net is then shot. Sometimes two boats cooperate. In that case, one of the boats equipped with an echo sounder stays above the school until the second one has shot the net around it. Small mechanical purse winches are commonly available. Sometimes, in the case of smaller boats, manual winches are used. During pursing, the vessels have to be anchored in order to stay clear of the net. In the case of cooperation of two boats, the search boat sometimes purses by steaming with one end of the purse line away from the catch boat. Power blocks are not generally used. (Personal communication from Hjörtur Fjeldsted, Akureyri.)

The season starts in late April and lasts as long as schools can be found, usually until late July. If the fish is scattered, the vessels take up other fishing gear, such as handlines or Danish seines. The average catch of boats above 20 GT is in most years more than 200 metric tons, whereas the smallest open boats seldom exceed 50 metric tons each.

References

ANON Records of catches. Aegir, 1961–69.

JAKOBSSON, J 1964 Recent developments in Icelandic Herring Purse Seining—In Modern Fishing Gear of the World, 2, pp. 294–305. London.

THORSTEINSSON, G 1965 Fangmethoden in der Kabeljaufischerei. Protokolle zur Fischereitechnik, Vol. IX, pp. 288–381.

THORSTEINSSON, G 1970 Icelandic purse seines with double leadline—Construction and experience. FAO Technical Conference on Fish Finding, Purse Seining and Aimed Trawling. Reykjavik. (See p. 273 ff.)

Technological Aspects of the Modern Norwegian Purse Seine Fisheries

J. Hamre, O. Nakken

Aspects technologiques des pêcheries norvegiennes modernes à la senne coulissante

Les plus importantes espèces capturées sont le hareng, le maquereau et le capelan, qui sont essentiellement destinés aux industries de transformation. La pêche à la senne coulissante, d'origine suédoise, a été introduite en Norvège au début du siècle et a par la suite été fortement influencés par les pratiques américaines et islandaises. Avec l'introduction de la poulie mécanique (power block) en 1963–64 et d'autres dispositifs méchaniques de relevage, la méthode à deux doris a été remplacée par la méthode à un seul bateau; parallèlement, la dimension des navires et des filets a considérablement augmenté. Cette pêche exige l'assistance de remorqueurs ou l'emploi d'hélices de poussée latérale (à l'avant et à l'arrivère), hélices dont sont aujourd'hui équipés de très nombreux grands bateaux. Les navires sont évidemment dotés de l'équipement le plus récent en matière de détection (sonars, échosondeurs) et de navigation. Les dimensions des bateaux varient entre 70 et 80 pieds environ pour la pêche côtière et entre 80 et 190 pieds environ pour la pêche hauturière, avec une capacité de charge allant jusqu'à 700 t. Les filets sont essentiellement fabriqués en nylon, à fils noués pour les grandes sennes (environ 600×150 m) à hareng et maquereau, et à fils sans noeuds (Raschel) pour les petites sennes (environ 400×75 m) et les sennes à petites mailles utilisées pour les sprats et les capelans. Le pourcentage d'armement est approximativement compris entre 40 et 50 pour cent. Etant donné que les stocks de harengs et de maquereaux semblent en diminution et sont protégés, la pêche aux capelans apparaît très prometteuse pour le proche avenir. On tend de manière générale à réduire le nombre des bateaux de petite taille et à constituer une flotte comportant un nombre relativement faible de grands navires ayant une forte capacité de charge.

Aspectos technologicos de las modernas pesquerias noruegas con redes de cerco

Las especies más importantes capturadas son arenque, jurel y capelán, que se emplean, sobre todo, para la obtención de harina y aceite. La pesca de cerco fue introducida, procedente de Suecia, a principios del siglo y más tarde sufrió fuertes influencias de los Estados Unidos e Islandia. Con la introducción de la polea mecánica (1963–64) y otros instrumentos mecánicos para el halado de la red, el método de pesca de cerco con dos botes fue sustituído por el método de pesca con una sola embarcación y al mismo tiempo el tamaño de las embarcaciones y las redes aumentó considerablemente. La operación requiere la ayuda de un bote remolcador o de hélices de empuje lateral (proa y popa), con las que hoy día están ya equipadas muchas grandes embarcaciones. Los barcos elevan, como es natural, equipo modernísimo de sonar, sondeo acústico y navegación. El tamaño de las embarcaciones va de 70 a 80 pies de eslora, para la pesca de bajura, y de 80 a 190 pies para la pesca de altura, con capacidades de carga de hasta 700 toneladas. Las redes son predominantemente de nilón; en las redes grandes (de unos 600×150 m), empleadas para el arenque y el jurel, se utilizan paños anudados, mientras en las redes más pequeñas (de unos 400×75 m) y de malla más estrecha, empleadas para el espadín y el capelán, se utilizan paños sin nudos (Raschel). El coeficiente de armadura oscila entre el 40 y el 50 por ciento. Como las poblaciones de arenque y jurel parecen ir disminuyendo y están protegidas, la pesquería del capelán parece ser la más prometedora para el próximo futuro. En general, se tiende a una reducción del número de embarcaciones pequeñas y a formar una flota constituida por un número relativamente reducido de embarcaciones grandes, con mayor capacidad de carga.

THE species fished by Norwegian purse seiners are herring (*Clupea harengus*), sprat (*Clupea sprattus*), capelin (*Mallotus villosus*), mackerel (*Scomber scombrus*), bluefin tuna (*Thunnus thynnus*), coalfish (*Gadus virens*) and polar cod (*Gadus saida*). The most important fisheries are the herring fishery which takes place along the whole Norwegian coast, the mackerel fishery off the southern coast, and the capelin fishery off the north coast of Norway. The bulk of the purse seine catches has so far been used for industrial purposes (i.e. reduction).

The purse seine has been used by the Norwegians since

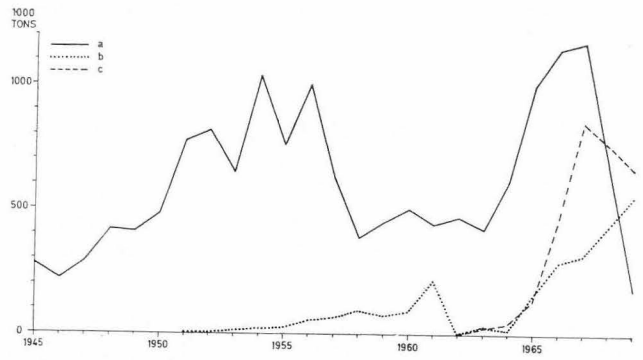

Fig 1. Yield of the Norwegian purse seine fishery 1945–69. (a) herring (b) capelin (c) mackerel

the very beginning of this century, but it was after the last world war that the fishery developed on a large scale. In fig 1 are shown the yearly catches of herring, capelin and mackerel caught by Norwegian seiners since 1945. The curves indicate that the seiners have had two good periods, one culminating in 1956 and one which seems to have culminated in 1967. In between these periods is a poor one (1958–63). The catches before 1964 consisted of herring mainly, whereas recent yield from purse seiners also include considerable quantities of mackerel and capelin.

The increased catches of herring during the first period was due to large investments in seiners equipped with nets operated from two dories. The natural basis for this fishery was the Atlanto-Scandian herring stock exclusively. This stock was very abundant during the period concerned due to several rich year classes (Dragesund, 1970).

In the late 1950's, the strength of the Atlanto-Scandian herring stock was reduced drastically due to failure in recruitment, and Norwegian purse seiners, losing their only source for exploitation, ran into a serious economic crisis. This was met by various measures of government loans and guaranties to convert the boats to other types of fisheries, mostly trawl and longlines. Some attempts to find new fishing grounds for seiners were also made but without success.

This was the situation when the Puretic power block became known in the early 1960's. In the beginning, the new device was met with scepticism, especially with regard to the very large seiners. But every doubt was overthrown when the first boats, equipped with the new gear, started to land large catches of herring from the North Sea in autumn 1964. These grounds which were new for Norwegian seiners soon provided herring and mackerel schools of high catchability and purse seining became again very profitable. By 1968, about 450 vessels were fitted for the new seining technique, representing a new investment of at least 725 million N. kroner (about U.S. $ 100 million) (Mietle 1969).

HISTORICAL REVIEW

According to Thor Iversen (1912), the purse seine technique was introduced in Norwegian waters at the beginning of this century. Norwegians learned the method from the Swedes, who had used purse seines in the Bohuslän fishery since early 1880's. The nets were of the American one-dory type with the fish bag located at one end. This system has later been used in various Norwegian coastal fisheries such as juvenile herring, sprat, cod, coalfish, mackerel and tuna. The boats were relatively small, up to 80 ft long, with pilot house and engine room situated in the stern. Most seiners carried the net on the aft deck, but a few boats operated it from the deck in front of the wheelhouse. The nets varied in size and construction according to the type of fishery. Those used for sprat and juvenile herring measured some 300 × 70 m, whereas the tuna nets could be up to 800 × 90 m.

The deck arrangement and operation of the nets was similar for various fisheries (Hamre 1963). The seiners carried a seine skiff, which was towed when searching for fish. Usually, the seiner was accompanied by a towing boat whose main task was to keep the seiner square with the shot net. When fishing on submerged fish schools, the seiners used bas-boats for directing the shooting of the net. The net was shot to starboard, often with full speed. For hauling in the net, the seiners used a long roller with mechanical drive. Winch power was used for drying up the fish, strapping in the bunt netting sectionally. The fish were brailed aboard except for large fish (tuna), which were hoisted in individually.

The one-dory seiners took part in various fisheries and only changed the nets according to the fish they were searching for. At the end of the 1950's, Norway had some 450 such seiners. The power block became of great importance to this fleet.

The largest catching power lay with big seiners equipped for the two-dory purse seining system. This system is also of American origin and became known to the Norwegian west coast fishermen at the same time as the one-dory net was introduced on the east coast. The first two-dory net was tried by the west coast steamer *Bremnes* under the herring fishery at Iceland during the summer of 1899. The method proved very successful, and purse seining for herring in Icelandic waters during summer became a very important fishery for fishermen from various countries (Iversen 1912). Norwegian steamers equipped for herring seining soon started to operate also in Norwegian waters, first in the winter herring fishery on the west coast, but later they expanded to fish juvenile herring and capelin on the north coast.

The power block

Schmidt (1959) has described the development of the Puretic power block and Jakobsson (1964) how it was adopted by Iceland. Jakobsson states that low catches of herring since 1944 forced the Icelandic fishermen to change from the two-dory, 18-man system, to a one-boat system using only 10–11 men. By the time the power block came, most Icelandic seiners had already changed to one dory. According to Jakobsson, main advantages of the power block were:

(a) saving time and labour in operating nets
(b) enabling fishermen to handle larger and deeper nets, and
(c) securing larger catches without assistance of other crews.

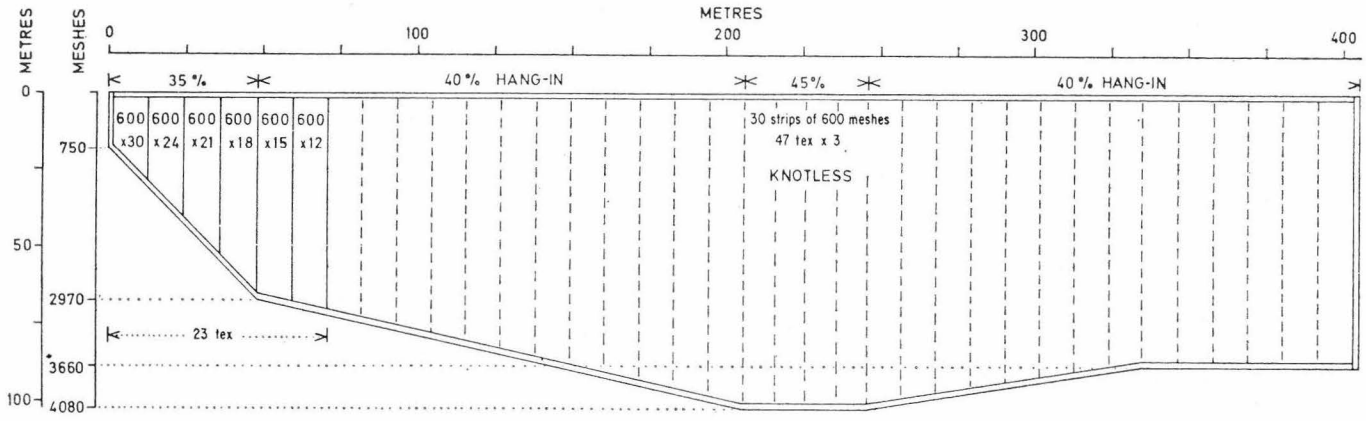

Fig 2. The first Norwegian herring purse seine for power block hauling. The net consisted of 36 vertical strips 600 mesh wide and had a 60 mesh wide selvedge strip of twine 23 tex × 30 around. Framing lines were Terylene. The hang-in along the leadline was about 10 per cent less than for the floatline. tex = 0.1111 × Td

The power block had the same effect for Norwegian small sized seiners. For big seiners, the new system led to a complete change in fishing tactics and it was these large boats which best could utilize the new system. The very serious economic situation due to low catches with traditional gear, gave boat owners no other choice but to try new fishing methods.

The breakthrough for the power block in Norway, resulted from developments in the Icelandic herring fishery. In 1961, Norwegian fishermen went to Iceland to study the technique developed by Mr. Haraldur Agustsson in which the net could be handled from the upper deck aft of the wheelhouse (Jakobsson, 1964). This arrangement met the requirements of the big seiners for carrying the net, because they had no free deck space aft of the bridge. The Icelandic net had also been adjusted to the new hauling technique. The hang-in had been lowered from 60 per cent to 40–45 per cent, which made the net more tight in the hauling direction and the bunt end was cut down in depth so that the fish could be dried up by help of the block only. Details of the first net, which was tried on board a Norwegian herring seiner in 1962, is shown in fig 2.

The new seining technique caused a revolution of the fisheries. In the course of 1963–64, most of the two-dory seiners were equipped with the new gear. The power block system had many advantages and purse seining became suddenly profitable, as new species and grounds could be exploited which previously had not been available to the old seiners. This lead in turn to investment in new and bigger boats, and increased size and efficiency of nets. The building up of the fleet was mainly based on the herring and mackerel stocks in Skagerak and the North Sea, but the new technique has also been of great importance for the herring and capelin fisheries of the north Norwegian coast. This last season (January–April 1970) the purse seiners caught some 900,000 t of capelin, and it is believed that the capelin stock may become the main natural source for large seiners in years to come.

THE VESSELS

As indicated, the Norwegian purse seining fleet may be divided into two groups according to the size of vessels and type of fisheries.

1. Vessels larger than 80 ft catching herring, capelin, mackerel, and polar cod in the open sea and coastal waters
2. Vessels less than 80 ft catching sprat, juvenile herring, coalfish and tuna in coastal and inshore waters.

In addition to the converted two-dory seiners, 130 new vessels of more than 80 ft were equipped with power blocks or similar net hauling devices in the period 1963–68 (Mietle, 1969). Of these, 70 were quite new vessels, 30 were converted whalers and 30 were former trawlers or transport ships. These new seiners were large ships, 120–190 ft with a loading capacity of 350–700 t. But the design of the new boats and the deck arrangement did not differ much from the converted two-dory seiners.

Up to the middle of the 1960's, it was generally believed that vessels smaller than 120 ft would best fit the new technique. Recent trends in development show that this idea has changed completely (Table 1), and even quite new vessels are now lengthened and their decks lifted, so

TABLE 1. NUMBER OF VESSELS ACCORDING TO SIZE AND TOTAL LOADING CAPACITY OF EACH SIZE GROUP IN 1000 T

	Size of vessel in tons	100 to 190	200 to 290	300 to 390	400 to 490	500 to 590	600 to 900	Total
1967	number	103	145	73	27	30	14	392
	capacity	15.5	36.3	25.6	12.2	16.5	10.5	116.4
1969	number	92	121	71	28	38	23	373
	capcity	13.8	30.2	24.9	12.7	20.9	17.3	119.7

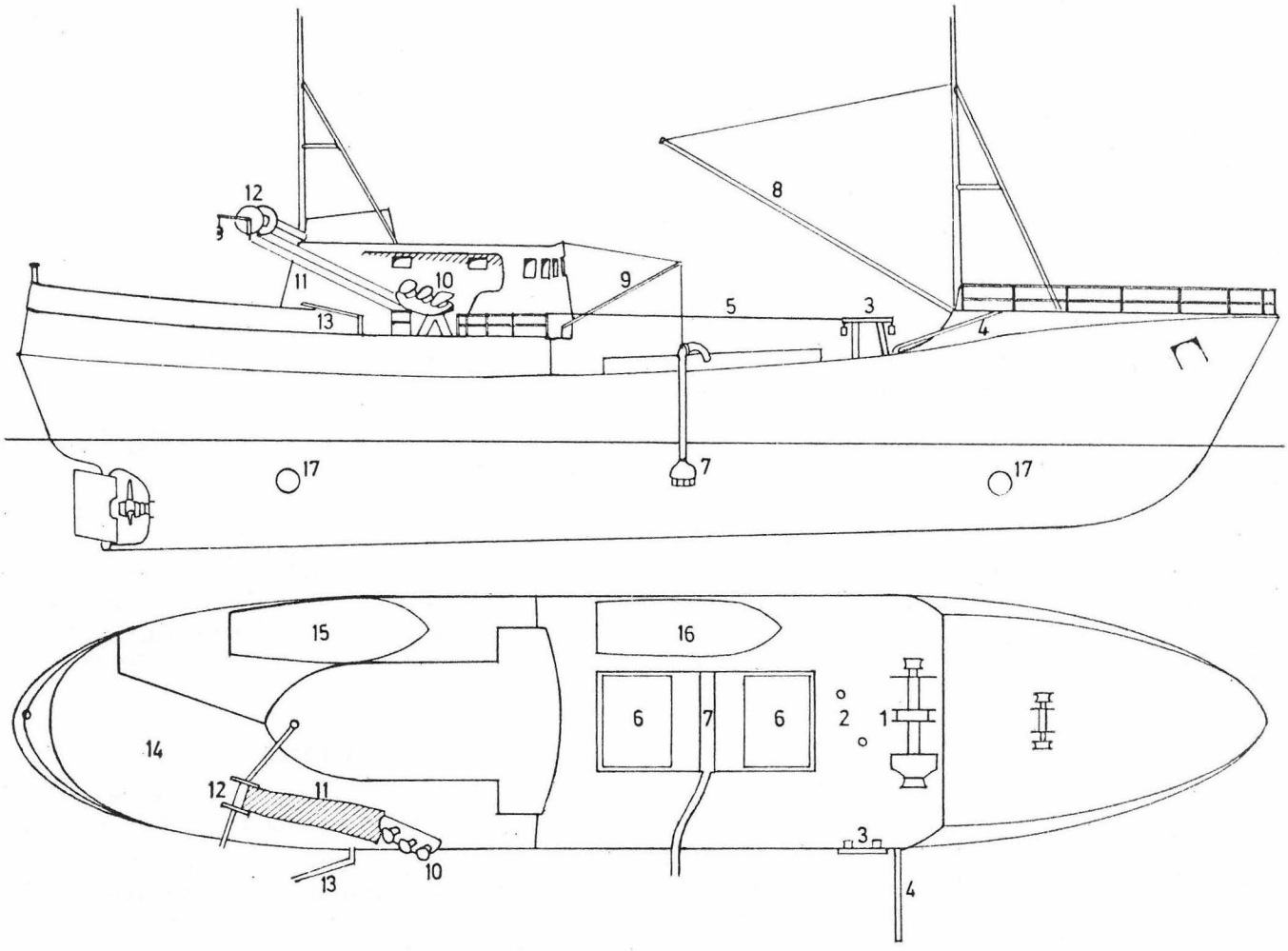

Fig 3. Typical Norwegian purse seine built in 1967. General particulars: LOA: 41.1 m; B: 8.23 m; T: 4.25 m; hold capacity: 400 t; fuel capacity 85 t; freshwater: evaporator and 9 t tank; main engine: 800 hp; auxiliary motors: 35 and 125 hp; speed: 12 kn; accommodation for 14 men

Key: 1. purse winch, 16 tonf; 2. block for purse line; 3. purse gallow; 4. breast boom; 5. ring wire; 6. fish hold; 7. fish pump and dewatering screen; 8. main boom; 9. boom for fish pump; 10. seine winch, 3 and 6 tonf at high and low speed respectively; 11. seine slide; 12. transport drum; 13. ring needle; 14. net bin; 15. towing boat, 22 ft, 100 hp; 16. bas boat, 20 ft, 30 hp; 17. transverse thrust propellers, 100 hp each

that their loading capacity may be increased by up to 30 per cent. The bulk of the catch has been prepared and stored for reduction purposes only. During 1968–69, some 50 seiners were, however, equipped with tanks in which the fish can be stored for human consumption (Mietle, 1969). In the tanks, the fish are kept in refrigerated sea-water—cooling either done by ice or by a combination of ice and cooling machinery. Due to the tendency of failure in availability of herring and mackerel, such tanks are now being installed in most boats.

Figure 3 shows a typical Norwegian purse seiner. The deck arrangement is similar to that described by Jakobsson (1964). The net is carried on the boat deck behind the wheelhouse while pursing and brailing are carried out on main deck. Some of the biggest vessels have two net bins and two nets both ready for shooting (fig 4). Smaller seiners may carry the net on the main deck at the stern. The crew consists of 9–12 men. They are accommodated in single and double cabins, have a large messroom and good sanitary conditions. These, of course, vary with size and age of the ship, but on an average the social standard has been greatly improved in recent years.

In the wheelhouse this standard equipment is found: Decca navigator, radar, radio direction finder, autopilot, radio-telephone, V.H.F. radio-telephone, walkie-talkie sets, sonar and echosounder. In addition, some seiners are equipped with Loran.

Vessels less than 80 ft

Small seiners previously operated their nets from the stern and were the first to adapt power blocks for hauling their nets.

Figure 5 shows a small Norwegian seiner. The net is carried on the main deck behind the wheelhouse and the technique used is similar to that of the large one (fig 3). However, the dimensions and capacities of the equipment are reduced according to the size of the vessel. Standard equipment in the wheelhouse is: Decca navigator, radar, radio direction finder, radio-telephone, walkie-talkie sets, sonar and echosounder.

The crew consists of 7–9 men and they are accommodated in two cabins, one fore and one aft.

Generally, catches of this fleet are for human consumption.

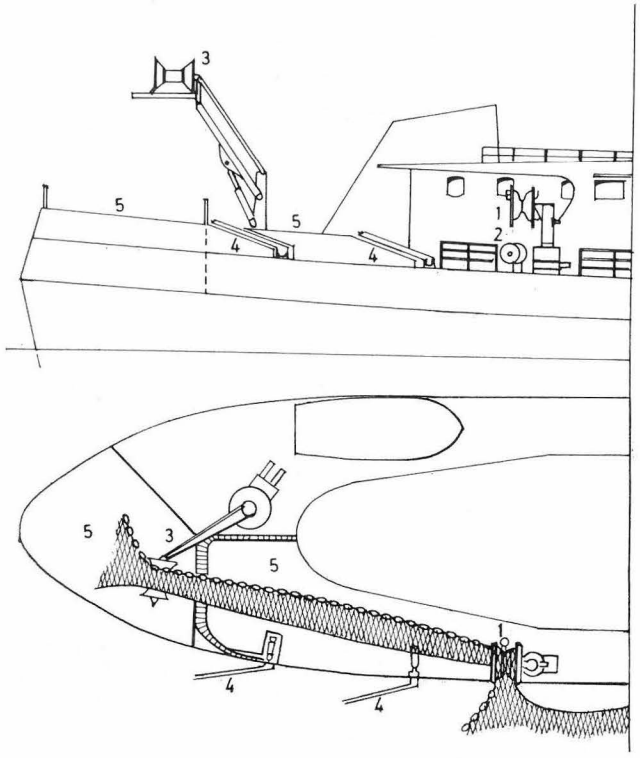

Fig 4. Net hauling arrangement. Key: 1. seine winch; 2. jockey drum; 3. transport drum and crane; 4. ring needles; 5. net bin

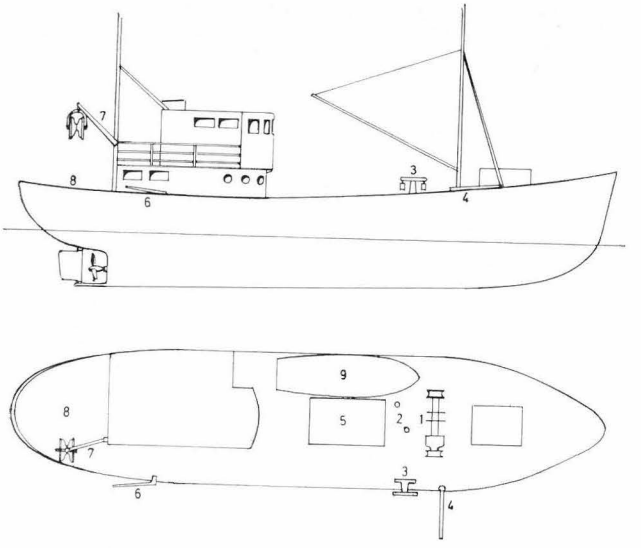

Fig 5. Small Norwegian seiner built in 1962. General particulars: LOA: 21.2 m; B: 5.2 m; T: 2.7 m; hold capacity: 80 t; fuel capacity: 6 t; main engine: 300 hp; auxiliary motor: 10 hp; speed 10 kn; accommodation for 10 men

Key: 1. purse winch, 4 tonf; 2. blocks for purse line; 3. purse gallow; 4. breast boom; 5. fish hold; 6. ring needle; 7. power block; 8. net bin; 9. bas boat, 18 ft, 30 hp.

THE NETS

With regard to tuna nets, reference is made to the paper by Hamre (1963). The net used for coalfish is of a similar construction, but has smaller meshes and much lighter twine in the fish bag. Although now handled by power block, these nets are not specially built for that purpose.

Nets in use for catching mackerel and herring, capelin and sprat are all designed for power block hauling. The shape of the nets and the rigging are similar for the various types, but the size of the net and the dimension of the netting differs according to which species is to be caught. As to details, the nets have no standardized construction, but differ according to the skipper's personal idea of how a net should be made. But a fisherman has a very limited knowledge of the behaviour of his net when shot, and the many but small individual differences in net rigging have probably no operational significance.

The details of net design in the following paragraph, do not refer to particular nets, but are average samples of net specifications collected from four Norwegian factories.

The herring-mackerel net

Details of this net are shown in fig 6. To give an idea of recent development in net design, two sketches of nets are given, one of nets made in 1964–65 (A), and one showing details of nets made in 1969 (B).

Nets made during the conversions period were similar to the Icelandic nets described by Jakobsson (1964), but slightly bigger. Nets made recently have the same shape and rigging, but the size of the gear has increased both in length and depth. But the most marked change occurs in the dimension of twine; the nets now being made are much heavier and stronger. It is natural that the larger seiners built recently require larger and stronger nets, but it is also a fact that most nets made before 1968 were too weak. Particularly for catching mackerel during winter and spring when the fish strongly resist being forced up into cold surface water. Thousands of tons of mackerel have been lost because of light netting used in many nets made during 1964–67.

The netting is hung to the corkline with a hang-in ratio ranging from 35 per cent in the bunt end to some 50 per cent in the centre. The hang-in to the leadline is some 10 per cent less, which makes the leadline correspondingly longer. Plastic floats with a central hole are used instead of cork, and lead pieces fitted to a terylene rope are used as sinkers. The lead weight of the nets, made in 1965, were some 4 kg/m leadline, whereas this weight now is increased some 6 kg/m. The purse rings are made of brass or stainless steel, weighing 4 kg or 6 kg.

Skirts are used in some nets, but dimension and shape may vary. In large nets the skirt is made up to 300 meshes deep, 62.8 mm bar mesh size, twine size 23 tex $\times$ 60. The skirt usually covers half of the central portion of the net. At the wing end, the nets are prolonged by a triangular piece of netting to which the edge rope is attached. This netting is made of relatively big meshes (50 mm bar) and thick twine (23 tex $\times$ 90), and its function is to obtain a well-balanced pull on floatline and leadline when hauling in the edge rope.

In some of the first nets made for power block hauling, knotless netting was used in central portions of net. Knotted netting is, however, predominating in this type of net.

The sprat and capelin nets

Sketches of these typical nets are shown in fig 7. These are very similar in size and rigging, but the capelin net is some-

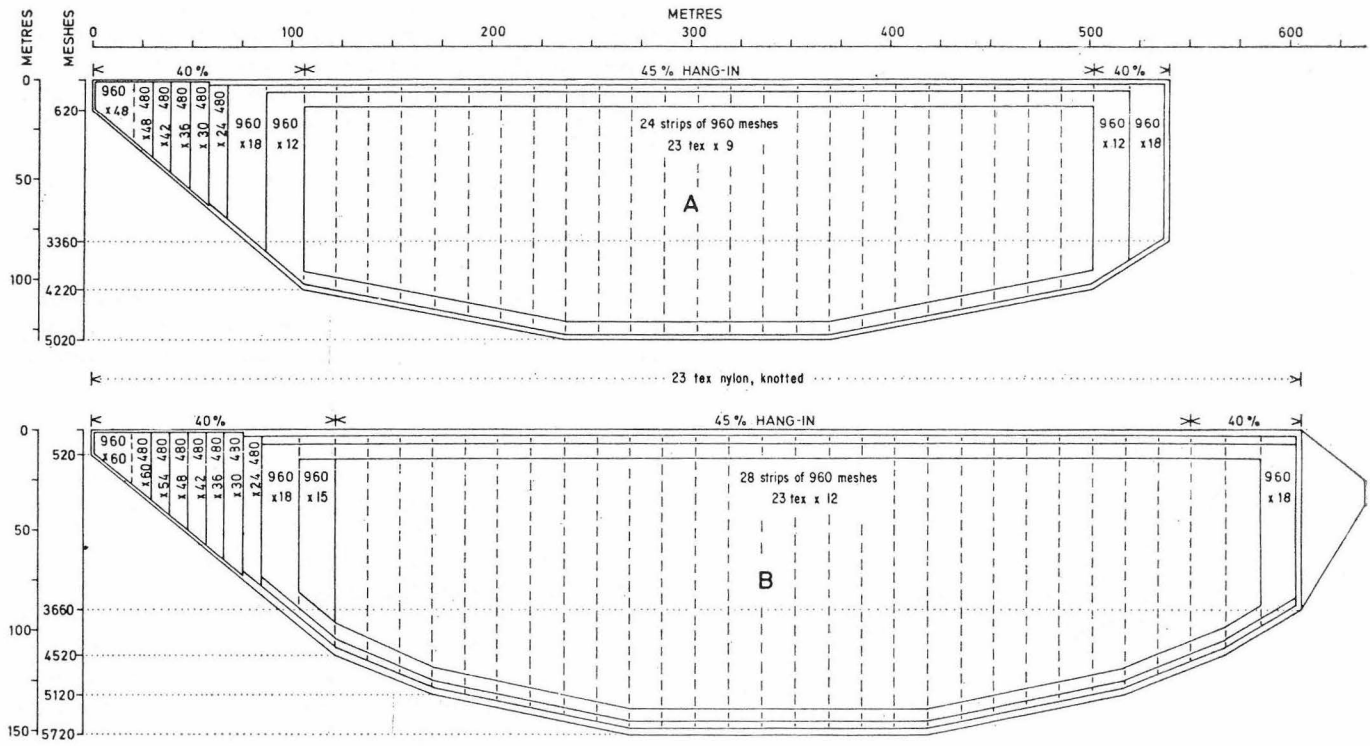

Fig 6. Typical Norwegian herring and mackerel purse seines from 1965 (A) and 1970 (B). The nets are made up of vertical strips of 960 meshes each, and have a 60 mesh wide selvedge strip of twine 23 tex × 72 around, which is gradually reduced in strength inwards to twine 23 tex × 30. The vertical strips are strengthened at the ends as follows: (A) 100 meshes of 23 tex × 18 at the top and 200 meshes of 23 tex × 12 at both ends. (B) 100 meshes of 23 tex × 24 and 200 meshes of 23 × 18 at both ends. The mesh size is 15.7 mm bar except for the strips of twine thicker than 23 tex × 24. Here slightly bigger meshes are used (16.5 mm and 17.4 mm bar). All netting is made of knotted nylon twine, 23 tex. tex = 0.1111 × Td

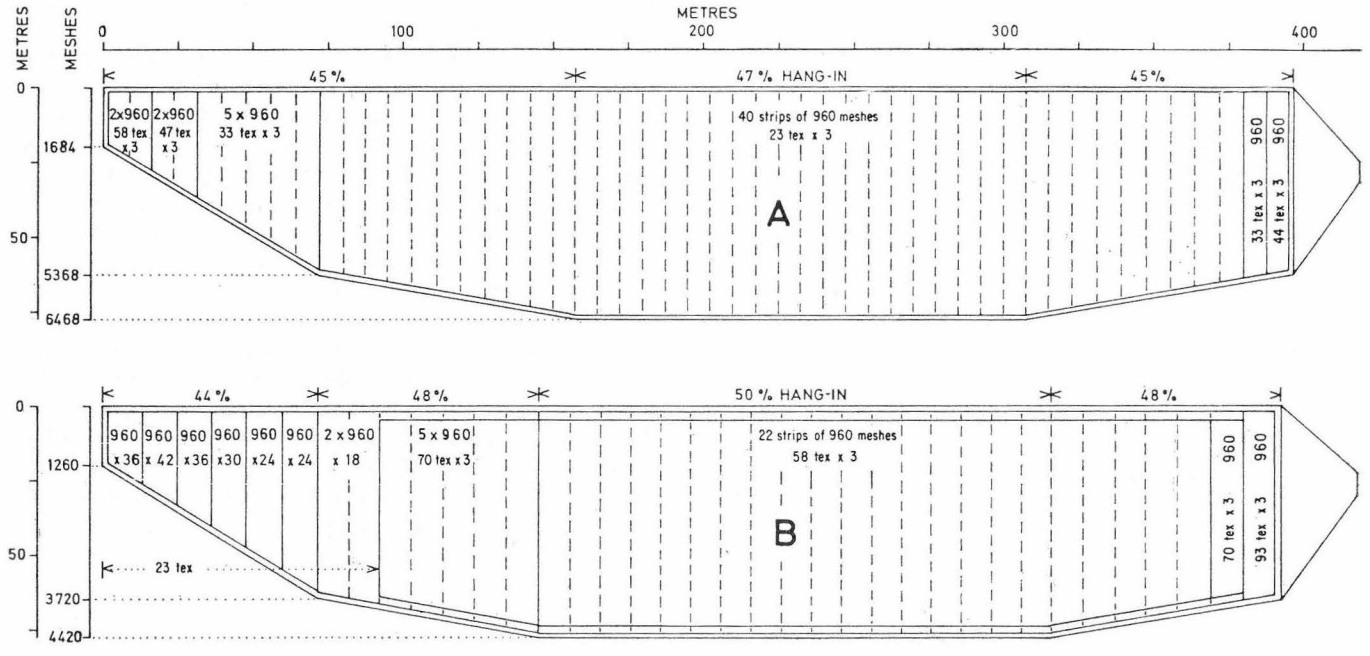

Fig 7. Norwegian sprat (A) and capelin (B) purse seines for power block hauling. The sprat net consists of 51 strips of 960 meshes each and has an 84 mesh wide selvedge strip of twine 93 tex × 3. The whole net is made of knotless netting of 7.4 mm bar. The netting is hung to double Terylene ropes and the hang-in on the leadline is some 10 per cent less than on the corkline. The net has 1,100 kg lead and 32 purse rings of 4 kg each. The capelin net is made up of 37 strips of 960 meshes each, and has a 60 mesh wide selvedge strip of twine 23 tex × 60 decreasing to 23 tex × 24. The vertical strips of the wings are strengthened at both ends by 200 meshes, twine 23 tex × 18. The mesh size is 9.8 mm bar (10.1 mm in the bag). The net is hung similar to the sprat net. It has 1,600 kg lead and 32 purse rings of 4 kg each. tex = 0.1111 × Td

what heavier. The latter is built for use on large seiners and is supposed to handle much bigger catches. The capelin net has not been made bigger according to the increased size of the seiners as was the case for herring and mackerel nets. This is due, most likely, to the fact that capelin fishery often takes place in very shallow water close to the coast. With the exception of the bunt end and selvedges, these nets are normally made of knotless netting.

THE OPERATION

Jakobsson (1964) has described in detail how the Icelandic fishermen handle their nets made for power block hauling. The same system is used by the Norwegians, and slight differences of tactics are no doubt of minor importance. Only some few relevant things which may be specific for Norwegian seiners will be mentioned.

Sonar guided shooting, as described by Jakobsson (1964), is used, but experience has shown that the chances of a successful shot are improved by the use of a bas-boat to locate the top of the school. Bas-boat guided shooting is therefore preferred.

A recent device for keeping the purse line square with the net under the shooting operation is a movable ring needle. This can be moved 1.5 to 2.0 m out from the shipside reducing the risk of getting netting entangled on the purse line.

Specially-made purse winches with capacities up to 20 tons f are now installed on board most modern seiners. They are on the port side opposite the gallow and on a platform so that the wire can run directly to the gallow blocks. To shoot and purse a 600 m net takes about 20 min. When shooting on very deep schools, the pursing operation may be prolonged some minutes to leave time for the net to sink.

Various kinds of hydraulic net hauling systems are used. Three of these are shown in figs 3, 4 and 5. The capacities of these systems vary within a wide range, but large purse seiners use mainly net winches or power blocks with a capacity of 4–6 ton f. The hauling of a 600 m net takes 35–50 min.

During hauling, the vessel is kept square with the net, either by use of a towing boat or thrust propellers. Quite a number of the larger seiners have got thrust propellers of 100–150 hp both fore and aft.

Brailing

Mechanical hauling in of the net is continued until the catch is dry enough for brailing. Brailing is now mostly carried out with fish pumps. If the fish are heavy to dry, pumping is started as soon as possible in order to avoid net-breaking. In the most difficult cases, pump tubes of up to 30 m in length may be used. To prevent the seiner from capsizing when drying-up a heavy catch, a specially-made netholder is mounted to the starboard rail. By this invention, the bag can be untied within a few seconds if necessary for the safety of the vessel.

TRENDS OF FUTURE DEVELOPMENT

Returning to figure 1, the catch curves indicate decreasing herring and mackerel catches, but a yearly improvement in the yield from capelin. In the former species, the curves reflect decreasing stock size due to high exploitation by the purse seine fleet. To prevent further overfishing of these stocks, extensive regulation measures on the Norwegian herring and mackerel fisheries were brought into force from the 1 May this year (1970). The new law prescribes considerably lower catches of these species.

The future prospects of the capelin fishery are, on the other hand, more optimistic, especially after the last season's record catch of some 900,000 t. This general situation in the natural resources has been the guide line for recent fleet development. The boat owners now regard the capelin fishery as the main basis for fishery management at least for the next few years. In this fishery, transport of the catch from the fishing ground to the factories is extraordinarily time consuming. As compensation, the boats receive a price per ton of fish according to distance of transport.

This favours, to a very large extent, the seiners with high loading capacity. The tendency of increasing tonnage by lengthening the hull and lifting the main deck which, discernable last year, is believed to be more pronounced in 1970 (Table 1). As the existing capacity of the purse seine fleet is considered too large for profitable management (Mietle, 1969), a large number of less-profitable seiners has to be removed from the fleet so the fleet may soon be reduced drastically in number, unless other use can be found. This reduction will take place in the group of smaller boats mainly, and the Norwegian purse seine fleet may within some few years consist of a relatively small number of seiners with large loading capacity and highly-specialized in fishing for industrial purposes.

References

DRAGESUND, O 1970 Factors influencing year-class strength of Norwegian spring spawning herring. *Fisk Dir. Skr. Ser. HavUnders.*, 15:381–450.

HAMRE, J 1963 Some technological aspects of the Norwegian tuna purse seining fishery. *FiskDir. Skr. Ser. HavUnders., 13:* 106–119.

IVERSEN, T 1912 Snurpenotsaken. *Årsberetn. Norg. Fisk.*

JAKOBSSON, J 1964 Recent developments in Icelandic herring purse seining. pp. 294–305 in *Modern fishing gear of the world 2.* Fishing News (Books) Ltd., London.

MIETLE, P L 1969 Development and investments in recent years in Norwegian purse seine fisheries for herring, capelin and mackerel. *International conference on investment in fisheries. FAO, Rome, 1969 (Bp/43):* 1–21.

SCHMIDT, P G 1959 The Puretic power block and its effect on modern purse seining. pp. 400–413 in *Modern fishing gear of the world.* Fishing News (Books) Ltd., London.

VESTNES, G 1970 Review of present status of sonar equipment and its application. *Technical conference on fish finding, purse seining and aimed trawling, FAO, Reykjavik, 1970.* (See p. 123 ff.)