FISHERIES DEPARTMENT
WESTERN AUSTRALIA

MONTHLY SERVICE BULLETIN

Vol. VIII, No. 2. February, 1959

STAFF NOTES

Commencing February 9 the Superintendent (Mr. A.J. Fraser), as Chairman of the Fishermen's Advisory Committee, accompanied by members and the acting Secretary, will visit the Mandurah and Bunbury districts where meetings will be held with the respective fishermen's associations. On February 16, in company with the members and secretary of the Rottnest Biological Station Committee, he will visit Rottnest Island for a meeting of the committee. During two or three days on the Island work in hand at the Station will be inspected.

Inspector R.J. Baird will leave Perth on February 14 for Broome after biennial leave. Inspector B.A. Carmichael is relieving at Broome and Inspector J. Traynor at Albany.

Inspector G.H. Lyon resumed duty after annual leave on January 19. At the moment he is on special crayfish patrol work in coastal areas with Assistant Inspector C.J. Seabrook.

Assistant Inspector S. LaRoche is still stationed at Lancelin.

Cadet Inspectors D. Smith and J. Kelly are at present assisting the Fleet Maintenance Officer (Mr. A.J. Bateman) at Fremantle.

Inspector S. Stokoe and Cadet Inspector E. Barker are patrolling the Abrolhos area in p.v. "Kooruldhoo".

Assistant Inspector E.I. Forster and Cadet Inspector R. Emery are stationed on the p.v. "Silver Gull" in the Jurien Bay area.

The p.v. "Misty Isle" is operating from Fremantle with Inspector H.D. Kavanagh and Cadet Inspector G. Hanley on board.

Congratulations and good wishes are extended to Mr. W.K. Cherrington, of Head Office, and Mrs. Cherrington, on the birth of their second daughter, Susan Peta, on January 24.

Other officers resuming duty after annual and accumulated leave include Mr. C.R.C. Haynes, mate, r.v. "Lancelin", and Assistant Inspector R.J. McKay on January 19, and Captain H.C.W. Piesse on January 29. Mr. McKay is at present acting as Technical Officer. Technical Officer J. Simpson is duck banding in the metropolitan area.

Mr. C.R.C. Haynes entered hospital on January 26 to undergo minor surgery to his arm. Satisfactory progress has been reported.

Inspector R.M. Crawford, of Geraldton, who is on long service leave, recently visited Sydney with Mr. R.M. Saunier, who has purchased a 120-foot ex-navy vessel for crayfishing on this coast. Mr. Crawford is returning in the vessel, which is expected to reach Fremantle on February 5.

PERSONAL PARS

Mr. H. Ito, First Secretary of the Japanese Embassy, Canberra, called on the Minister for Fisheries (Mr. Kelly) and the Superintendent on January 13. The following day he left for Broome to investigate conditions pertaining to his nationals engaged in the pearling industry. On January 20 he left Broome for Darwin. While at Broome he had discussions with Inspector B.A. Carmichael.

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We have been advised that Dr. Mary Gillham, lecturer in botany at the University of Exeter, has been delayed in her visit to this State. Our latest advice is that she will not reach Western Australia until August, 1959.

CRAYFISHING IN "AUSTRALIAN WATERS"

On January 15, a notice was published in the Commonwealth Gazette declaring a close season for crayfish from August 16 to March 14 in each year in the whole of the Abrolhos area. It was further declared that a minimum legal length for crayfish of $2\frac{3}{4}$" carapace measurement be applied. This has the effect of bringing crayfishing restrictions in extra-territorial waters very largely into line with those already in existence in Western Australian waters. We understand that further measures designed to close legal loopholes which permitted certain vessels to operate last season are imminent.

A notice also appeared bringing "Australian waters" between parallels 30° and 33°S. into line with "Western Australian waters".

COMMONWEALTH LICENSES

The attention of all officers is drawn to a memorandum received from the Director, Fisheries Division, Department of Primary Industry, Canberra (Mr. F.F. Anderson).

Mr. Anderson suggests that in the case of the renewal of licenses for which applications are received towards the end of November, the applications should be held until December, when licenses valid to December 31 of the following year may legally be issued. In no case should a license be post-dated or issued in November as if it were December.

In the case of a first license, <u>not a renewal</u>, the applicant should be advised that he is required to take a second license for the following year. It has been the practice in some States, but so far not in W.A., for officers to issue licenses in late November marking them valid to December 31 of the following year. This is contrary to the Commonwealth law.

MARINE MAMMALS AND FAUNA PROTECTION

A legal opinion has been obtained from the Crown Law Department regarding the interpretation of fauna as applied to such birds and animals as penguins, albatrosses, turtles, dugongs, seals and dolphins, which are normally found at sea, either for the whole or part of their lifetimes. It will be remembered that the definition of fauna specifically includes birds and reptiles. It seems therefore that as both seals and dugongs for example, are ordinarily to be found in parts of the State such as sandy beaches and resorts used for breeding purposes, they are fauna within the meaning of the Fauna Protection Act. Dolphins, which are always found in the water and are indigenous to no part or parts of the State but to the high seas, cannot be classified as fauna within the meaning of that Act. They are strictly "fish" in terms of the Fisheries Act.

LUCKY BAND DUCK SCHEME

Through the co-operation of Imperial Chemical Industries of Australia and New Zealand Limited, Western Australia this year is participating in the "Lucky Band Scheme" in regard to duck tag recoveries. The scheme was introduced in Victoria in 1958 and proved so successful that it is being repeated this year.

Fifty band numbers have been chosen and lodged in safe custody. The envelope containing the lucky numbers will be opened on April 30, and all persons who have sent in one of the numbered bands will receive from ICI a case of cartridges of their own choosing.

As the number of bands returned over the past few years has totalled only about 300, and 30 have been returned in the first month since the scheme started this year, there is no doubt of the interest brought about by the introduction of this scheme.

Any bands recovered should be forwarded immediately prior to the close of the season on April 30, together with the following details - the exact location of recovery, date of recovery, and recoverer's name and address.

Scorecards and post-free envelopes are available at Head Office, and any enquiries should be referred here.

GAME LICENSES

We have been notified by the Director of Fisheries and Game, Melbourne, that a game license at a fee of £1 has been introduced into Victoria. Initially, this license will apply to ducks only. This license will come into operation before the next duck open shooting season in that State, which commences on February 21.

HOUSING OF GOVERNMENT EMPLOYEES

The Government recently formed a committee to determine the districts in which houses for Government employees would be erected, the conditions of tenancy, and any matters generally applying to the leasing of such. We have now been advised that allocations have been completed for this financial year, and that this Department has not been granted any allocation.

GIANT PETRELS

On pages 24 - 29 are listed the recoveries of giant petrels ringed as nestlings at Signy Islands in the South Orkneys by the Falkland Island Dependencies Scientific Bureau in 1958. It will be observed that many of these birds, which make a circumpolar flight during their first year, were recovered in Western Australia as well as other parts of the Commonwealth.

LABOUR DAY PROCESSION

This Department will once again be taking part in the Labour Day procession on March 2, with a float publicising the fishing industry. Arrangements are in the hands of Mr. A.J. Buchanan and Acting Supervising Inspector J.E. Munro.

RECOVERIES OF GIANT PETRELS RINGED AS NESTLINGS
IN 1958 AT SIGNY ISLAND, SOUTH ORKNEYS, BY THE F.I.D.S.

Ring No.	Banding Station	Date Ringed	Date Recovered	Condition of Bird	Location of Recovery
54442	F.I.D.S. Base 'H' Signy Island	1.3.58	24.5.58	Alive and released	Lat. 34°39'S. Long. 18°07'E. South Africa.
54901	"	29.3.58	25.5.58	Alive and released. Ring removed.	Slangkop, between Cape Point and Cape Town, South Africa.
55042	"	29.3.58	26.5.58	Alive	Elands Bay, Cape Westem Coast, South Africa.
54576	"	11.3.58	26.5.58	Alive	do.
54824	"	29.3.58	4.6.58	Killed	Lat. 32°30'S. Long. 16°20'E. South Africa.
54737	"	27.3.58	7.6.58	?	Cape Columbine, 110 miles N. of Cape Town, South Africa.
54720	"	27.3.58	7.6.58	Alive and released. Ring removed.	Off Coast of Dirk Hartog Island, Western Australia.
55258	"	2.4.58	9.6.58	Dead	Hout Bay, 14 miles S. of Cape Town, South Africa.

Ring No.	Banding Station	Date Ringed	Date Recovered	Condition of Bird	Location of Recovery
54227	F.I.D.S. Base 'H' Signy Island.	27.2.58	10.6.58	Alive and released. Ring removed.	King George Sound, Albany, Western Australia.
54863	"	29.3.58	June	Alive	At sea in Port Nolloth area, S. Africa.
54109	"	25.2.58	15.6.58	Alive (weak condition) died.	Los Angeles Court, St. Kilda, Victoria, Australia.
54268	"	10.3.58	18.6.58	Alive	Lat. 32°40'S. Long. 16°53'E. S. Africa.
54035	"	25.2.58	22.6.58	Alive and released.	Off Port Edward, Natal, S. Africa.
54906	"	29.3.58	Late June	Alive and released. Ring removed.	75 miles NW of Cape Columbine, S. Africa.
54717	"	27.3.58	Late June	Alive and released.	Later captured 29.7.58 Lat. 33°30'S. Long. 17°20'E.
54886	"	29.3.58	27.6.58	?	Esperance, W. Australia.
53986	"	25.2.58	27.6.58	Alive and released. Ring removed.	Turtle Bay, Dirk Hartog Island, W. Australia.

Ring No.	Banding Station	Date Ringed	Date Recovered	Condition of Bird	Location of Recovery
54373	F.I.D.S. Base 'H' Signy Island	10.3.58	Probably June/July	Alive and released. Ring removed.	"At sea", probably near E. London, S. Africa.
54701	"	27.3.58	27.6.58	Alive & released.	Burnie, Tasmania, Australia.
54961	"	29.3.58	30.6.58	Killed.	Off E. London, S. Africa.
54744	"	27.3.58	29.6.58	Dead.	Ohau Beach, North Island, New Zealand.
54836	"	29.3.58	1.7.58	Alive & released.	Laura Bay, S. Australia. Later captured (probably August) Streaky Bay, S. Australia.
54435	"	10.3.58	1.7.58	Alive & released.	Busselton, S.W. Australia.
53924	"	24.2.58	2.7.58	Alive.	Laura Bay, S. Australia.
54531	"	11.3.58	2.7.58	Alive, later died.	Waterman's Bay, nr. Fremantle, W. Australia.
54759	"	29.3.58	6.7.58	Alive & released.	Cape Moreton, Moreton Bay, Brisbane, Queensland.
55096	"	29.3.58	6.7.58	Alive & released. Ring removed.	14 miles E. of Coff's Harbour, N.S.W. Australia.

Ring No.	Banding Station	Date Ringed	Date Recovered	Condition of Bird	Location of Recovery
54798	F.I.D.S. Base 'H' Signy Island	27.3.58	7.7.58	Dead.	Turtle Bay, Dirk Hartog Island, W. Australia.
55085	"	29.3.58	8.7.58	Alive & released. Ring removed.	Ponta Zavora area, Inhambane, Portuguese E. Africa.
53993	"	25.2.58	9.7.58	Dead.	Semisika, Vangaindrano, E. coast of Madagascar.
54577	"	11.3.58	17.7.58	Alive & released.	20 miles W. of Slangkop, S. Africa, Lat. 34°17'30"S. Long. 17°57'0"E.
54715	"	27.3.58	17.7.58	Alive & released.	Baird's Bay, 30 miles from Streaky Bay, S. Australia.
54788	"	27.3.58	17.7.58	Killed.	Benguela, Angola, Portuguese W. Africa.
55060	"	29.3.58	19.7.58	Dead.	Long Beach, Guicken Bay, SE coast of S. Australia.
52543	"	19.2.57	19.7.58	Alive & released. Weak condition.	5 miles NE of Eden, Twofold Bay, NSW, Australia.
54673	"	11.2.57	mid-July	Alive & released.	120 miles SE of Port Lincoln, S. Australia.

Ring No.	Banding Station	Date Ringed	Date Recovered	Condition of Bird	Location of Recovery
54649	F.I.D.S. Base 'H' Signy Island	27.3.58	23.7.58	Alive & Released. Ring removed.	14 miles ENE of Coff's Harbour, NSW, Australia.
54629	"	11.3.58	26.7.58	Dead.	Fraser Island, Queensland, Australia.
55122	"	2.4.58	27.7.58	Exhausted, died.	28 miles S of Mandurah, nr. Coolup, W. Australia.
54717	"	27.3.58	29.7.58	Alive & released.	Lat. 33°30'S. Long. 17°20'E. S. Africa. (Previously captured late June, 75 miles NW from Cape Columbine, S. Africa)
54836	"	29.3.58	Probably early August.	Exhausted and released.	Streaky Bay, S. Australia, (Previously captured Laura Bay, S. Australia, 1.7.58).
54774	"	27.3.58	16.8.58	Dead.	S. Pambula (300 miles S. of Sydney), NSW, Australia.
54153	"	26.2.58	19.8.58	Alive & Released.	Tory Channel, Whaling Station, New Zealand. Lat. 41°12'S. Long. 174°19'E.
55267	"	2.4.58	Probably August	Dead.	Abrolhos Islands, W. Australia.

Ring No.	Banding Station	Date Ringed	Date Recovered	Condition of Bird	Location of Recovery
54053	F.I.D.S. Base 'H' Signy Island	25.2.58	approx. 23.8.58	Dead.	15 miles north of Carnarvon, W. Australia.
54096	"	25.2.58	24.8.58	Dead	Nuhaku, Hawke's Bay, North Island, New Zealand.
54987	"	29.3.58	26.8.58	Alive and released.	Tory Chanel Whaling Station, New Zealand, Lat. 41°12'S, Long. 174°19'E.
54999	"	29.3.58	5.9.58	Alive and released. Ring removed.	Mossel Bay, S. Africa.
55277	"	2.4.58	15.9.58	Alive, died later.	Riverdale, SE coast, North Island, New Zealand. Lat. 41°09'S. Long. 176°02'E.
54997	"	29.3.58	24.9.58	Killed.	45 miles SE of Cape Willoughby, Kangaroo Island, S. Australia.
54532	"	11.3.58	Probably Sep.'58	Alive and released. Ring removed.	5 miles from Port Nolloth, Namaqualand, S. Africa.
54338	"	10.3.58	9.10.58	Dead.	Waipu, Whangarei, New Zealand.
55189	"	2.4.58	19.10.58	Alive and released. Ring removed.	Durban, S. Africa.

CRAYFISH EXPORTS

Hereunder are the details of exports of crayfish tails and whole crayfish from Western Australia for the last six years, viz., 1952-1958.

Year	Frozen Crayfish Tails lb.	Frozen Whole Crayfish lb.	Total Weight lb.
1952	2,746,043	24,036	2,770,079
1953	2,855,553	55,780	2,911,333
1954	3,280,235	27,118	3,307,353
1955	4,274,975	172,043	4,447,018
1956	3,170,790	41,805	3,212,595
1957	4,078,510	117,440	4,195,950
1958	4,565,735	453,368	5,019,103

From the table it can easily be seen that 1958 was a record year, with a production of over 13 million lb. It is also evident that whole cooked crayfish are becoming popular outside this State. This year production has risen by nearly 300% since the earlier record figure of 1955.

MANDURAH FISHPOT

Through the co-operation of Ampol Pty. Ltd., and the Mandurah Businessmen's Association, Mandurah is once again conducting a Fishpot competition. Though the prizes have been very attractive, and the crowds great in numbers, the fish have not proved at all co-operative and they at times have been scarce. The prize for taking the tagged fish is £7,500. The tagging will be done by Technical Officer L.G. Smith.

BOTULISM

The first report of botulism for 1959 has been recorded. Technical Officer J. Simpson reported on an extensive outbreak at Lake Karrinyup, affecting all kinds of water life, including cranes.

PRAWNS

Lively interest is now being evinced in Western Australia in the Department's search for prawn fisheries and the possibility of exporting these crustaceans. It will be remembered that references have been made in this Bulletin to the consideration which has been given to removing prawns from the Schedule of Minimum Legal Lengths in New South Wales. In fact their removal was reported last month.

A letter has now been received from the Superintendent of Fisheries in N.S.W. (Mr. N.V. Harris) setting forth in detail the reasons for the new policy. As the staff will undoubtedly be interested, Mr. Harris' letter is quoted in its entirety -

Dear Mr. Fraser,

The Marine Biologist of this Department, Dr. A.A. Racek, has recently completed a detailed study of the prawn fisheries of eastern Australia with particular reference to the fisheries of New South Wales. His final report on this investigation is now in the hands of the Government Printer and arrangements will be made to supply copies as soon as they are available.

Two recommendations varying prawn fishing controls in New South Wales made by Dr. Racek on the basis of his investigations have been approved by the Chief Secretary for adoption from 1st May, 1959. These amendments are :-

(1) The abolition of the present legal minimum length provided for prawns. After 1st May, 1959, fishermen will be legally entitled to be in possession of and consign for sale prawns of any size.

(2) To increase the mesh size of prawn trawl nets from the present $1\frac{1}{4}$ inch minimum to a new minimum of $1\frac{1}{2}$ inches. No variation has been made in the mesh size of prawn haul nets or set pocket nets, but it is proposed that these nets be the subject of some further investigation by the Biologist with a view to determining whether any variation in size is required.

Briefly, Dr. Racek's investigations have shown that the present legal minimum length of prawns is not serving any conservational purpose for the main commercial species. Size limitations were originally introduced in this State at a time when prawns were captured solely in estuarine waters and all species present were then believed to be immature below a mean body length of $3\frac{1}{2}$ inches to 4 inches. The investigations have shown that except for both species of inshore greasy back prawns and perhaps the male of the shool prawn, all other species are still immature far above the present legal minimum length. Dr. Racek has commented "that the size limit of $3\frac{1}{2}$ inches is particularly ill chosen as it is just above the body length of the majority of greasy backs. Some species of prawns occurring in abundance in ocean waters mature just below $3\frac{1}{2}$ inches and therefore cannot be utilised at all. Modern research has also exploded the old belief that every prawn must have the opportunity of spawning at least once before being killed."

The fishing trials carried out by Dr. Racek have clearly established that the vast majority of undersize prawns landed on the deck failed to survive, even if returned to the water immediately. The pressure during the lifting of the net mainly caused the injury leading to mortality. From the tests carried out, it is clear to Dr. Racek that the minimum mesh size of $1\frac{1}{4}$ inch for a prawn trawl net is too small for proper size selection during fishing operations.

In order to overcome any difficulties which might arise from the market being flooded with large quantities of very small prawns, fishermen have been requested to grade their catch into three sizes and from 1st May, 1959, the Market Authorities will sell prawns according to their grade. The grades proposed are :-

Large (over $4\frac{1}{2}$ inches)
Medium ($3\frac{1}{2}$ to $4\frac{1}{2}$ inches) and
Small (under $3\frac{1}{2}$ inches).

Yours faithfully,

N.V. HARRIS,

Superintendent of Fisheries.

January 28, 1959.

HUMPBACK WHALING - 1958

STATION	WHALES TAKEN				AVERAGE LENGTH		PRODUCTION				
							Oil				
	Males	Females	Total	%age of Males in Total	Males	Females	Total	Per Whale	Per Whale-foot	Meal etc.	Solubles
					ft.	ft.	barrels	barrels	barrels	tons	tons
Carnarvon	473	412	885	53.35	39.48	41.2	45,044*	50.6*	1.23*	2,729*	1,968*
Albany	36	46	82	45.12	37.6	39.6	3,841	46.84	1.2	148	-
TOTALS	509	458	967	52.36	39.34	41.15	48,885	50.3	1.26	2,877	1,968

* Includes two blue whales and three bryde whales.

WHALING PRODUCTION

Humpback whaling figures for 1958 are published on page 33. Neither Station obtained its full quota for the season, due mainly to the weather conditions experienced this year. Although there was a slight decrease in the average length of the whales, the production per whale was maintained.

STAFF INJURIES AND WORKERS' COMPENSATION

We would like to stress again that any member of the staff who receives any accidental injury when on duty must report the facts immediately. It does not matter whether as a result of the accident an officer remains on duty or not, the injury must be reported straight away. If this is not done, a subsequent claim for workers' compensation may quite conceivably be rejected, and there would be no redress.

GERALDTON-ABROLHOS ISLANDS

The Minister for Fisheries (Mr. L.F. Kelly) has approved of the following recommendations in relation to the Geraldton-Abrolhos Islands crayfish fishery :-

(1) The open season for the taking of crayfish at the Abrolhos Islands be the same as the previous season, that is from March 15 to August 15, 1959.

(2) That fishermen be permitted to operate in the waters lying west of the Abrolhos Islands.

(3) During the 1959 crayfish season, no fisherman who operates in the Abrolhos Islands area be permitted, during the whole of the Abrolhos season, to engage in the taking of crayfish elsewhere.

(4) No crayfish pots may be set or baited in the Abrolhos waters prior to March 14, 1959.

THE CLEARING HOUSE

Sustenance from the Sea

by F.G. Walton Smith, Director, The
Marine Laboratory, University of Miami.

(A Paper presented at the Energy Resources Conference, Denver, Colorado, U.S.A., October 15, 1958.)

The energy used by the human race goes to run our machines, to provide light, winter heat and summer coolness in our homes and to transport both materials and people over increasingly large distances at increasingly high speeds. But the one indispensable form of energy without which we could not even exist is the energy required to run the human machine, our food. The statement has been made that the land is not able to provide food in adequate quantity, even for our present population, and some have pointed to the sea as the great new frontier to which we may look for a bountiful harvest of plenty.

The ocean, potentially, has a capacity for providing nearly ten times as much food as the land could possibly grow under the most favourable conditions. It occupies 71% of the earth's surface and is over 2 miles deep, on an average. In spite of this, the total harvest of all kinds of food from the sea today, including fish, shellfish and even edible seaweed, is only about 27 million tons annually, or about half of the world's consumption of beef, or one-thirtieth of the total food production of the land.

There have been other conflicting statements. In the U.S.A., farmers have been rewarded for <u>not</u> growing crops and penalised for growing too much food. The taxpayer pays the bill. But he also pays the bill for attempts in this country and part of the bill for attempts of the United Nations to develop increased supplies of food for our planet. He reads articles in which the sea is regarded as a great untapped source of food, but meanwhile hears reports of the rapidly declining production of a New England fishery.

In the face of such apparent contradictions, it would be well to inquire whether there is any real likelihood of the land being inadequate to supply us with food today or in the future and whether there is any truth in the belief that the ocean can one day provide what the land does not. What is the truth?

The truth is not always a simple matter of black and white and, in fact, it often varies according to the viewpoint of the observer. Thus, there is a surplus of food in the U.S.A. today. But, looking at the world as a whole, the total amount of food produced is insufficient to provide an adequate diet for the present population and there are enormous numbers of people in the more poorly developed areas of the world today who live on the verge of starvation. Again, although present day conditions are adequate, the population of North America is increasing at the rate of 2 million every year. If it should continue at the same rate, there will come a time when all available land must be exploited to the full extent to maintain adequate food supplies. From this point on, the growing numbers of people will have progressively less to eat.

The United Nations organisation has estimated that, merely to keep pace with population growth, at the present rate of consumption, the world will need an increase of over 8 million tons of protein in its annual production within the next fifty years and that to take adequate care of those areas of the world now starving, the increase must be in the order of 50 million tons.

Unquestionably, the food production of the land can be increased, but not without very considerable difficulty and effort and the development of new and unsuspected techniques. Using essentially present day methods, improved and extended to all suitable land, using more irrigation, fertiliser and insect control, with plant improvement and more intense operation we could, by hard work increase food production to the point where, properly distributed, the harvest might support 8 billion people instead of the present 2 billion - but at considerably lower standards of living than most of us enjoy today and only after 50 years or more of continued effort at improvement.

The difficulties in improving land production are thus very considerable and are reflected in the fact that the world-wide production of food has actually fallen behind in its race with the growing human population since the beginning of the century, instead of overtaking the deficit or even keeping pace with the existing inadequacy.

Apart from political and economic difficulties and apart from other technological difficulties in increasing agricultural production, the one great obstacle is the water supply for irrigation of lands at present either sub-standard or useless for growing food. There is little doubt that the water must be supplied from the sea. In fact the improvement of the world's food supply may depend as much upon the economically successful extraction of fresh water from the sea as it does upon the direct utilisation of the seafisheries.

At present, about 11 percent of the world's farmland is irrigated and the amount is rapidly increasing. The maximum possible amount, even using impractically expensive irrigation processes, is estimated as 20 percent. There is simply not enough water in the streams to irrigate more land than this, using today's methods. So the utilisation of desert and steppe land, which would almost treble the area of land under cultivation, must await the development of economically sound methods of reclaiming sea water.

The usually accepted maximum cost at which irrigation can be economically carried out is $10.00 per acre-foot of water. But under certain conditions it is proposed to extend the practice in the future at a cost of $40.00 per acre-foot. Supplementary irrigation is already being carried out, using minimal quantities of water, at a cost of $75.00 per acre-foot. The most likely forecast of the cost of reclaiming seawater today lies between $100.00 and $200.00 per acre-foot, plus heavy capital investment in canals and pipelines. The probability that this cost can be out in the future is no less than the probability of economic use of atomic power appeared a few years ago.

In addition to the problems which beset the expansion of agriculture, there is also the question of increased demands upon it, above and beyond those of human hunger. As eventually coal and oil became scarcer and eventually prohibitively rare, they may well be replaced by other forms of energy not dependent upon the sun.

As sources of raw materials for organic components, plastics, medicines, textiles and so forth, they may be replaced by materials derived from living vegetation, which is constantly renewed, rather than a capital resource.

Another answer to the food problem which has been popular in the rosy atmosphere of today's engineering and technological era, is that of the food factory in which algae are grown on a kind of assembly line. The production of organic matter here depends, as in the case of ordinary crops, upon the efficiency with which the energy of sunlight falling upon the surface is utilised to reduce carbon dioxide. The efficiency in the case of cultivated algae is not greatly higher than in the case of the better crops, so that little advantage is gained here. On the contrary, the cost of preparing the land is a good many times higher than that for conventional agriculture.

The considerable difficulties and limitations in the way of expanding agricultural production to keep pace with the present colossal population growth of 100,000 per day serve to enhance the importance of the two remaining solutions to the problem. Technologically, though not politically and sociologically, the simplest of these is a rational and equitable system of birth control, universally applied. The least obstacle in the way of this supremely logical solution is that of religious prejudice. A far greater obstacle is that population growth has become almost an instrument of racial and national domination. Crowded populations must either emigrate to the less crowded countries or subjugate them in warfare. The policies of dictators, no matter how repugnant, have at least recognised the realities.

The remaining solution relates to the major 70% of the earth's surface, the ocean. What is a realistic estimate of its food potentialities? At first sight it would appear that, because of its great extent, more than twice the surface covered by land, its food production should be at least twice that of the land. But much of the land, unlike the sea, lacks the water necessary for growth of living matter, or is otherwise unavailable for growing crops. It is not surprising, therefore, to find that scientists estimate the growth of vegetable material in the sea to be nearly 9 times the total for both cultivated and uncultivated land.

When we begin to evaluate the actual harvest from the sea the facts are discouraging. The use of marine vegetable matter for food is negligible. Seaweeds are used in Japan and elsewhere as food but more are used as raw materials for a variety of medicinal and manufacturing purposes. In any case, the total crop of seaweed is only a fraction of 1 million tons. Since seaweeds inhabit only the shallow margins of the continents they are restricted in distribution, and no matter what food value might be found in them, the total quantity is still small compared to the need.

The main bulk of vegetable life in the sea consists of microscopic organisms known as planktons, which over the entire ocean, have been estimated to manufacture as much as 300 billion tons of plant starches each year. In terms of living material this would be much higher. None is harvested. Instead, the plankton is eaten by small grazing sea creatures, and these by larger ones or by young fish, which in their turn are eaten by larger fish.

This process of feeding is similar to the grazing of beef cattle. Nine tenths of the calories eaten by cattle are used in keeping them alive. Less than one tenth comes to us as beef. So, with marine food, because of the intervention of more than one step in the chain between planktons and fish, the first yield in fish may be as little as 1/100 to 1/100,000 of the original amount of plankton. Based upon calculations such as these, the actual growth of fish over the entire ocean has been estimated at two billion tons per annum. Even if we accept a more conservative figure of a few hundred million, this is still many times the world's meat production of 50 million tons.

In actual fact the world catch of fish is only about 26 million tons, or about 1/20 to 1/100 of the potential. There is good reason to believe this can be increased, however. But, as in the case of agriculture, there are many obstacles of varied kinds in the way. The degree to which these can be overcome is the measure by which future fishery yields must be estimated.

In the case of existing fisheries the yield could be increased by better control and management. Overfishing of a stock may result in reducing it in numbers or in size until the annual catch diminishes. Thus, the British Ministry of Agriculture and Fisheries has recommended cutting the amount of fishing effort for plaice and haddock to one half and estimates a 20 percent catch increase will result. Other cases exist, such as the Pacific salmon and halibut, where heavy fishing actually reduced the catch. In the halibut fishery an increased catch resulted from restriction of fishing.

Existing fisheries could also be improved in other cases by improved methods of locating, catching, transporting and marketing fish. Whereas some fisheries have been overfished, other fisheries are underfished, a notable example being the herring of northern Europe.

Fishing is still using the methods of antiquity, the net, the hook and line and the trap, with various modifications and improvements. Comparatively little has been spent in public funds, compared to agriculture, in developing radically new methods of fishing. But the few innovations are very promising. The use of electric fields to attract fish and pumps to transfer them to the ship has been successfully adopted by the Russians and is being used in the Menhaden fishery of this country. Elsewhere it has been found possible to attract fish to nets by the use of lights, as in the Japanese sawry fishery. A considerable amount of research upon the behaviour of fish might well lead to new applications in the development of fishing methods.

Just as important as methods of catching fish is the ability to locate fish in sufficient concentrations. The use of sonic devices has resulted in some advances but more may be expected as the sonar or asdic systems are improved.

Basic to the location of large concentrations of fish, is the need for a knowledge of the habits and requirements of fish in relation to the various chemical, physical and biological conditions of seawater. Instances of the effective use of such knowledge is the employment of thermometers by British cod fishermen in the vicinity of Bear Island to locate cod waters. Off the coast of France, tuna are also located by water temperature. The North Sea herring fishermen find the herring waters by means of a device which samples the water to determine the kind of plankton in it. Herring favour certain types of plankton and avoid others, and the plankton indicator enables the fishermen to select good herring water.

All of the foregoing help to increase not only the total catch, but also the efficiency of the operation and so lower the cost of the product. This is of considerable importance, since one obstacle in the way of developing some of the major fisheries is the lack of demand. If the price can be reduced, the demand may be increased. In the U.S.A. the average consumption of fish is 10 pounds per head, compared to 75 pounds in Japan.

The economic aspects of existing fisheries may also be improved as a result of careful investigations into the oceanographic and biological factors which affect the year-to-year fluctuations, as well as the local distribution of fish. These may be very considerable, and a considerable saving in cost could be effected if fluctuations could be predicted in advance.

Better methods of refrigeration, handling and transportation will all help to extend the market for fish and therefore stimulate its production.

So far, we have only considered the improvement of existing fisheries. But these account for a very small part of the potentials of the ocean. About 90% of the total world catch today comes from a few major fisheries in the North Atlantic and North Pacific. Yet the oceans south of the equator are nearly half again as extensive as the northern seas.

Not only are there great areas of ocean still awaiting exploitation in the southern hemisphere, but also in the northern hemisphere. Many of them will be discovered when intensive exploration is carried out. But the problems of transportation over large distances from the areas where fish concentrate to the areas where people concentrate will arise. These do not always coincide. Oceanographic research such as that which recently established the distribution of tunas along a Pacific equatorial belt may also help to develop more new fisheries of the open ocean.

In addition to exploiting vast new areas of the sea, there is the possibility of using new kinds of fish. Although there are over 20,000 species of fish in the sea, the major fisheries use less than fifty of them.

As we have seen, every time a new step is introduced into the food chain there is a loss of calories needed to sustain growth, so that fish growth in the sea is only a small fraction of that of plankton. But other creatures than fish, such as shrimps, squids and invertebrates in general feed more directly upon plankton. As a result the ocean produces something like ten times as many invertebrates as fish. Yet the invertebrates form only ten percent of the world fishing catch. Obviously, if people could be persuaded to eat more squid or the squid made more attractive, a great new fishery could be developed here alone.

Part of our invertebrate fisheries, the oysters and clams, occupy a rather special place. Although we cannot plow and fence and cultivate the sea as we do the land, it is possible greatly to increase the yield of clams and oysters by cultivation methods. Under these conditions the yield of shallow coastal waters could be as great or greater than the richest agricultural land. Yields can be increased to over 700 lb. of shellfish meat per acre by appropriate techniques, which have long been used in some areas but which could be greatly extended.

It is not possible to fence in and cultivate the sea and, in spite of experiments which have been carried out, it does not seem that we can expect to fertilise the sea to any great extent in the way we fertilise the land, by adding fertilisters in appropriate amounts. But the sea itself is a great reservoir of fertiliser which is largely unavailable to the plankton crop. The phosphates and nitrates arising from the death and decay of surface-living plankton accumulate in deep waters, below the surface, where plankton is unable to survive through lack of light. In certain parts of the ocean there are vertical currents of water known as upwellings, which bring the deeper waters rich in fertiliser to the surface. In such places as these, we find a great outburst of plankton and a rich supply of fish.

If it were possible to bring these deep rich layers of water to the surface - a kind of gargantuan plowing operation - then new rich fishing grounds might be developed. But the energy required would reach a staggering amount. It is not inconceivable, however, that atomic energy might be put to some such use. At least it seems that the control of large scale water movements is scarcely more impractical than the control of large scale air movements involved in harnessing the weather and dissipating hurricanes.

One question that is periodically raised cannot be ignored. If we were able to utilise plankton directly, either as animal food or as human food, the potential yield of the ocean would be increased a thousand times or more beyond the potentials of fishing. So far this has not been accomplished. In the light of present knowledge the outlook is not very optimistic. Plankton, though it exists in huge quantities in the aggregate, is distributed through enormous volumes of sea water and the basic problem is to pump and filter literally oceans of water, so as to concentrate and collect the plankton. So far the concentration of plankton is done far better by fishes, even though 9/10 of the food value is lost in the process. But, in the search for knowledge it sometimes happens that new facts and ideas appear which may revolutionise our entire attitude. The probability, even the thought of atomic energy harnessed to useful purposes would not have occurred to one until the unexpected discoveries of not so many years ago. A similar major breakdown is not impossible in our attempts to exploit the food of the sea.

The ocean provides energy in forms other than food. Besides the energy of tidal movements there is also a thermal energy potential due to the heating of the sea surface. Attempts have been made to pump cold water from the deep sea and to use it in combination with the warm surface water in a low pressure turbine to develop electric power. The large size of the plant in relation to power produced, the high capital costs and the difficulty in designing a pipe large enough, long enough and strong enough to transport water from the turbulent deep sea have held back this development. The high proportion of power developed needed to pump the cold water to the surface has also contributed to the unpracticability of this idea.

Materials such as magnesium and bromine are extracted from seawater and, as the ore reserves on land diminish, it is possible that other metals may be derived from the sea. In all such operations one of the expenses is that of pumping of large volumes of seawater. There exists at least a possibility that a combination of mineral production, thermal energy utilisation, plankton extraction, and the transport of fertiliser-rich water from the bottom to the surface might form the basis of an efficient operation.

The development of other forms of energy on land provides what may turn out to be a minor problem, but nevertheless an important one. This is the disposal of the radioactive wastes at sea. Although dumped in deep water, the slow movement of deep currents may eventually bring radioactive contamination to the places where it can affect food fish. For this reason a careful investigation of deep submarine water movements is necessary.

Just as atomic energy has been developed at huge capital expense in research and engineering, and is now becoming available to replace coal and oil when it may be needed, though perhaps at a higher cost, so food from the sea will surely become available in quantities vastly greater than available from the land. But this will only come about if the investment in basic research followed by applied research is applied to the sea as it is to the land.

Whereas agriculture has been the recipient of financial investment in research for a good number of years, the ocean has been relatively neglected. Even now, with a potential production many times greater than the land, ocean research receives less than 20% of the federal funds devoted to agriculture. We know less of great areas of the ocean floor than we do of the moon's surface, and yet, indications are that more money and brains will be devoted to landing instruments or mice upon the moon than upon basic oceanography.

The ocean potential for food is very great. The technological, economical and sociological difficulties in the way of exploiting it are also great. And the need for research on the biology and oceanography of the sea is fundamental. But there is every reason to believe that a great part of the harvest of the sea can be brought home to us if the effort is made. It is to be hoped, however, that the achievement of this goal will not result in the rewarding of fishermen for NOT catching fish.

Another Indication that Broadbill Swordfish is Wide-Ranging Species

Another indication that the broadbill swordfish may be as wide-ranging a fish as any in the ocean has been noted by California Department of Fish and Game biologists at Terminal Island. A longline hook, used by Japanese fishermen, was recovered by a California commercial fisherman July 17 off Santa Cruz Island. The hook was imbedded in the jaw of a 350-pound broadbill caught by a fisherman from Corona Del Mar.

California biologists say the hook, about a size 8-0, can tell them almost as much as a tag recovery can. The unique gear appears to be hand-forged and is definitely the type used by Japanese west of Hawaii and in the longline fishery around Wake and Midway Islands. The fish apparently had been hooked by a Japanese fisherman but escaped by breaking the line.

(News release,
California Department of Fish & Game, August 22, 1958.)