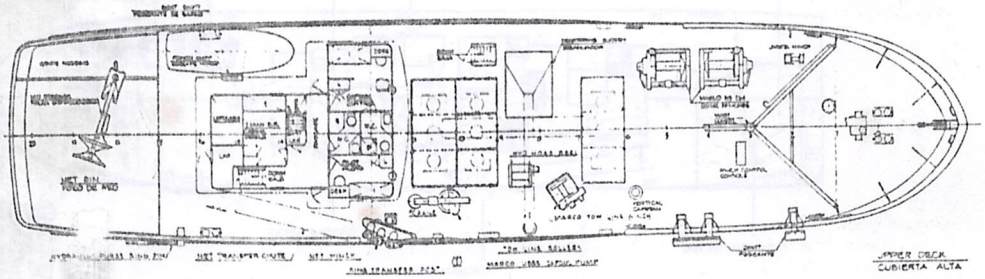


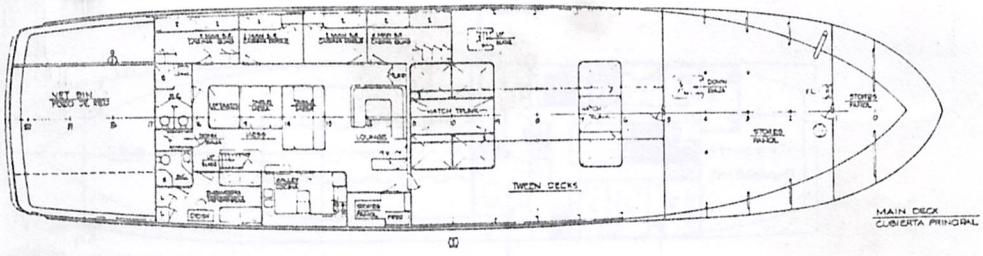
ASENAV 44M by 650 M³ DOUBLE DECK SEINER "PILMAIQUEN I"

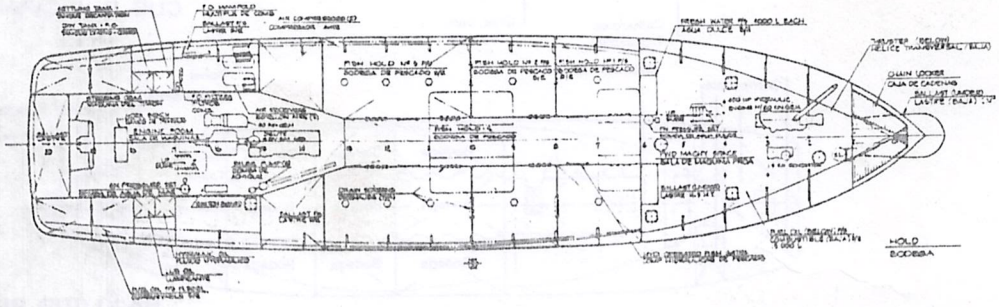
LENGTH OVERALL	43.4 M	DEPTH-UPPER DECK	6.8M
BEAM-MOLDED	8.6M	HOLD VOLUME	650 M³
DEPTH-MAIN DECK	4.6M	POWER	1500 HP

PLAN B-12





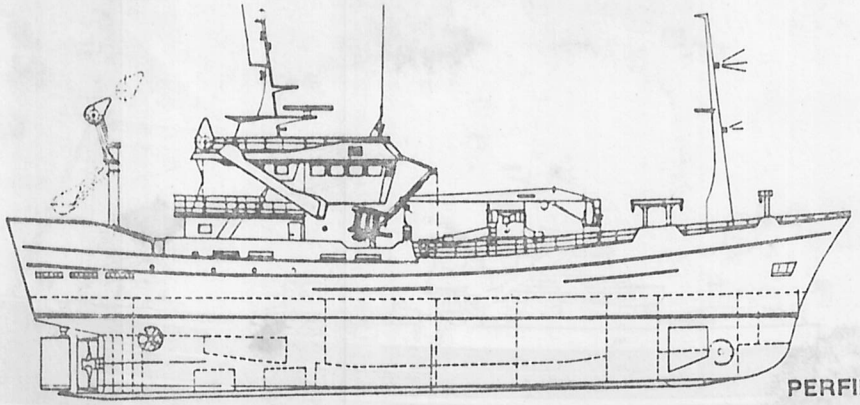




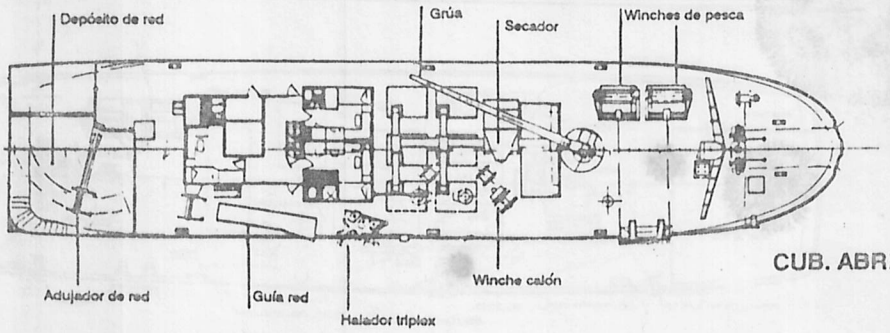
MARCO CHILENA 45 m by 650 m^3
"TIPO ARAUCO" DOUBLE DECK SEINER

LENGTH OVERALL	45.0 M	DEPTH-UPPER DECK	7.4 M
BEAM-MOLDED	10.2 M	HOLD VOLUME	650 M^3
DEPTH-MAIN DECK	5.0 M	POWER	1600 HP

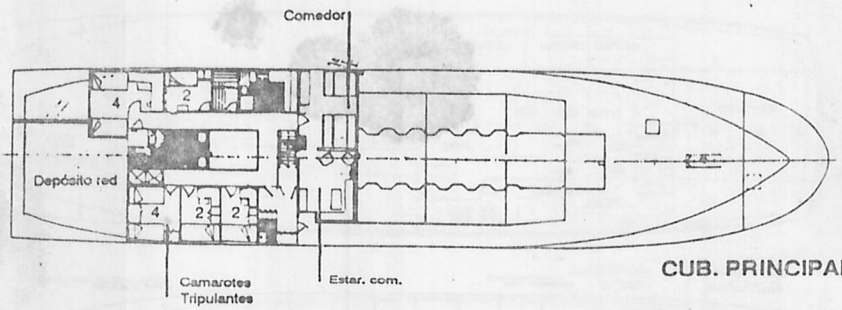
PLAN B-13



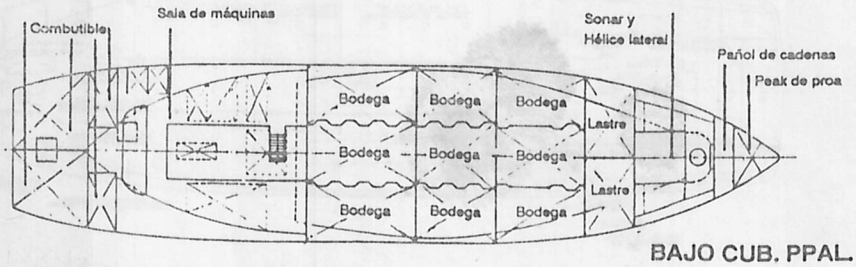
PERFIL



CUB. ABRIGO



CUB. PRINCIPAL



BAJO CUB. PPAL.

ASMAR 48M by 750M³
DOUBLE DECK SEINER

LENGTH OVERALL	48.0M	DEPTH-UPPER DECK	7.3M
BEAM-MOLDED	10.2M	HOLD VOLUME	750M³
DEPTH-MAIN DECK	5.0M	POWER	2250 HP

PLAN B-14