PART VI

INTERNATIONAL AND SMALL-SCALE FISHERIES
COMPARISON OF OPERATIONAL ECONOMICS FOR VESSELS WORKING FROM THREE WEST AFRICAN PORTS

By

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Abstract

It has not been uncommon among some developers to assume that a vessel which is profitable in a fishery, when working from a particular country and port, will prove equally successful when operated from a different country or port. There can however be a considerable difference in operating costs for the same vessel when working under such a situation, and this difference can have a marked effect on the unit cost of landing a particular species. Predicted costs for a similar vessel working from three West African ports are used to provide an example of how differences in operating, crew, and investment expenses lead to considerable change in landed unit cost of a directed fishery.

Introduction

Operational economics is always important, and often the critical factor determining profitability of a fishing vessel's operation. In Developing Countries both operating costs and earnings from catch sales can vary widely as a result of local conditions, yet it is not uncommon for developers to assume that a vessel which has proved profitable in a fishery when working from a particular country will be equally successful when based elsewhere.

While considerations other than pure profitability may be involved, e.g. the need to provide for fish protein needs of a population, it is obviously necessary that any vessel selected be appropriate for the facilities and services available locally, and have the ability to land fish at an acceptable cost within the particular situation. In some countries the need is critical that this be achieved at lowest possible cost with the least possible drain on foreign exchange needs, or in order to boost foreign currency resources.

The differences which can arise, even among neighbouring countries within the same area and working on essentially the same fish stocks, can be demonstrated by considering the West African countries of Senegal, The Gambia and Guinea Bissau, see Fig.1. (Fig.1.7.1 of Reference 1) and the case of a similar vessel working out of their principal fishing ports of Dakar, Banjul and Bissau.

Summary of Country Fisheries Situations

As shown in Fig.1, the three ports are situated between 11 deg. to 15 deg. North and 16-40 deg. to 18-30 West and have direct access to the ground fisheries of the West African continental shelf and the pelagic fisheries offshore.
Senegal is a net fish exporting nation, mainly high value species to Europe. Ref. 1, with the industrialized sector consisting of over 150 trawlers, shrimpers, purse seiners, gillnetters and handliners (Ref. 2). A major new (and expandable) fishing port at Dakar is well situated, and is a center for all services needed by a sophisticated fishing fleet, with daily air service to European, U.S., African, South American and Eastern destinations, and worldwide container services by sea. Both Senegalese and Foreign vessels (under license) land in Dakar, and there is an energetic private sector involvement in the industry, with a free market situation prevailing. Fishing agreements are in force which allow Senegalese vessels to fish waters of The Gambi and Guinea-Bissau.

The Gambia (Ref. 1) is situated around a large river, with Senegal to the north, South, and East. The country has virtually no industrialized fishing sector; several foreign purse seiners land fish for export to Ghana, and a local private company is commencing the use of vessels larger than the traditional canoes to further develop a successful export trade to Europe. The port of Banjul is conveniently situated for direct access to the offshore fishing grounds, with facilities for landing fish available; ice and processing plant capacity is not fully utilized, vessel maintenance and repair facilities are situated in the port, with other services and supplies available locally or from Dakar (30 mins. by air, and some 2/3 hours by road). Private Sector involvement in the industry is developing, and public sector declining, with a free market situation prevailing. A Reciprocal Fishing agreement is in force allowing access to Senegalese waters.

Bissau, the principal port of Guinea Bissau (Ref. 1) is situated a short distance up the mouth of a large river, and an offshore group of islands must be cleared in order to reach trawling grounds. Principal fish landings from the Industrialized Sector arise from a mixed enterprise company (with USSR) "Estrello do Mar" which operates several vessels under the country's flag. Other mixed companies are no longer operating at sea, although a small private sector company is preparing to expand to offshore fishing. Fish unloading facilities are available and an extensive new freezing/cold store facility is complete. Vessel maintenance and service facilities are available from both the public (military) and private (restricted) although specialized services and supplies must be imported. There are daily flight connections by propeller aircraft to Dakar and several times a week by jet to Portugal and USSR. Fish prices are established by the Government as are the prices of fuel (rationed) and other supplies (all imported) which are often difficult to obtain or unavailable. The presence of offshore oil resources is expected to ease both fuel and import problems in due course. An extensive series of fishing agreements are in effect with some 15 countries including Senegal, EEC, USSR, Algeria and Portugal; private sector activities are becoming important in many areas of the economy.

Components of the Total Cost/Top of Landing a Particular Species:

In order to make a realistic cost comparison it is necessary to have data available for the operation of the same vessel type from the three ports of Dakar, Banjul and Bissau. Reference 1 provides
estimated figures for a 78 foot vessel to work the stocks of Balistes (Trigger Fish) which have recently developed within the 200 mile zones of West Africa, and which appear to be available almost year round from these ports (see Fig. 1). Typical catch rates obtained by the Norwegian Research Vessel R/V Fridtjof Nansen are also shown in Fig. 1; these, together with data from Reference 5 led to catch rates for the economic analyses contained in Reference 1 being set between 0.5 - 1.25 tons per fishing hour.

Projected Landings: The analysis also assumed a total capacity of 30 tons for the vessel, and that fishing continued until full. The number of days fishing per year and per trip therefore varied with catch rate, with the total days at sea (fishing and on passage etc.) set as 225 per year for vessels working from Bissau and Banjul, and 240 days per year from Dakar; this difference was to allow for increased down time and more difficult working conditions anticipated from those ports. A summary of the projected landings is shown in Table 1 (extracted from Table 1.8.1 of Ref.1), which reflects the difference in steaming time and hence trip length necessary to land 60 tons/trip.

Data from Reference 5 indicated that when undertaking a directed fishery for Balistes, high value food fish approximated 8% of the catch, and this was included in the analysis.

Vessel Operating Costs: In calculating vessel operating costs, both fixed and variable costs were added to give the total annual operating cost. The following were included:

Fuel: consumption estimated from Fig. 2, (compiled from Average fuel consumption figures given in Reference 3); Prices: Bissau: $1.90/US gal; Banjul: $1.22/USgal; Dakar: $0.77/USgal.

Oils: 8% of fuel cost (Ref.3)

Gear repair & Replacement: Reference 3 indicates an average cost for West African trawlers as $57,000 for an average of 180 fishing days per year. This figure was adjusted for number of fishing days per year, to give Assumed Cost = $57,000 x No. of Fish days/180. As no operations are presently taking place from Banjul and Bissau, no reliable data was available, and costs for vessels working from those ports was assumed to follow the above formulation.

Ice: (if used) based on a 1:1 Fish:ice ratio plus 20% allowance for loss. (Ref.3). Prices: Bissau $50/mt; Banjul $21.20/mt; Dakar: $40/mt.

Insurance: Taken as 3.5% of investment cost (Ref.3).

Fishing License: Varies with country: Bissau: not required for 3-8 Registry. Banjul: $24/grt vessels over 400 hp, $12/grt vessels less than 400 hp. Dakar: $25/grt.

Port Taxes: Varies with Port; Bissau: $1 + $12.75/mt landed; Banjul: private mooring $6/month, freshwater $5.20/thousand gals. (25000 gals/year assumed); Dakar: 1% value of landed catch.

Maintenance and Repair: For new vessel: 5.5% of investment cost per
year (Ref. 3). For used vessel 3.5% of investment cost per year. (Based on data of Ref. 3).

Crew Expenses: Expenses for local crew usually include food and transportation allowance. Bissau: $1/day at sea plus 24 kilos of rice/month/person. Banjul: total of $1200/yr allowed for local crew costs; Dakar: $12,000/yr for local crew. Also included here is the cost of housing and transportation of expatriate skipper, based on situation prevailing in each port.

Crew Costs: Crew requirements vary according to regulations and the practices common in each port. An expatriate skipper was assumed in all cases, with an annual pay of $3,400 per month plus $5/ton of fish landed. Pay of local crew was based on a scale and bonus common or recommended by the industry in each port. Bissau: Engineer (expatriate) $2000/yr + bonus, mate $1800/yr + bonus, Assistant Engineer $1800/yr + bonus, Cook $1650/yr + bonus, Deckhands (5) $1500/yr + bonus; Bonus shared by local crew: 1% of catch value per 10 tons/day. Banjul: Engineer $3300/yr + bonus, Mate $2640/yr + bonus, Assistant Engineer $1600/yr + bonus, Cook $1200/yr + bonus, Deckhands (4) $3840/yr + bonus; bonus shared by local crew: $4/ton. Dakar: Engineer $3600/yr + bonus, Mate $3200/yr + bonus, Assistant Engineer $2400/yr + bonus, Cook $2200/yr + bonus, Deckhands (4) $3000/yr + bonus; Bonus: $10 per ton.

Administration Cost: The average administration costs for West African vessels is approximately 4% of total operating and crew costs (Ref. 3).

Vessels and Investment Cost: The vessels used in the analysis were assumed to be of US origin and representative of those suitable for the fishing operations involved. A number of similar vessels have been sold to West African interests during the past five years, and Reference 4 provides typical first cost for vessels equipped for shrimp trawling and stern trawling on the African West Coast: first cost (investment cost) for such vessels is summarised in Fig. 3 (for the year 1982). As a basis for the cost calculations the principal particulars of the vessels were assumed as: Length 78 ft., HP 415, GRT appr. 84. In order to illustrate the effect of using ice versus RSW storage, and the difference between new and used vessels a range of vessel investment costs were used:

<table>
<thead>
<tr>
<th>RSW storage:</th>
<th>New vessel</th>
<th>$75,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Used vessel</td>
<td>$474,000</td>
</tr>
<tr>
<td>Ice storage:</td>
<td>New vessel</td>
<td>$600,000</td>
</tr>
<tr>
<td></td>
<td>Used vessel</td>
<td>$400,000</td>
</tr>
</tbody>
</table>

In each case, financing arrangements typically available in the United States were assumed: one third down payment with fifteen year amortization at 15% interest on the annual declining balance. Capital costs for the first year of operation were then calculated as:

| Investment cost:  | $75,000   | First year int. + amortization: $322,500 |
|                   | $475,000  | $283,667     |
|                   | $600,000  | $233,944     |
|                   | $400,000  | $191,111     |
Note that first year capital costs only were included, so that second and subsequent years would reduce considerably. No attempt was made to carry the analysis over years beyond the first.

**Earnings from High Value Food Fish By-catch:** As mentioned previously, approximately 3% of the total catch for trawlers pursuing a directed Balistes fishery consists of high value food fish which may be used for export earnings or for internal consumption in the country. The earnings from sale of these fish was considered to act as a credit, hence reducing the actual cost of landing the Balistes. Applicable fish prices for the various ports were found to be:

- Bissau (official maximum prices): Class 1 fish: $0.75/kg ex-boat, $1.25/kg retail; Class 2 fish: $0.56/kg ex-boat, $1/kg retail; Class 3 fish: $0.38/kg ex-boat, $0.75/kg retail; Class 4 fish: $0.34/kg ex-boat, $0.56/kg retail. For the analysis an average figure of $891/tonne was assumed as potential retail earnings to be set as a credit against cost of landing Balistes.

Banjul and Dakar: Assumed Average price received for exported food fish was $720/mtonne. (Refs. 2 & 3)

**Cost of Landing Balistes:** The total cost of fishing for any particular combination of vessel and port was therefore given by:

\[
\text{Total Cost} = \text{Vessel operating cost} + \text{crew cost} + \text{Administration cost} + \text{capital cost}.
\]

The actual cost of landing Balistes was then calculated as:

\[
\text{Total cost of Balistes} = \text{Total Cost} - \text{Value of Other Fish}
\]

From this the unit cost of landing Balistes is calculated as $/mtonne (assumed equivalent to long ton), and in cents/lb.

**Cost Comparison**

Reference 1 provides tables showing estimated landed cost of balistes for the range of catch rates selected and for the various vessel types and investment costs outlined previously. Table 2 shows a comparison of landed cost/mtonne for a used vessel utilizing REU holding, when working from the three ports, and demonstrates the development of the figures for landed cost/mtonne. Table 2 is extracted from data presented in Tables II.A.5.2, II.B.4.2, and II.C.4.2 of Reference 1.

As may be seen from Table 2, there is a spread of more than 22% in total operating cost between Bissau, the most expensive; and Dakar, the least expensive. When the value of local high value catch is included the spread rises to some 24%, and in terms of Cost in $/tonne of Balistes landed, the difference rises further to 32% although the costs for both Banjul and Dakar are almost identical. It is interesting to note that the difference in operating expenses (other than crew and capital costs) is 54%.
The Effect of catch rate on the landed cost can be seen from Fig.4, which was compiled using data from the same Tables, Reference 1. The increase in landed cost per unit weight increases sharply as the catch rate decreases, although the percentage difference between costs decreases. As the catch rate increases the cost per unit weight landed tends towards a constant value.

The effect of applying new or used vessels, together with the method of hold storage can be seen from Fig.5 which shows the results for the port of Banjul (Fig.II.B.4.6 of Reference 1). In general, the costs for both methods of storage approximate one another, with RSW having an advantage above a catch rate of about 0.6 tons/hour, which reaches about 10% at a catch rate of 1.25 tons/hr. As might be expected, operation of a brand new vessel results in increased capital costs; in practice, of course, it may well be possible to close the gap between the new and used vessels through judicious use of financial manipulation.

The effect of vessel investment cost for the Port of Banjul is shown in Fig.6 (Fig.II.B.4.7 of Reference 1) for a catch rate of 1.25 tons/hr. Under the capital cost situation used in Reference 1, it may be seen that an RSW vessel of approximately $150,000 greater initial investment is predicted to produce Balistes at the same unit cost as an ice storage vessel.

References


Figure 1: West African Countries of Senegal, The Gambia, and Guinea Bissau, with Trigger Fish Resource

Source: Reference 1.
Figure 2: Average Fuel Consumption For West African Trawlers
Compiled From Data Included In "Some Observations on Formulation of Alternative Strategies for Development of Marine Fisheries" (Ref.3)

Figure 3: Assumed First Cost for Vessels Equipped For Shrimp Trawling and Stern Trawling, African West Coast (1982)
Compiled From data Included in "Bioeconomic Analysis of a CBCAF Shrimp Fishery" (Ref.4)
**Figure 4: Effect of Catch Rate on Landed Cost**
Compiled from Data included in Ref.↑

**Table 1: Projected Landings for Economic Analysis**

<table>
<thead>
<tr>
<th>Port</th>
<th>Catch Rate</th>
<th>Catch tons/yr</th>
<th>Fishing days</th>
<th>Trips</th>
<th>Landings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tons/hr.</td>
<td>12hr. day</td>
<td>per year</td>
<td>per yr</td>
<td>tons/yr</td>
</tr>
<tr>
<td>Bissau</td>
<td>1.25</td>
<td>15</td>
<td>180</td>
<td>45</td>
<td>2700</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>12</td>
<td>187.5</td>
<td>37.5</td>
<td>2250</td>
</tr>
<tr>
<td></td>
<td>0.75</td>
<td>9</td>
<td>195.6</td>
<td>29.4</td>
<td>1780.4</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td>6</td>
<td>204.5</td>
<td>20.5</td>
<td>1227</td>
</tr>
<tr>
<td>Banjul</td>
<td>1.25</td>
<td>15</td>
<td>200</td>
<td>50</td>
<td>3000</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>12</td>
<td>204.5</td>
<td>40.9</td>
<td>2454</td>
</tr>
<tr>
<td></td>
<td>0.75</td>
<td>9</td>
<td>209.3</td>
<td>31.4</td>
<td>1833.7</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td>6</td>
<td>214.3</td>
<td>21.4</td>
<td>1285.8</td>
</tr>
<tr>
<td>Dakar</td>
<td>1.25</td>
<td>15</td>
<td>192</td>
<td>48</td>
<td>2880</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>12</td>
<td>200</td>
<td>40</td>
<td>2400</td>
</tr>
<tr>
<td></td>
<td>0.75</td>
<td>9</td>
<td>208.7</td>
<td>31.3</td>
<td>1878.3</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td>6</td>
<td>210.2</td>
<td>21.8</td>
<td>1309.2</td>
</tr>
</tbody>
</table>
Table 2: Comparison of Landed Cost/mtonne of Balistes for Used PSL vessel working from Bissau, Banjul and Dakar at catch rate of 1 tonne/fishing hr. Vessel Cost: $4,75,000

<table>
<thead>
<tr>
<th>Port</th>
<th>Bissau</th>
<th>Banjul</th>
<th>Dakar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catch rate: tonnes/hr</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Trips/year</td>
<td>37.5</td>
<td>40.9</td>
<td>40</td>
</tr>
<tr>
<td>days/trip</td>
<td>6</td>
<td>5.3</td>
<td>6</td>
</tr>
<tr>
<td>days at sea/year</td>
<td>225</td>
<td>225</td>
<td>240</td>
</tr>
<tr>
<td>days fishing/year</td>
<td>187.5</td>
<td>204.5</td>
<td>200</td>
</tr>
<tr>
<td>Catch: Balistes: tons/yr</td>
<td>2250</td>
<td>2454</td>
<td>2400</td>
</tr>
<tr>
<td>Other: tons/yr (8%)</td>
<td>180</td>
<td>196.3</td>
<td>192</td>
</tr>
<tr>
<td>Total: tons/yr</td>
<td>2430</td>
<td>2650</td>
<td>2592</td>
</tr>
<tr>
<td>Ice: tons/yr</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>cost: $/yr</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fuel: Gal/hr</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Gal/yr</td>
<td>81,000</td>
<td>81,000</td>
<td>86,400</td>
</tr>
<tr>
<td>Cost $/yr</td>
<td>153,900</td>
<td>98,820</td>
<td>66,528</td>
</tr>
<tr>
<td>Oils cost $/yr</td>
<td>12,636</td>
<td>7,906</td>
<td>5,322</td>
</tr>
<tr>
<td>Gear cost $/yr</td>
<td>59,375</td>
<td>58,283</td>
<td>63,333</td>
</tr>
<tr>
<td>Insurance $/yr</td>
<td>16,625</td>
<td>16,625</td>
<td>16,625</td>
</tr>
<tr>
<td>Fishing License $/yr</td>
<td>-</td>
<td>2,016</td>
<td>2,100</td>
</tr>
<tr>
<td>Port taxes $/yr</td>
<td>30,911</td>
<td>171</td>
<td>5,400</td>
</tr>
<tr>
<td>Maint. &amp; Repair $/yr</td>
<td>40,375</td>
<td>40,375</td>
<td>40,375</td>
</tr>
<tr>
<td>Crew Expenses $/yr</td>
<td>12,000</td>
<td>12,000</td>
<td>12,000</td>
</tr>
<tr>
<td>Total Oper. Cost $/yr</td>
<td>325,822</td>
<td>236,196</td>
<td>211,093</td>
</tr>
<tr>
<td>Crew Cost $/yr</td>
<td>85,979</td>
<td>80,023</td>
<td>86,120</td>
</tr>
<tr>
<td>Total: Oper. + crew</td>
<td>411,801</td>
<td>316,219</td>
<td>296,203</td>
</tr>
<tr>
<td>Admin. cost $/yr</td>
<td>16,472</td>
<td>12,649</td>
<td>11,312</td>
</tr>
<tr>
<td>Capital cost: 1st yr.</td>
<td>226,944</td>
<td>226,944</td>
<td>226,944</td>
</tr>
<tr>
<td>Total Cost $/yr</td>
<td>655,217</td>
<td>555,812</td>
<td>536,658</td>
</tr>
<tr>
<td>Value of by-catch $/yr</td>
<td>160,380</td>
<td>141,336</td>
<td>138,280</td>
</tr>
<tr>
<td>Total Cost: Balistes</td>
<td>494,837</td>
<td>414,476</td>
<td>398,379</td>
</tr>
<tr>
<td>cost: Balistes $/mtonne</td>
<td>219.9</td>
<td>168.9</td>
<td>166.0</td>
</tr>
<tr>
<td>Cents/lb.</td>
<td>9.8</td>
<td>7.5</td>
<td>7.4</td>
</tr>
</tbody>
</table>
Figure 5: Effect of Storage and New/Used Vessel on Landed Unit Cost: Port of Banjul
Source: Reference 1.

Figure 6: Effect of Vessel Investment Cost on Landed Unit Cost: Port of Banjul
Source: Reference 1.
APPROPRIATE DESIGNS
FOR
FISHING CRAFT IN BANGLADESH
by R.G. MacAlister, C. Eng., Mrina
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S04 9AH England

1. SYNOPSIS
In 1982, MacAlister Elliott and Partners were asked by the Bangladesh Krishi Bank (BKB) to design and organise the construction of a number of small fishing boats for the Asian Development Bank (ADB) Bangladesh Fisheries Credit Project (BAN 420). This paper describes the design thinking for a series of gillnetters and trawlers to be built in local yards with local materials and facilities but optimising vessel efficiency and safety.

2. BACKGROUND
Bangladesh is a deltaic country with a population of some 100 million people. The marine fisheries have been largely confined to coastal activities but in recent years, efforts have been made to exploit the deeper Bay of Bengal waters within their Exclusive Economic Zone. The traditional fisheries for Hilsa, jewfish, pomfret and Bombay Duck, as well as sharks, skates and rays, are facing increasing competition from high value catches of shrimp for export. Although the value of annual catches has risen by as much as 26% per annum since independence, in 1972, landings of fish for local consumption have dropped over the years. Various projects are in hand to try and increase domestic landings, including the A.D.B. project with which we are involved.

The A.D.B. Bangladesh Fisheries Credit project aims to provide 200 mechanised wooden gillnetters and 100 small wooden trawlers plus associated back up and distribution infrastructure such as landing places, workshops, ice plants, cold stores and refrigerated trucks. The project is being coordinated by the counterpart agency, the Bangladesh Krishi Bank.

In 1982, MacAlister Elliott and Partners were asked by the A.D.B. to review some fishing boat designs which had been prepared in Bangladesh for the project. As is so often the case when drawings are required for an activity which has been carried on for generations by skill and experience without drawings, the results were sadly lacking and did not define realistic or safe vessels.

MacAlister Elliott and Partners were consequently retained by the Bangladesh Krishi Bank to research and prepare suitable designs, to identify appropriate yards and to provide the necessary master boatbuilder to guide construction.
In December 1982, the writer visited Bangladesh to glean information for the
design process. This involved understanding the fishermen's preferences, the
fishing methods and conditions, the facilities and materials available and the
skill and techniques of traditional boatbuilders.

3. TRADITIONAL BOATBUILDING

With the myriad of estuaries, rivers, canals and waterways in Bangladesh,
the number and variety of vessels is enormous. Most of the inshore fishing
however, is carried out by Balams or similar craft. Gill netting and drift
netting has been practiced in the Bay of Bengal for generations, and the
Balams were traditionally sailed, drifted or rowed. Their fine lines and low
profile are well suited to gill netting and their shallow forefoot and kneeless
section allows beaching and settling in the mud which is prevalent along the
coast.

The building method is simple and requires few structures or premises. The
Balam is a well developed traditional boat.

Figure 1. Gillnetter in Cox's Bazaar.

For operational and logistical reasons, the project concentrated in S.E.
Bangladesh and time was spent in that area studying building methods.

A number of yards in Chittagong and Cox's Bazaar were visited, both to
assess competence and facilities and to select the yards which would be asked
to tender. There are perhaps 100 more or less established yards in the area
and 50 or so had expressed interest in participating.

Yards vary from the Bangladesh Fisheries Development Corporation (BFDC)
(ex Danida) yard in Chittagong with extensive space, plant and equipment and
material stores, to informal organisations seemingly without staff or premises
which mobilise to build boats if asked. Generally, yards consist of a small
area of land with access to water with one or more boats being built or
repaired with hand tools. Some have electricity but few have any wood working
equipment. Many have nevertheless been building durable boats for genera-
tions. Many boats are also built by fishermen employing itinerant carpenters
in their own villages.

The design and building of fishing boats has remained virtually unchanged
over generations except for the introduction of mechanisation. The Balam type
boats vary in length from about 10 metres to 20 metres overall.

Construction methods vary little up and down the coast but represent a
regional boatbuilding method not found elsewhere. The hull is started by
laying down a 'keel' or 'hog' which is a wide, flat board running from stem
to transom. This is propped at the ends and fastened down in the middle to
form a pronounced rocker. A substantial stem is attached to the 'hog' with a
single knee, and a flat planked transom is supported at the aft end. Rudimen-
tary sawn floors which extend to the turn of the bilge are attached to the
'hog'.
Figure 2. Gillnetter under construction showing floors and transom.

The garboards and bottom are planked with boards about 150 mm to 175 mm wide, the garboards being butted directly to the 'hog' but rabbeted into the stem. Fastening is usually by wire nails and some long bolts.

Thus the bottom structure of the boat is completed with few supports, the shape being defined by the curve of the 'hog' and the floors faired by eye and experience. No structures or building or machines have been necessary, though the planks nowadays are generally machined in a saw mill.

Frames for the topsides are next attached to the floors and nailed or bolted in place rather haphazardly. Planking continues, the boards being wedged together without caulking bevels and nailed to the frames. Planks are kept plane with each other by edge nailing into specially chiselled slots. Thus the canoe body of the hull is complete.

At this stage, there is no deadwood/keel. This is cut from solid or fabricated and attached to the canoe body with long bolts or 'U' bolts. This unusual procedure may have been adequate before mechanisation but is a source of weakness today.

The hulls are decked with a small camber and a simple accommodation deckhouse built over the engine room. Finally, the hull and decks are payed and caulked, using cotton and pitch.

Below the waterline, the hulls are burnished and tarred to restrict activity of marine borers. In service, well maintained boats are hauled, burned and tarred, about every three months.

Balam type gillnetters are generally reported to last about 5 or 6 years, during which time there will have been some replacement of planking and steel fastenings.

4. MATERIALS

Timber.

Most of the timber available for boatbuilding in the region comes from the hill country behind Chittagong and Cox's Bazaar. Generally, trees are felled and floated down to saw mills in the towns. In Chittagong, higher usage of timber for various trades has exploited most of the larger trees and boards seldom exceed 10 metres in length. In Cox's Bazaar, large trees can still be felled and due to their size, are pit sawn where they fall. At the yards in this region, boats are built using some planks over 20 metres long.

The most common boatbuilding timber in the region is Gurjun (Dipterocarpus), also known as Keruing and Yang. This teak-like wood is moderately coarse grained, has some resistance to rot and marine borers, and has satisfactory cutting and working properties. It is an acceptable, though not ideal, boatbuilding timber. Other timbers such as Jarul are available in smaller quantities.

Toredo worm is a major hazard in these waters and can reduce a hull to scrap if not protected.
Figure 3. Toredo damage to a section of stem.

Gurjun is moderately responsive to CCA (Copper Chrome Arsentate) treatment to reduce attack by parasites. Ideally, this process needs to be carried out under pressure to obtain optimum penetration and protection. Only one plant, at the BFDC (Dhanida) yard, has pressure equipment but it is of insufficient capacity to treat timber for outside yards.

Other yards have various immersion tanks but the efficacy of the treatment is lower. Nevertheless, all immersed timber (keel, sternpost, underwater planking, etc.) should be treated as efficiently as possible, after shaping.

Fastenings.

All the yards with the exception of the BFDC yards, construct boats with steel wire nails and a few bolts. Only one yard was using cut boat nails and these were secondhand. The BFDC yard galvanises its own fastenings. There appears to be insufficient galvanising capacity in Bangladesh to allow an adequate supply of fastenings and the Project will have to rely on traditional methods for treating planking fastenings. It is however, considered essential that the main structural bolts are galvanised.

Fabricating and Machining.

There are numerous small workshops with fabricating and machining capabilities. Raw material is in short supply but most items can be made with ingenuity and the re-use of materials.

Paints and Caulking Materials.

Boats are caulked with a satisfactory pitch compound in adequate supply. All boats are tarred below the waterline and many above as well. A few boats have painted topsides and general purpose alkyd paint is available.

Fitting out Materials

There is no organised supply of chandlery or engineering supplies in Chittagong or Cox's Bazaar. Items can be obtained on an occasional basis but the suppliers of the main machinery and equipment must provide all necessary parts for complete installation.

5. CONCEPT OF THE NEW DESIGNS

This then was the background for the design and building of 200 gillnetters and 100 small wooden multi-purpose trawlers; a region which since time began has built numerous boats on a casual basis and which has developed an efficient inshore 'Balam' type craft.
Since mechanisation, however, there have been few developments and the hull is no longer ideal. Mechanised boats go further offshore and encounter worse weather. The round sections and lack of keel on the Balams make the vessel tender and unstable. Consequently, much fishing time is lost in even moderately bad weather. The stresses and vibrations from the engine cause problems with the structure of the boat which is weak due to the keel and non-rabbeted garboard configuration. Even with the low horse power mechanised gillnetters, bailing and pumping is often a full time occupation.

There is little tradition of inshore trawling in Bangladesh and few small trawlers exist along the South East Coast.

These vessels will be bottom trawling in areas with strong currents and predominantly silt and mud bottom. This can be difficult and requires a versatile, powerful boat. Great strains can be put on the hull and gear if the trawl doors drop into the mud. The sea is calm much of the time, but dangerously rough during the monsoons, so safety and good sea keeping are essential.

The fishing grounds are about a days steaming from most of the bases and there were long discussions with potential owners about preferred vessel dimensions. There is a natural tendency to associate safety with length and there were many requests for craft out of all proportion to the task and potential catch, though due to the long rake of the stem and narrow waterlines, the volume visualised for a given length is much less than might be expected.

Eventually the following basic dimensions were selected as suiting both practical and personal requirements (clients requested imperial units):

Gillnetter:

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>L.O.A.</td>
<td>42'7&quot;</td>
</tr>
<tr>
<td>Length on deck</td>
<td>37'6&quot;</td>
</tr>
<tr>
<td>Length at datum W.L.</td>
<td>34'9&quot;</td>
</tr>
<tr>
<td>Beam</td>
<td>11'0&quot;</td>
</tr>
<tr>
<td>Beam at datum W.L.</td>
<td>9'9&quot;</td>
</tr>
<tr>
<td>Draft to datum W.L.</td>
<td>3'5&quot;</td>
</tr>
<tr>
<td>Moulded depth</td>
<td>5'1&quot;</td>
</tr>
<tr>
<td>Fish hold capacity</td>
<td>160 cu. feet</td>
</tr>
<tr>
<td>Fuel oil tank capacity</td>
<td>60 gallons</td>
</tr>
<tr>
<td>Fresh water tank capacity</td>
<td>60 gallons</td>
</tr>
<tr>
<td>Displacement at half load</td>
<td>8 tons approx.</td>
</tr>
<tr>
<td>Displacement at 4'0&quot; draft (level trim)</td>
<td>12 tons approx.</td>
</tr>
<tr>
<td>Main Engine</td>
<td>approx. 35 hp.</td>
</tr>
</tbody>
</table>
Trawler:

L.O.A. 51'02
Length on deck 48'9"
Length at datum W.L. 45'6"
Beam 14'0"
Beam at datum W.L. 12'6"
Draft to datum W.L. 6'0"
Moulded depth 6'9"
Fish hold 565 cu. feet
Fuel oil tank capacity 720 gallons
Fresh water tank capacity 90 gallons
Displacement at half load 23 tons approx.
Displacement at 6'6" draft 27 tons approx.
Main Engine approx. 160 hp.

Gillnetter

The new gillnetters are designed to be built in the traditional yards, using available materials and to be operated by local crews. The design, therefore, shows a vessel of traditional appearance but designed to be a good, robust sea boat. The shallow forefoot has been retained for beaching, but a substantial keel forms the basis for the structure. This will, incidentally, improve the sailing ability of the hull and outlines of suitable rigs are included in the design.

The lines have been designed to minimise the curvature of the planking to the deadwood as this will be unfamiliar to the builders. It is nevertheless considered essential that the keel/deadwood is integrated into the structure.

Layout of holds, low windage accommodation, cooking and toilet facilities is traditional, although the hold insulation has been upgraded. The construction of the cantilevered heads has been left strictly to the builders. We are not sure what goes where.

The gillnetter has been designed for a crew of up to 8 people with fuel, water and ice for up to 7-day trips. The vessel will cruise at about 7 knots.

Trawler

Trawlers are marine tractors and although the installed horsepower in the project vessels is relatively modest, a substantial and adequately deep hull is required to carry the machinery and stern gear.

The design shows a fine vessel with similarities in appearance to fishing boats in the region and Bay of Bengal. The hull is deep enough for an efficient propeller, and will be dry and stable. The layout is as a stern trawler with a forward wheelhouse and mechanically driven winch. The 16 ton fish hold is sufficient for the maximum likely catch of fish and ice. Trawling in these waters can impose severe strains on trawl gallows so a strong gantry system has been included.
For some of the year, trawling is not economic and layout and topside heights have been maintained for gill netting. During this period, the gantry can be removed and a steading sail may help the boat lie to the nets.

Accommodation and tankage are sufficient for 9 people for up to 7-day trips. The trawler will cruise at about 8.5 knots.

6. CONSTRUCTION.

It would be simple to specify construction methods and materials of the highest standard. In practice, it is illogical to specify anything which cannot or will not be used. The designer must accept the fact that the hulls and much of the structure will be made of keruing, that the timber treatment will be rudimentary, the fastenings mostly wire nails and the cotton caulking driven into unbevelled seams. However much lofting, mould making and supervision the Master Boatbuilder does, the boats will tend to look the way the builder thinks they should.

The designs, drawn in our design office by Robert Brasted, take these realities into account. A proper keel structure is essential to provide adequate strength for a mechanised boat but a simple parallel keel is acceptable. Although they may not provide an ideal depth of rebate, they can be sawn, if necessary, in a pit without too much skill and with close frames and floors the garboard strake can be more than adequately fastened. Galvanised boat nails are not indigenous and the facilities for making them are very variable. It has been assumed that ordinary round wire nails will be used much of the time and in order to provide well fastened structures, clenched fastenings have been used in some areas, and threaded through fastenings only in major items of structure. The wire nails will be dipped in hot tar and driven wild in piloted holes.

Mechanical installations are basic with minimum electrics and mechanical drive to the trawler winch. Engine starting is manual on the gillnetters, and would be on the trawlers too if more manufacturers offered the option. With plenty of room and several crew at each end, it is amazing what size of engine can be started by hand.

These two designs define, we hope, strong safe vessels which will perform the functions well, can be built in the existing yards and with machinery which can be maintained in the somewhat rudimentary facilities available.

7. CONCLUSION.

The aim of this project has been to provide finance and technical assistance to enable the Bangladesh fishing and boatbuilding industries to expand their small mechanised fleet using local boatbuilders and local crews. Within this context, the technical assistance is endeavouring to ensure the best possible boats. Progress is not fast but procurement of machinery is under way and construction of the first batch of gillnetters should commence soon.

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Figure 1. Gillnetter in Cox's Bazar

Figure 2. Gillnetter under construction showing floors and transom

Figure 3. Toredo damage to a section of stem.
PARTICULAR NEEDS OF FISHING VESSELS
FOR USE IN THE DEVELOPING WORLD

Alejandro Acosta
Theophilus Brainerd
Bambang Priyono
Norbert Simmons
Rajapaksa Don Warnadasa
Stephen Drew, Editor

International Fisheries Association
University of Rhode Island
PARTicular Needs of Fishing Vessels for Use in the Developing World

Alejandro Acosta, Theophilus Brainerd, Norbert Simmons, Bambang Priyono, Rajapaksa Don Warnadasa, and Stephen Drew, editor
International Fisheries Association, University of Rhode Island

Abstract

The fisheries of developing nations sometimes require vessels whose characteristics are quite different from those used in the industrialized countries. The panel assembled here is composed of representatives from East Asia, Latin America, West Africa, Southeast Asia, and the Caribbean. Each of these regions encompasses a tremendous variety of fisheries and physical conditions. For example, to discuss the requirements for fishing vessels for Southeast Asia may be like discussing the needs of fishing vessels for North America. Constraints in space and time permit only general overviews, and detailed description of any one fishery is impossible here. In some cases the focus will be on a particular country within the region, and in other cases the discussion may center on considerations which are generally common to an entire region.

Also present in many of these areas are foreign flag, distant water fishing vessels, often with on-board freezing or processing capacity. The following discussion will not include such operations, but will focus on the fishing operations of the nations within each region.

Many developing nations have recently established 200 mile Exclusive Economic Zones, and they are anxious to increase their benefits from the fisheries resources of these zones. Where industrial fleets have increased, small scale fisheries have sometimes been neglected. Nevertheless, small scale fisheries are often extremely important local sources of protein, employment, and income. The particular problems and considerations involved in vessel operations in developing areas often have a greater impact on small craft than on large vessels. For the above reasons, this discussion will focus primarily on the small scale fishing sector. There is endless debate on the definition of small scale fishing, and any definition will find many exceptions. For discussion purposes here, the terms small scale fishery and artisanal fishery are used interchangeably, and defined as those fisheries involving vessels of less than 15 meters in length, generally operating within 20 miles off the coast.

The versatility offered by multi-purpose, combination fishing vessels is a great advantage in many developing areas, if the cost of conversion to a different fishery is not prohibitive. Many developing nations have high unemployment, and in these areas, innovations which tend to decrease crew size might do more harm than good.

Many developing countries have a shortage of foreign exchange with which to buy imports. Where this causes high fuel prices or shortages, fuel efficiency and alternative energy sources such as sail should be important considerations. In the fisheries of developing areas, inboard motors are sometimes far more economical to operate and maintain than outboards.
Motors, spare parts, and repair facilities are sometimes lacking, and new technology should be as easy as possible to maintain and repair. Provision for long-term supply of spare parts is a must. Vessel construction maximizing the use of local materials and labor can sometimes ease problems with foreign exchange.

In many areas, adequate harbor facilities are lacking, and small craft must be launched directly from the beach. In most areas, there is much room for improvement of fish handling and preservation on board.

The traditions and desires of local fishermen are extremely important considerations in the planning of new technology. Whenever unfamiliar equipment or methods are introduced, it is most important that they be accompanied by thorough training programs in their efficient operation and maintenance.

Southeast Asia

Bambang Priyono, Resource Economist, Indonesia

This region covers an area much greater than that of the United States, with many island and coastal nations which harbor a tremendous range of maritime conditions and fisheries. Commercially valuable stocks include pelagic schooling species such as tuna, skipjack, sardines, and mackerel; as well as demersal fish species and crustaceans such as prawns, crabs, and lobsters.

The region's traditional fishing vessels are made of wood. Some are dugout canoe-style, but most are planked. Most small craft have one or two outriggers. This style of construction is common in vessels from six to eleven meters in length overall, and larger outrigger canoes are also seen in some areas. Most of these vessels are equipped with sails, and many also use outboard motors or inboards, a typical installation being a 5-20HP direct drive inboard gasoline engine. The most common fishing methods employed by these craft are handlines, pole and line, gillnets, bagnets, and various seines. Many use light to attract schooling fish at night. A very substantial part of the region's production comes from small craft in this category.

In the early 1960's bottom trawling was introduced to many countries of the area. It proved highly effective in many areas, and led to substantial increases in production. Many countries in the region now have a number of trawlers, longliners, and purse seiners of 50-200 Gross Tons.

Several countries are also involved in large scale offshore fishing operations, with vessels ranging up to 300 GT, either owned nationally or operated in joint ventures with countries such as Japan.

While some areas of the region are overfished, in many places there is room for expansion or improvement of the fleets. Many nations are very anxious to exploit the offshore waters of their recently
established 200 mile Exclusive Economic Zones. It is felt that vessels in the range of 30-60 GT might be most appropriate for this purpose. Fishing vessels are quite expensive in the area at this time. For example, in 1980, the price of a new wooden tuna pole and line vessel of 30GT in Indonesia was approximately US$72,000, including motor and fishing gear. High quality wood for boatbuilding is very expensive, and in these tropical waters worms and borers contribute to short vessel life and high maintenance costs. Alternative building materials such as fiberglass, ferrocement, or steel would be superior in many ways. In addition, the following criteria should be considered in vessel design.

Many fisheries are aimed at fast-swimming pelagic species. For chasing these fish and maneuvering with fishing gear, high speed and moderate speed vessels are most effective. Distances traveled to the fishing grounds are often greater than those seen in the fisheries of other regions. For example, some tuna boats of 20-30 GT make trips of one to four days, traveling to grounds 10 to 80 miles from their ports. Travel time to and from the grounds is often a high proportion of total vessel time, and faster boats facilitate landing fresher catch for higher prices.

Several nations of the region are oil producers, and although fuel is sometimes unavailable on outlying islands, fuel prices in many areas are lower than in the USA. Sailing fishing boats have been used in this region for thousands of years, and their use is still common in many areas. Although the transitions between the monsoon seasons frequently bring strong winds which interrupt fishing, during most of the year steady, moderate trade winds provide favorable conditions for sailing. However, local fishermen are well aware of the advantages of motors, and many consider that the combination of sail and motor is most appropriate. Japanese motor manufacturers have very aggressive and effective practices for marketing, distribution, and service in the region, and most fishing vessels use Yanmar, Kubota, or Yamaha motors. These are also considered the most reliable and easiest to maintain and service.

Although a few fisheries of the region concentrate on low value species such as sardines, most fisheries produce moderate to high priced species, so most vessels do not need the capacity to hold very large quantities of low priced fish.

Some areas are characterized by strong currents and choppy seas. However, in most areas, seas are generally moderate, and permit operation in the medium speed range most of the time.

Most craft which make trips of more than one day's duration use ice on board to preserve the catch, so insulated holds or fish boxes are necessary. The pole and line fishery for tuna is widespread, and vessels for this fishery must have live bait wells.

The more developed areas have good harbor facilities with support services, although drydocking facilities are few, and generally very expensive. Outlying islands may be less well equipped, supporting only very small boats which fish strictly one day trips.
With regard to the above criteria, any new small craft must offer characteristics at least as favorable as the traditional banca fishing craft, or they are not likely to find acceptance by the fishermen.

In introducing prototypes, care must be taken to provide instruction in fishing methods which can take advantage of improved fishing capability of the prototype boats.

Due to the importance of small scale fisheries in the region, the FAO has done a great deal of work in the design of vessels appropriate for use in this sector, concentrating on the Philippines. A few of their sketches of traditional and alternative craft are included in the Appendix of this paper, as well as a design by the World Bank of a 30 GT tuna pole and line vessel. Since many other fisheries of the region are similar, this work may be considered a good base for working in many other nations.

Southern Asia - Focus on Sri Lanka

Rajapaksa Don Warnadasa, Marine Engineering Assistant, Sri Lanka

Sri Lanka is a large island in the Indian Ocean off the southeast coast of India. Its large fishing sector exploits several pelagic species such as tuna, skipjack, mackerel, swordfish, and shark, as well as a variety of semi-pelagic and demersal species. Shrimp, lobsters, and crabs are also fished commercially.

Wind and sea conditions in the area are generally moderate, allowing a relatively high number of fishing days per year. Occasionally, during the monsoon seasons, winds blow up to 30 or 40 knots, causing several consecutive days of down time for fishermen.

The island has a few trawlers of about 100 GT, but the majority of the fishing activity is done with an estimated 25,000 fishing craft of less than 15 meters LOA. Almost half these small craft are wooden, non-motorized sailing outrigger canoes less than 12 meters in length. Another 5,000 similar boats are powered by outboard motors which run on kerosene (in 1983 kerosene and diesel sold for around US$2 per gallon, while gasoline cost about US$3 per gallon due to excise tax). In the 10 to 12 meter range there are also many fishing vessels with inboard diesel engines which fish offshore waters.

Dominant fishing methods are hook and line, trolling, gillnetting, beach seineing, longlining, and shrimp trawling. Boats of less than 10 meters generally make 1-day trips, while the 10-12 meter vessels stay at sea for periods up to 1 week. On these trips ice is used for preserving the catch on board. The larger boats fish out to 80 miles offshore.

Most of the harbors in the country are overcrowded, and almost all the small craft are forced to land and offload catch directly on the beach, sometimes through moderate surf. Support facilities for hauling out vessels, maintenance and repair are also insufficient. Rising costs of materials, equipment, and operations have seriously hurt the fishing sector.
The Sri Lankan government is currently engaged in an ambitious campaign to improve its fishing fleet and increase production. Since the native woods which were used for boatbuilding are becoming very rare and expensive, alternative materials are being used, primarily fiberglass with some construction in steel as well. High fuel costs have prompted a great deal of experimentation with alternative energy sources, concentrating on sails for wind power as well as on solar power. Fuel efficiency is a top priority in boat design for the area.

The experience of recent fisheries development programs in Sri Lanka should provide valuable lessons for similar programs in other regions. The following guidelines for the introduction of new vessels and gear to the artisanal sector have been developed.

Combination vessels, which can switch to different methods and concentrate on different species according to the seasons and fishing grounds, would be most valuable.

Any new technology must be well suited to operation under local conditions, as outlined above. Vessel stability and safety for open water fishing is the top priority. Cost effectiveness is, of course a most important factor.

Since few vessels concentrate on very high volumes of low priced species, carrying capacity relative to vessel size need not be excessive. However, vessels over 10 meters need a capacity sufficient for trips of several days' duration.

Artisanal fishermen are most likely to accept new technology which is not too dissimilar from that which they are familiar with. New types of vessels, motors, and sailing rigs should be as simple and easy to use and maintain as possible. It is essential to introduce new technology carefully, with demonstrations and training programs in which the fishermen are taught proper operation and care of new equipment.

The Caribbean Region

Norbert Simmons, Fisheries Technologist, Bermuda

The Caribbean region includes an area from 10 to 32 degrees North Latitude, stretching from the Grenadines to Bermuda. It contains dozens of self-governing, inter-trading islands. The quality of the different fishing grounds of the region are strongly affected by the two categories of islands:

1) Islands that rise immediately from the seabed with very deep water almost immediately offshore.

2) Islands surrounded by an extensive shallow (coral covered) reef with gradual drop-offs.
The resources of the latter include pelagic as well as reef dwelling species, grouper, snapper, and lobsters. Waters surrounding the former type of island, with a sharper drop-off, generally have fewer reef-dwelling stocks, and fishermen there must concentrate more on deep-water or pelagic species. The major commercial stocks include the reef species mentioned earlier as well as tunas, kingfish, mackerel, shark, and wahoo.

Fisheries play a very prominent role in the regional economy, in most places ranking third or fourth in terms of GNP behind such activities as tourism, agriculture, home industry, and offshore company (tax exempt) business.

Fishing vessels range from the traditional long and narrow West Indian dugout canoe to large modern diesel work vessels and shrimp trawlers of a few areas. The four to six meter open craft usually use 1.5-25HP outboard motors, and operate with one or two man crews. Wood is the most common construction material, but in some areas fiberglass boats are increasing in number. Making one-day trips, these boats use hook and line, fish traps, trolling gear, beach seines, and in some areas, gillnets.

In the southern part of the region, the most common larger vessels, of 9-12 meters in length, are the traditional decked wooden fishing sloops, most of which have small inboard diesels. These may have a crew of up to five members, and fish over 100 traps in deeper water. Some also use deep water reels for snapper and grouper. In the northern islands, moving closer to the USA, it is more common to see fiberglass vessels of 9-14 meters in length, often with relatively large inboard diesels, equipped to fish traps or deep water snapper reels.

Hydraulic and electric line haulers and reels have contributed significantly to offshore vessel development. The larger vessels of this category make trips of up to one week's duration. Most of these preserve the catch with ice. However, during some seasons shortages of fresh water lead to unavailability of ice. For many years live wells have been used to keep reef fish and lobsters on board. As the reef dwelling stocks have become less abundant, many fishermen are concentrating more on the faster swimming pelagics, which do not survive in live wells; consequently, the use of ice is on the increase.

The use of sail is not uncommon in most fisheries of the region. It was very common 20 years ago, and is still used in inter-island freight delivery. The steady northeast trade winds provide very good conditions for sailing throughout the region. Fuel is very expensive in most areas (fuel in Bermuda cost US$1.50 per gallon in 1982), and the reintroduction of sail to local fisheries could lead to substantial savings in operating costs. Many fishermen are becoming increasingly interested in this fuel-saving alternative.

The main cities of most islands provide limited landing facilities for commercial vessels, transport and fishing craft together. There is a need for more dock areas and facilities for commercial fishing vessels. In some areas, smaller fishing boats use beaches for landing and offloading catch.
Most fisheries concentrate on species of moderate to high individual value. While these vessels are not required to carry very large loads of low priced fish, the range and duration of fishing trips is generally increasing, and longer trips require increased hold capacity for the catch.

Although there is some evidence of overfishing in some inshore waters, there may be room for expansion of the fisheries for pelagic species, and there is definitely room for modernization of currently used vessels and equipment. The planning of new vessels must take into account the local conditions outlined above. One major design criterion would be a vessel's ability to participate in a variety of fisheries. A combination, multi-purpose vessel would be able to explore new fisheries, and take advantage of the region's diverse resources as well as stocks which migrate seasonally.

The 200 mile Exclusive Economic Zones of many Caribbean nations are presently fished by foreign nations under permits, with vessels generally of the 30 meter, 200GT classes. Most of these vessels are longlining tuna. This is a possible area for future fisheries expansion for many island nations.

Latin America - Focus on Venezuela

Alejandro Acosta, Fisheries Technologist, Venezuela

Venezuela has a coastline approximately 1700 miles long, on the north coast of South America. In some ways it is atypical of Latin American nations - for example, its oil production eases foreign exchange problems, and provides fuel for the fishing fleet at relatively low prices. However, the country provides a good illustration of the contrasts between large and small scale fishing operations working in the same area.

Species most commonly fished commercially include sardines, tuna, skipjack, snapper, grouper, shrimp, squid, and octopus. The continental shelf along this coast is relatively narrow, and it is intensively fished by over 200 Venezuelan shrimp trawlers of the double net type typical in the Southern USA and other areas. Since the resources and grounds of waters off the edge of the shelf are not well known by local fishermen, both small scale and industrial scale vessels compete for the resources of the narrow shelf. The country also runs a small fleet of offshore tuna vessels, pole and liners, longliners and purse seiners, which have the capability of freezing on board, and making longer trips to more distant grounds.

Steady northeasterly trade winds dominate the area, and provide conditions generally favorable for operation of a wide range of vessels.

The small scale fishery in Venezuela supplies much of the fresh fish and the domestically consumed protein. It also provides employment and income for a large percentage of the population in some areas of the country. However, it is generally considered a low priority, and many
obstacles hinder its development. The small scale fleet consists of around 6,000 vessels, ranging from 3 to 12 meters in length. Wood is the traditional building material, and the most popular. There are some small fiberglass fishing craft, including boats recently manufactured in the country under a joint venture with Yamaha of Japan. However, the fishermen have little experience operating, maintaining, and repairing fiberglass craft, and despite its advantages, they are sometimes reluctant to accept this new material. More energetic promotion of this fiberglass for fishing craft might overcome this problem.

Most of the small vessels use outboard engines running on gasoline, and Yamaha is the most common brand seen. Vessels over 8 meters in length often have inboard diesel motors. Fishing gear most commonly used by the artisanal fleet includes handlines, longlines, traps, beach seines, trolling, and gillnets. Most craft have neither electronics for navigation and fishfinding, nor mechanical equipment for hauling gear, and fishing operations require a great deal of manual labor. Most of these vessels make one-day trips, but some stay at sea for up to one week, using ice for preservation of the catch. Crews on small vessels generally have one to six members.

While harbor facilities for the industrial fishing fleet are adequate, dock and offloading facilities for small craft are lacking, and many small craft land their boats and catch directly on the beach.

In Venezuela, fishery products have a high demand, and seafood prices are relatively high. It is felt that improved management and modernization of the fleet can lead to increased production in the long run. The mollusks such as squid and octopus are underexploited. More research is needed to estimate resources farther offshore, outside the range of the traditional fisheries. Vessels of 11 to 15 meters in length might be within the reach of some artisanal fishermen, and such craft could work on the resources near the edge of the continental shelf.

Since local stocks are very diverse and knowledge of potential new fisheries is incomplete, any new vessels must be designed for multi-purpose fishing. Conversion from one fishery to another should be as fast and simple as possible, allowing the fisherman to experiment with new stocks and grounds, as well as to enter seasonal fisheries.

In order to increase the efficiency of vessels in the 8 - 12 meter range, some electronic and navigational equipment, such as compasses and depth recorders would be very helpful. Mechanical or hydraulic equipment for hauling fishing gear would also be a significant improvement. However, since the coastal region depends heavily on fishing for employment, innovations which lead to reduced crew size would probably bring more problems than benefits. Planners should be careful not to displace fishermen from their current occupations.

Unfortunately, in contrast to cheap fuel, imported equipment and machinery is quite expensive, and sometimes unavailable. For successful operation in the long run, any new vessels or equipment must be accompanied by a commitment to provide spare parts and service in the country.
Sea and wind conditions would be favorable for sail-assisted fishing craft, but in Venezuela where fuel is inexpensive, they might not be able to compete with faster motorized craft.

Artisanal fishermen have very little exposure to vessels and gear not found in their area of operation. The introduction of new technology must be accompanied by education and training of fishermen. They should be made aware of the advantages and disadvantages of unfamiliar systems, and when new vessels are actually delivered, it is essential to provide thorough training in the operation, maintenance, and servicing of the new equipment.

West African Region (Eastern Central Atlantic)

Theophilus Brainard, Resource Economist, Sierra Leone

Along the coast under consideration, from Morocco to Zaire, fishing is an important activity for the production of food and income. The area contains large concentrations of pelagic stocks, such as sardines and anchovies, as well as moderate to sparse distributions of demersal species. Some countries have reasonably high stocks of shrimps and other shellfish. The fishing grounds in the northern part of the region are generally the richest.

For discussion purposes, the region can be said to contain four fishing sectors - a foreign flag distant water fleet, an African-owned industrial fleet in which some nations enjoy the right to fish in the waters of other African nations, local industrial scale fleets fishing in the waters of their flag states, and small scale, artisanal fleets. The distant water fleet is composed principally of foreign-owned freezer or processor fishing vessels, sometimes operating under agreements or joint ventures with local governments.

In the industrial sector of the African owned vessels, boats over 15 meters LOA include shrimp trawlers, purse seiners, side trawlers, longliners, and vessels which employ fish and lobster traps. The most common construction material is steel, but there are also wooden and fiberglass vessels. These vessels fish the grounds from 5 miles offshore to out past the edge of the continental shelf. Duration of voyages ranges from 3 days to one month, depending on the country and the fishery. Most of these boats use ice for preserving the catch, but some have freezing capability.

In this region there are approximately 40,000 artisanal fishing vessels, fishing one-day trips within 10 miles off the coast, using hook and line, cast nets, set nets, drift nets, surrounding gillnets, purse seines, and longlines. These craft fall into 3 main categories. The first category consists of vessels ranging in length from 5 to 6 meters with beams less than one meter. They are usually dugout from tree trunks, operated by one man with paddle as the means of propulsion. In recent years, the number of these vessels has declined considerably as fishermen move to the larger vessels.
The second category consists of vessels with lengths ranging from 6 to 9 meters, with beams greater than one meter. These vessels are usually operated with outboard engines in the 6HP to 15HP range. In some countries the use of sails is becoming popular due to high fuel costs and economic conditions. These vessels are built with wooden planks and carry up to 10 fishermen.

In the third category, which has received a great deal of attention because of its suitability for use with larger fishing gear, vessels range in length from 9 to 15 meters with beams less than 5 meters. They are operated with outboard engines in the 25HP to 40HP range. Construction is of wooden planks, and the boats carry up to 15 fishermen. The fishing gear used by these boats consists of surrounding nets, purse seines, gill nets, and some longlines. Since winches and hauling machinery are not generally used in the area, a great deal of manual labor is needed to haul and set the relatively large nets.

In the past, storage facilities such as insulated ice boxes have been lacking on the vessels, and this limits the duration of fishing trips. Recently, insulated fish boxes are becoming popular in some countries, but their use is also dependent on the sporadic local availability of ice. Cabins or other crew shelter are lacking on virtually all small craft.

In small fishing craft, wood has been the traditional building material because of its availability, and also because local boatbuilders have experience only in wood construction. Fiberglass vessels have been introduced in some countries, but have not found much success.

In many areas, there is room for expansion of both the industrial and the artisanal fleets. New vessels could fish the same stocks currently exploited, as well as some underexploited species such as squid and sharks.

In planning effective vessels, certain deficiencies in the supporting coastal facilities must be kept in mind. Adequate harbor and port facilities are sometimes few and far between, and in many areas the small craft land and unload product directly on the beach. Problems in obtaining foreign exchange often cause difficulties in importing motors and spare parts, and it is best to find out in advance which manufacturers have effective local networks for parts and service. It is all too common to see fishermen unable to fish because their motors need repairs or parts which are simply not available in the country.

Fuel is generally quite expensive in the region; for example, in 1983, in Sierra Leone, gasoline and diesel cost approximately US$2.00 per gallon. Any new vessels should be as fuel efficient as possible. The northeast trade winds and southwest monsoons are prevalent, often providing conditions favorable for sailing, and the use of sails as auxiliary power is increasing. Vessels which concentrate on pelagic species should be capable of relatively high speeds.

Since many large and small vessels fish low priced, high volume species, carrying capacity for any vessel should be as large as possible relative to the cost of the boat. In these tropical temperatures, there
is much room for improvement in on-board equipment for fish handling and preservation.

The versatility offered by multi-purpose vessels could be a very valuable quality for new fishing craft here, especially small craft. However, even with a multi-purpose vessel, conversion from one fishery to another is sometimes very expensive, especially with larger vessels. A careful feasibility study should precede any added construction expense involved in making a vessel suited for various fisheries.

Labor is relatively cheap in the region, and unemployment is sometimes a problem. Consequently, crew numbers tend to be quite high relative to vessel size. While modernization of equipment could bring some benefits, changes which would reduce crew size might cause serious social and economic problems.

Worms and borers are a serious problem for wooden vessels in the area, and fiberglass, steel, or WEST (wood-epoxy saturation technique with an outer coat of fiberglass), would offer significant advantages in increased durability and low maintenance. However, the infrastructure and expertise for service and repair of these materials is presently incomplete, and support facilities must accompany such new developments.

Artisanal fishermen may be reluctant to try technologies which differ significantly from traditional methods. Planning of new vessels and gear should include input directly from the fishermen. Actual introduction of new technology must be done carefully and tactfully, and thorough training programs to familiarize fishermen with new equipment are a must.
DEVELOPMENT OF A 40 FOOT MULTI-PURPOSE FISHING VESSEL: A 12 YEAR RETROSPECT BY THE BUILDER

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Abstract:
This paper explores the concept of semi-custom boat building for a variety of commercial purposes, using a standard production hull form. The viewpoint is the builder's, from the inception of the idea, through the production and sale of the boats, to a point some 12 years later, when certain conclusions are drawn as to the success of the product based on usage. The author's company for semi-custom construction, for seven years of operation, was Marine Management Company, of Miami, Florida.

Design Development and Basic Construction

Prior to 1969, there were almost no fiberglass boats in the 40'-50' size range designed for commercial fishermen, using state of the art technology, being built on the U.S. east coast. Most of the boats in this size range were re-interpretations of hulls designed for pleasure or military use. Based on my past experience in boat operation and repair and on many conversations with commercial fishermen, I decided to commission a design for a commercial hull to be built in fiberglass. The underlying philosophy was that the needs of fishermen and other commercial users in diverse areas could best be met by taking a well designed, versatile, production hull and customizing it to fit an individual's needs. Construction would be rugged, easy to maintain and building techniques would be flexible enough to permit semi-custom construction at a price that the user could afford while the builder could make a profit. To this end the basic hull design had to be suitable for multipurpose uses.

To meet these requirements, the boat had to be seaworthy and fast in the lightly loaded condition, given adequate horse power, and at the same time, be seaworthy and efficient at pure displacement speeds in a heavily loaded condition. A draft of four feet or less was considered practical to provide access to shoal harbours. Adequate protection was required for the propeller in case of accidental grounding. Lastly, the vessel had to provide a relatively stable and comfortable work platform.
A hull of about 50' in length seemed to offer the most versatility as a boat small enough to be operated by two men on a day trip basis and yet large enough to accommodate 4 to 5 men, plus ice and gear for longer trips offshore.

Because of the varied load and speed capacities which were anticipated, trim was a very important consideration in the design. Regardless of load situations, traveling for any distance either down by the bow or stern was not acceptable. Ballasting and/or trim tabs were not options for practical use by working owners.

Given these basic criteria, Wynne Marine Inc. designed a hull to be built in fiberglass with the following specifications:

- LOA 46'7" or 48'
- Beam 14'7"
- Draft 3'6"
- Hold capacity 600 cu. ft.
- Fuel 1200 gallons for single engine
- 500 gallons for twin engines
- Water 300 gallons

Basic Hull Drawing
The design is hard chine with a sharp vee forward to reduce pounding and ample flare for dryness. Aft, the hull flattens out for load carrying ability. The molded-in keel helps provide good propeller protection and, in combination with a specially designed tunnel, allows shoal draft and a low shaft angle of 6 1/2 degrees in the single engine configuration. Twin engine installations also make use of shallow tunnels, so that shaft angles are low and the propeller tips are above the bottom of the keel.

In the single engine installation, the engine with the fuel tanks outboard on either side is located near the center of buoyancy. Trim does not change adversely with a change in fuel load. This also permits the use of a short propeller shaft of approximately 80 inches. Space is available for a below deck fish or storage hold forward of the engine, thus eliminating the often noted problems of long shafts and inaccessible intermediate bearings.

The topsides are almost vertical, not slab sided but with some curve, to make it easy and safe to work over the side. The working deck is 30' long in the 46'7" model and 32' long in the 48' boat. The length options and single and twin tunnel options are made possible by the use of mold inserts. There is sufficient room under the forward deck to provide 4 bunks, head and galley.

One of the most obvious variations from boat to boat is in the configuration and layout of the superstructure/pilot house. Especially in commercial fishing, the location of steering and controls are significant to the individual user. While one style of molded deck house and fore deck, of core construction, was offered, most customers required a special design and fabrication in this area.

Construction is on the heavy side. The hull is solid glass laminate (i.e., no core material) and is laid up in a one piece female mold, as described in the Appendix.

After stringers, bulkheads, deck clamp and frames were installed, the hull was removed from the mold, by crane, and set on a wheeled, steel shop cradle. The fuel tanks, of fiberglass or metal, were then set in place. If a standard molded fore deck and/or house were to be used the crane would position the pieces. The cradle was then moved to a construction station, the hull leveled, the sheer cut to owner's specifications, and finish work commenced.

Construction differed from industry standards in several ways. As previously mentioned wood frames were installed from station 3 to the transom on 34" centers. These frames extended from just above the chine to the sheer line and served several purposes - to stiffen the hull sides and to
eliminate stress concentrations at the hull to deck joint, when the rub rail lands against a dock or loading platform. These frames also provide an easy point for securing the cockpit ceiling, with space between the frames for air vents to engine spaces. All interior cabinet work was considered structural and glassed to the hull accordingly.

As indication of the rigidity of this construction, all engine alignment was completed in the shop to .003" at the shaft coupling faces. Each boat was then trucked about 6 miles to the water and launched. After launching alignment was checked with a dial indicator. In the three years after adopting this procedure, it was not necessary to realign an engine after launching.

A method was developed whereby deck houses were generally built of fiberglass and balsa core panels laminated in conveniently sized sheets, then cut and joined as necessary. While this technique was not new in custom construction, it offered much flexibility for the semi-custom builder faced with a variety of cabin arrangements.

Since our basic construction techniques were the same on all boats and as the work force was experienced and stable, it was not necessary to have formal drawings for each commercial boat even though each was different from all the others in some ways.

Pleasure boats were usually custom designed by Wynne Marine Inc., with a complete and detailed set of plans. With few exceptions all of our commercial customers were experienced and knew what they wanted, how it should work and what it should look like. The only problems were communications. Experience proved that the overall appearance of a boat, in plan and profile, could be worked out with the owner quickly by using preprinted basic hull drawings, a pencil and a big eraser.

We would discuss with the buyer in detail how he planned to work the boat. These conversations made clear the problems of weight distribution, gear location, work stations, etc. that had to be solved. Compromises were usually worked out by going aboard boats under construction. With four or five boats in the shop at varying levels of completion, the eventual solution to a problem could be illustrated in actual construction detail. We had very few cases of misunderstanding and subsequent rework using this system.

With the details worked out, a fixed price contract was prepared. Pricing was somewhat laborious even though many elements and costs were the same from boat to boat.

A detailed contract form, describing construction
techniques and materials, was utilized, and a very specific payment schedule was part of the contract. A 10% deposit upon signing of the contract was followed by an additional 20% upon the date that the hull was begun. Other payments were tied to specific events in the progress of construction - such as the date of engine delivery or the date that the cabin exterior was in place. A balance of about 15% to 20% was reserved for the date of delivery and acceptance by the buyer. With this very clear cut approach to finances, we experienced little difficulty with cash flow and had a good relationship with the customers in terms of our mutual responsibility. For the protection of both parties to the contract, it was understood that the cost of builder's risk insurance was tied to boat value and built into the contract price.

Review of Boats In Use

Evaluation of the semi-custom approach to work boat construction is obviously tied to financial results. Assuming that the builder can make a profit, the winner or loser is then the boat owner. The building-in of specific utility for the individual and the building-out of maintenance and breakdown worries can go a long way towards enhancement of the bottom line. After 7 years of production and approximately 65 boats built, we determined that most of the boats were still being operated by their original owners. Their uses were extremely varied and included such applications as a fast research support boat for the University of Miami, mackerel and king fish gill netters with roller rigs for South Florida, tub trawlers and offshore lobster boats for New England, tour boats for Bermuda and a tuna boat for Hawaii. One boat was in service as a treasure/salvage vessel and several had been U.S. Coast Guard certified to carry diving parties of up to 35 persons. With suitable variations in superstructure, interior layout and power, the hull was being used for charter sports fishing and pleasure cruising.

With this variety of employment, some hulls were being operated with light loads at relatively high speeds, some were viewed as strictly displacement hulls and others were used in both modes. To demonstrate the success of the design concept as implemented by semi-custom construction methods, a description of several boats is offered here.

The attached plan and profile drawings demonstrate the flexibility that can be developed with this single good hull design.

One South Florida fishery requiring speed and load carrying capability is the gill netting of kingfish and mackerel. In this fishery, spotter planes are frequently
used. Working with several boats, the plane’s pilot searches for fish, and when a school is sighted, he radios the location to his boats. The race starts for the fish with the first there controlling the school and making the first set. If there are large numbers of fish, another boat may have an opportunity to set its net and share the catch. It is not unusual to catch 20,000 to 35,000 pounds in a set. Consequently, when the net is hauled back and cleared, the boat is back to the slow speed range. Power for most of these boats is usually a 12V71TL, which provides speeds of approximately 26 to 28 knots, running light.

A particular New England offshore lobster boat is a good example of the hull used at semi-displacement speeds. In this case the cruising speed is 11 to 12 knots. The average trip is 3 days with 12 hours spent traveling each way and 48 hours fishing. Cruising speed is about the same in each direction as the vessel loading does not change much. The weight of lobsters in an aerated, sea water tank on the return trip is offset by the use of 4500 lbs of bait, fuel and water consumed prior to returning. Fuel consumption is 500 to 600 gallons of diesel, with a Caterpillar 343 for power. The live tanks will hold up to 6700 pounds of lobster.

This boat tended 800 traps set in trawls of 25 to a line in 600' of water. Sea keeping was important. Even though the boat did not begin a trip in adverse weather conditions, she was caught offshore in a blow many times. Her original owner operated her so successfully for 7 1/2 years that he has just taken delivery of a replacement for her – a 65' aluminum vessel whose cost is approximately a half million dollars.

The day fishery for stone crabs in southwest Florida requires a fast, maneuverable boat when pulling traps and a seakindly load carrier when moving traps. In this usage, the boats leave the dock before daylight at a time that will permit them to be at their trap lines at first light. The daily run out may be as short as fifteen miles or as long as sixty miles. Power for boats in this fishery is usually provided by either a GM12V71N or GM12V71TL, giving cruising speeds of about 20 knots light and 10 to 12 knots loaded.

Most boats of the 40 to 50 foot size are equipped with two hydraulic haulers mounted at the stern. These are operated by two crew members on an alternate basis, so that one man is hauling a trap while the other is engaged in clearing and rebaiting a trap just hauled. Traps are individually buoyed and set in water depths ranging from 10 to 60 feet with 500 to 650 traps per line. Traps are spaced approximately 200' to 300' apart and are hauled, cleared, baited and reset, at the rate of one per minute per hauler in 25 to 30 feet of water and one every 1.5 minutes in deeper water. Speed of the boat and spacing of the traps are such
that there is just enough time for each puller to complete his job before his next buoy is along side. This pace requires team work and a very maneuverable boat, especially when working in cross winds and tides. It is also a strain on engines and steering systems. In a typical hauling cycle, engine RPM can vary from idle to 1800 RPM in forward, then quickly change to idle and up to 1800 RPM in reverse when a buoy is reached. This procedure represents a minimum of 1200 gear changes a day and often times some powerful backing down.

In this daily routine, boats usually return to the dock between 3 and 7 P.M.. The product is light in weight and is carried to the dock unrefrigerated, so speed is important. By contrast, the seasonal setting out or bringing in of traps is slow work requiring unusual load carrying ability. Moreover, lines of traps are often moved in the course of the season. During these operations a full line of 600 traps, weighing 42,000 pounds dry or 48,000 pounds wet, is stacked on deck.

Builder's Conclusions

The preceding examples prove that a well designed production hull can be an effective multi-purpose boat when finished on a semi-custom basis.

The top fishermen of today using boats in the 40' to 50' range have significant capital investments. A stone crabber with a new 48' boat might have $150,000 in boat and electronics costs and $85,000 in traps. Additional funds will be committed to off season fishing gear, such as long lines and fish traps. This crabber will employ two full time crew members to help him work the boat, and two additional persons may be needed during the off season to build and repair traps. This man is not ready for a smaller, fuel conservative boat that might put him back into the "mom and pop" category of fishing, although he is definitely receptive to means of reducing costs and improving profit. For example, a savings in fuel costs is not beneficial if such factors as travel time, productivity or crew wages are adversely affected.

With specific regard to construction methods and materials, my experience supports the concept of over building for strength and longevity. Most of the fishing boats that I have known well in the past 15 years have no regular preventative maintenance programs. Repairs are made when a failure stops the fishing. The gradual deterioration of structural components is apt to be ignored as long as the boat can be fished successfully. This means that hull, underwater gear, steering systems and engine foundations
should be over built to compensate for rough usage. Use of light weight, modern materials and sophisticated building techniques must be balanced by regard for the abuse which the end product will receive.

The semi-custom concept has particular value for the builder who prefers a relatively small operation while appealing to a broad market. With the aid of the small personal computers now available, pricing and contract preparation could be accomplished in minutes instead of several hours. The computer could also be used to generate shop drawings and regulate inventory and billing. This would give the innovative builder in a small shop more time to solve customers' problems.

In each of the fishing situations described previously, the boat is the central tool in an economic unit which provides employment for several persons while producing a significant food product for distribution to a large number of people. My observation of motivated fishing boat owners suggests that they have in common a traditional approach to their work and that they are interested in innovations in their tools only if those innovations improve their financial basis. In this regard, the boat builder can emerge as a force for conservation by employing good structural techniques and reliable, easy to maintain materials. The semi-custom building situation offers a unique framework in which to keep costs under control and quality high.
APPENDIX

General Specifications for construction of hulls by Marine Management Company

DIMENSIONS: 46′ or 48′ long x 14′6″ beam x 3′6″ draft

HULL: hand lay up, lamination of solid fiberglass, with approximate thickness in sides of 1/2″ to 3/4″ at chines to 1 1/8″ or 1 1/4″ at keel. Hull laminate schedule: gel coat/one layer of 3/4 oz. mat / 5 layers of 1 1/2 oz. mat and 24 oz. woven roving in pairs to develop the hull thickness of nominal 1/2″. Additional hull thickness is developed when stringers are glassed in place as follows.

STRINGERS: Four full length of 1 1/2″ x 8″ mahogany, totally encapsulated with one layer of 1 1/2 oz. mat and two layers of 24 oz. roving. In way of engine(s), stringers are doubled to 3″ thickness and covered with two layers of 1 1/2 oz. mat and four layers of 24 oz. roving. Voids between wood and hull are filled with fiberglass putty and a radius is formed in the putty between stringer and hull.

BULKHEADS: Four standard bulkheads of 3/4″ plywood glassed in place on each side with bonding angles of one layer of 1 1/2 oz. mat and two layers of 24 oz. roving. All four bulkheads are watertight. Voids between bulkheads and hull are filled with fiberglass putty and radiuses formed.

FRAMES: Frames from 1″ x 6″ mahogany glassed in place with one layer of mat and two of roving. Frames installed on 34″ centers starting at station #3 and going to transom, and extending from shear to chine. Forward of station #3, framing and support are provided by cabin floors and interior accommodations, such as bunks, which are glassed in place with one mat and two rovings and which are considered structural.

DECKS: Main deck of 3/4″ plywood nailed with threaded bronze nails and glued to 2″ x 4″ deck beams on 12″ centers. Deck beams bolted to clamp with 5/16″ stainless steel machine screws. Main deck is fiberglass covered with two layers of 1 1/2 oz. mat and gel coated.

Forward deck is of same construction as main deck, or is of molded glass, hand laminated with 11/16″ balsa core, depending on buyer’s requirements.

RUB RAILS at shear of mahogany, 1 1/2″ x 3″ x 2", with metal guard at buyer’s option.

GUNWALEs and COAMINGS of 3/4″ plywood secured with stainless steel screws and glassed with one layer of mat.

ACCOMMODATIONS to buyer’s specifications.
FINISHES and MATERIALS: All molded surfaces to have gloss gel coat finish. Other fiberglassed surfaces which require finish to be painted with mat gel coat. Painted wooden surfaces to have one coat of primer and one coat of gloss enamel of epoxy type. Interior mahogany trim to be varnished. All woven roving to be 24 oz., and all mat, except surface next to hull gel coat, to be 1 1/2 oz. Bottom painted with anti-fouling.

FUEL TANKS: With single engine installation, either molded fiberglass as standard (two tanks with capacity of 550 each), or custom tanks of aluminum or epoxy coated black iron.

With twin engines, custom tanks of aluminum or epoxy coated black iron.

WATER TANKS: Fiberglass or aluminum to meet buyer’s requirements.

UNDERWATER GEAR: Extra heavy duty construction. Sturts, rudders and skegs of stainless steel; shafts of Armco Aquamet stainless steel, 2" or 2 1/2", depending on engine; rudder ports, shaft logs, and propellers of bronze, with propellers to be four blade sized to engines.

Single engine boats to have "Y" strut and skeg; twin engine boats to have "U" struts and no skeg.

ENGINE(S) of buyer’s choice.

ENGINE BEDS: 1/2" x 6" x 6" steel, epoxy coated, full length of engine, and through bolted with ten 1/2" carriage bolts on each engine stringer.

RUDDER PORT BRACKET: 6" steel channel, epoxy coated, with bronze bearing.

STEERING: Mechanical or hydraulic to buyer’s requirements.

EXHAUSTS: Dry or wet as required.

ELECTRICAL SYSTEM: 12-24-32 volt systems available. All circuits properly fused and wire correctly sized for load and length of run. All underwater metal parts bonded.

THRU HULL FITTINGS: Bronze with bronze gate values if below water line and acetal resin U.L. approved if above water line.

LIGHTS: Navigation lights in accordance with International Rules; cabin and deck lights to buyer’s requirements.