FISHERIES DEPARTMENT, WESTERN AUSTRALIA

MONTHLY SERVICE BULLETIN

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STAFF NOTES

Technical Officer L.G. Smith entered hospital on July 29 and underwent an operation on the same day. On the following day he rang to say that the operation was successful and that he was feeling one hundred per-cent.

The Superintendent, Mr. Fraser, returned to Perth on July 17 from an interstate Fisheries conference in Sydney.

The Supervising Inspector, Mr. J.E. Bramley, will carry out a northern inspection lasting about a fortnight commencing on August 9. He will proceed as far north as Carnarvon, taking in Dongara, Geraldton and Shark Bay en route.

Mr. Ian Bartholomew of Head Office intends taking his annual leave from August 9. Inspector A.J. Bateman will also take annual leave this month. Inspector A.V. Green, of Bunbury, commenced leave on July 26. Inspector Melsom is relieving.

Inspector H.J. Murray recommenced duty after annual leave on July 26.

Tech. Off J. Traynor was absent on sick leave from July 13 to 19 but now seems his normal self again.

Inspector W. Davidson intends to commence annual leave during the first week in September.

PERSONAL PARS

Mr. Norman Robinson, Technical Secretary, Wildlife Section of C.S.I.R.O., is at present visiting Western Australia. While in Perth he was introduced by Dr. D.L. Serventy to the Chief Warden of Fauna, and discussed aspects of the C.S.I.R.O. and State bird banding schemes. Mr. Robinson intends to go north before returning to Canberra, and at Abydos Station will obtain first-hand experience of the Organisation's work there.

C.S.I.R.O. Technical Officer K. Godfrey became suddenly ill on board the research vessel "Lancelin" last month. Captain H.C.W. Piesse put in to Onslow and "Kitch" was taken to hospital and underwent an appendicectomy. At the time of publication he was believed to be recovering satisfactorily. Research Officer R.W. George will fly north on August 18 to replace Mr. Godfrey on the "Lancelin".

FAUNA COMMITTEE'S NORTHERN TOUR

Dr. D.L. Serventy and Messrs G.E. Brockway, A.M. Douglas and H.B. Shugg, members and secretary respectively of the Fauna Protection Advisory Committee, accompanied by the Government Botanist (Mr. Gardner), Technical Officer J. Traynor and Fauna Warden F.A.L. Connell, will leave Perth on August 6 for a tour of inspection in the Murchison - Eneabba - Cockleshell Gully areas.

The main object of the trip is to survey likely reserves for flora and fauna. Observations on occurrences of fauna will be made as opportunity offers.

The party will be away from Perth for a week or a little more.

WHEAT-BELT INSPECTION

Shortly after the party returns from the Murchison-Cockleshell Gully areas, Fauna Warden F.A.L. Connell will carry out a detailed inspection of areas lying between Perth and Merredin. He will proceed through York, Beverley, Quairading, Bruce Rock and Narembeen to Merredin and the lower part of the Mt Marshall Road District and return through Kellerberrin, Tammin, Cunderdin and Northam.

Apart from investigating the prevalence of kangaroos and emus, he will interview Road Board Secretaries, Farmers' Union officials, Police Officers and Honorary Wardens in respect to fauna matters generally. Many complaints have been received of unlicensed shooting and other breaches of the protection laws in these areas in recent months.

DUCK BANDING

Last month Technical Officer J. Traynor, visited a site at Greenbushes which had been recommended as a banding centre.

Although disappointed with the number of ducks which used the area, Mr. Traynor decided that it may be possible to establish a station there at certain times of the year.

On his way and on the return, investigations were made into alleged breaches of fauna protection. Mr Traynor was accompanied by Inspector A.V. Green in the Bunbury district inspections.

Recoveries: Since the publication of the previous Bulletin the following bands have been returned.

All but one of these were handed in by Mr. R. Cook whose farm near Moora was used as a banding station. Mr. Cook is of the opinion that from the time they were banded until they were shot the ducks had not left his property.

RECOVERIES

No.	Date Ringed	Place Where Ringed	Date of Recovery	Place Where Recovered	Distance Travelled
		Black Duck			
2317	13/2/54	Cook's Farm Moora	Some time before 31/5/54	Cook's Farm Moora	nil
2322	14/2/54	do.	do.	do.	"
2324	do.	do.	do.	do.	"
2327	do.	do.	do.	do.	"
2328	do.	do.	do.	do.	"
2380	16/2/54	do.	do.	do.	"
2390	do.	do.	do.	do.	"
2402	17/2/54	do.	do.	do.	"
2413	do.	do.	do.	do.	"
2443	20/2/54	do.	do.	do.	"
2446	do.	do.	do.	do.	"
2449	do.	do.	do.	do.	"
2458	21/2/54	do.	do.	do.	"
2803	21/5/54	Eyre River, Cape Riche, 50 miles N.E. Albany	Late June 1954.	Warriup Lake approximately 50 miles N.E. Albany	Not yet known

WARNING FOR WILDFOWL

In June last, Honorary Warden Waverney Ford of Fremantle reported that many black swans and wild duck were being killed by crashing into a recently erected high tension cable intersecting their flight path between Bibra Lake and North Lake.

The matter was investigated and a report forwarded to the State Electricity Commission. The Commission proved most co-operative. A senior engineer accompanied the Department's Fauna Warden, Mr. F.A.L. Connell, to the site and made an inspection. Advice has since been received from the Commission that a measure recommended by Mr. Connell has been adopted. Aluminium discs treated with luminous paint will be suspended at intervals along the cable, and it is hoped that they will give the birds adequate warning of the new hazard in their established line of flight.

TROUT

On July 1 Technical Officer J.S. Simpson inspected a dam on the property of Mr. S. North at Byford. The dam was approximately 8 yds long and 5 yds wide and only 2'6" deep. It is fed by a permanent stream and both the inlet drain and outlet are screened. Trout fry were planted in the dam in 1952 and 60 or 70 fish have survived and are now 10-12 inches in length and are reported to be in excellent condition. Mr. North hopes that the fish will spawn in the feeder drain and does not intend to fish his pond until after the third year.

From July 19 to 23 the Clerk-in-Charge, Mr. B.R. Saville, and Technical Officer J.S. Simpson held meetings with interested people at proposed trout distribution centres. The purpose of the meetings was firstly to acquaint farmers with the details of arrival times and delivery arrangements, and secondly to minimise losses due to incorrect handling from the moment of delivery to the time of release of the trout in the dams or ponds. Arrangements were made at each centre for the use of a central dam from which water will be taken for the farmers' small containers and for the transport tank. By this means water temperatures may be equalised and thus prevent the young fish from being subjected to sudden variations.

Advice was given at each centre on the type of container to be used and the best methods of transferring fish from the container to the dam. The officers also discussed methods of improving the carrying capacity of dams.

They were told that trout planted last year in dams in the Quairading district were making good growth and that no losses had been reported. Small dams in this district were reported still to be very low, although dams with good catchments had built up considerably.

Appreciation of the officer's visits and the information given was freely expressed at different meetings. Quite apart from the advice which it was possible to impart, the meetings were worthwhile in that past misunderstandings were cleared up and good relations established. It is hoped that many of the past losses will be avoided through the farmers being brought to realise the important part they play in the successful establishment of fish in their dams.

WHALING

Repellants tried

Assistant Inspector V.J. Sinclair has reported from the Nor'West Whaling Company's station at Point Cloates that late in June carbide was used experimentally to deal with the shark menace. Carbide, which had previously been soaked in oil, was placed inside cuts of whale liver and tossed overboard. One shark took a bait and shortly afterwards came to the surface thrashing around in mortal agony. Other sharks soon attacked and killed it.

It was said that this method has already been tried at other whaling stations in Australia with some success. The theory is that a number of sharks will take the baits and as they writhe and thrash about in pain other sharks attack them and leave the whale alone. It seemed, however, that during experiments at Point Cloates sharks preferred to tear their meat directly from the whale and were not greatly interested in any floating pieces. Further experiments with this method will be carried out by the Company, which is sanguine of greater success.

Permission was granted in July to the Company to use explosives as a trial shark repellant. Under the supervision of Assistant Inspector Sinclair charges of gelignite consisting of four 8" x 1" grade 60 plugs with a 16 seconds' fuse were used. When the first charge was thrown into the water about 20' from the whales, which many sharks were attacking, those nearest the charge were able to swim some distance away before it exploded. Some continued to feed off the whales and none seemed to suffer any effects from the blast.

The second charge was exploded close to five sharks, but of these only one was temporarily affected and the other four swam away. The affected one was blown over on its back, but quickly recovered and swam away. The second explosion did cause the sharks to move from the whales and to circle about some distance away. They were then so scattered that it was considered that to explode a third charge would have had no effect at all. Inspector Sinclair says that he counted four dead snapper floating on the surface, but these were the only casualities from the experiment. Half an hour later the sharks had returned and were continuing their attack on the whales. All the repellants which the Company has tried to date have proved ineffective.

Publicity was given in this Bulletin some time ago to a new American invention which the manufacturers claimed was highly satisfactory, and it is understood that supplies of this product have been ordered from the United States. They have not yet arrived.

Abandoned Baby at Albany

On July 13 it was reported to Inspector G.C. Jeffery at Albany that a baby whale was stranded at Middleton Beach and was still alive. After leaving the

Whaling Station that night Inspector Jeffery was unable to locate the calf in the dark, but, early next morning his search was successful. It proved to be a new-born female sperm whale 12'8" long. Assistance was needed to tow the whale off the beach. This was accomplished about 3 p.m. that afternoon. In spite of the fact that some sadist had made a cut approximately two inches deep all around the neck the poor animal was still breathing.

As this species of whale suckles its young for six to eight months, Inspector Jeffery decided that although it had displayed a remarkable tenacity to life the baby had no chance of survival and had it towed to the Whaling Station. It was during this tow that death through drowning occurred. After examination the carcass was eventually towed to sea and abandoned.

PEARLING

The table hereunder sets out the amount of pearl shell landed at Broome for the three months ended June 30, 1953 and 1954. It will be seen that while the number of ships increased by 16% from 25 in 1953 to 29 this year, the progressive total of shell landed increased from approximately 110 tons to 202 tons, or 84% increase. It is understood that better weather has been experienced by pearlers this year and that good fortune, together with the experience gained by the Japanese divers inducted last year, is mainly responsible for the outstanding increase in the production of shell during the first three months of this season.

LANDINGS

	1953				1954			
	Tons	cwt.	qr.	lb.	Tons	cwt.	qr.	lb.
April	13	11	1	20	22	10	1	22
May	44	4	2	0	94	15	1	21
June	52	1	2	11	85	3	1	1
Progressive Totals .	109	17	2	3	202	9	0	16

WEST AUSTRALIA'S CRAYFISH INDUSTRY

(a) Abrolhos Area

In the table on page 266 production figures for June, 1954, are compared with the figures for the same month of last year. There are also given progressive totals for the two years. Compared with the 1953 season this year's total catch has increased by 400,000 lb., and the catch per man has also increased in spite of the fact that the number of men is much higher this year.

It should be noted, however, that the average catch per man for June is down 2,000 lb. on the June, 1953, figure, representing a decrease of 12%. No doubt this has been to some extent brought about by the official direction to cray fishermen that they must not change from the Abrolhos to the Geraldton crayfishery.

The average number of men in June, 1954, was greatly in excess of the June, 1953, figure of 82. This is almost certainly responsible for the higher total catch and the lower catch per man.

Inspector Bowler reports that the crayfish handled this year continue to be of a much larger run than those handled last year.

The table comparing tail-size percentages bears this out and indicates that the usual trend towards a smaller percentage of midgets late in the season has been maintained along with this season's high percentage of larger-sized tails referred to in the June Bulletin. The percentage figures have been kindly made available by the Geraldton Fishermen's Cooperative Ltd.

(b) Other Areas

The table on page 267 records crayfish production figures for all those areas south of the 30th parallel during the 1951/52, 1952/3 and 1953/4 seasons.

ABROLHOS CRAYFISHERY

GROUP	JUNE 1953 Total	JUNE 1953 Average Catch per man	JUNE 1953 No. of men	JUNE 1954 Total	JUNE 1954 Average Catch per man	JUNE 1954 No. of men
	lb.	lb.		lb.	lb.	
Easter	66,878	1,967	34	62,867	1,699	37
Wallabi	58,355	2,334	25	87,957	2,199	40
Pelsart	17,684	1,179	15	38,274	1,664	23
North Island	25,724	3,215	8	21,524	1,266	17
Totals	168,641	2,057	82	210,622	1,800	117
Progressive Totals	1,371,348	13,713	Average 100	1,750,199	14,114	Average 124

TAIL-SIZE PERCENTAGES

CATEGORY	JUNE 1953	JUNE 1954
Midget	30.5%	24.23%
Small	38.74%	42.3%
Medium	16.8%	15.72%
Large	9.89%	9.92%
Jumbo	4.05%	7.82%

OTHER AREAS

AREA	1951/2 Season (To May 31, 1952)			1952/3 Season (To May 31, 1953)			1953/4 Season (To May 31, 1954)		
	Total Catch lb	Average Catch per man lb.	No. of men	Total Catch lb	Average Catch per man lb	No. of men	Total Catch lb.	Average Catch per man lb.	No. of men
Block 29 (south of Fremantle)	39,797	3,980	10	406,624	11,295	36	352,687	11,021	32
Block 36 (north of Fremantle)	1,924,876	21,152	91	1,947,885	18,204	107	1,948,845	16,947	115
Totals	1,964,673	19,452	101	2,354,509	16,465	143	2,301,532	15,656	147
Lancelin Island	2,604,364	23,676	110	1,837,073	17,169	107	2,096,619	20,555	102
Green Islets	501,450	20,894	24	331,645	16,582	20	405,025	23,825	17
Cervantes Island	1,107,564	22,151	50	572,995	22,039	26	416,708	18,941	22
Jurien Bay	-	-		-	-		919,667	15,587	59 x
Totals	4,213,378	22,899	184	2,741,713	17,919	153	3,838,019	19,682	195
GRAND TOTALS	6,178,051	21,677	285	5,096,222	17,217	296	6,139,551	17,952	342

x In the 1953-4 season, Jurien Bay was fished only from January 1, 1954. In other areas fishing commenced on December 1, 1953.

In contradiction of the apparent trend earlier in the year when it appeared that production this season would fall far short of the record 1951/52 season, it will be seen that the total catch to date is only some 39,000 lb. short of the progressive total two years ago, and is over one million lb. ahead of the figure for last season.

However, the true position of the fishery may have been masked by the fact that over 900,000 lb. of crayfish were taken from the newly opened Jurien Bay area, although there is no way of knowing whether or not a similar quantity would have been taken in waters south of Jurien Bay if the men working in the latter area had been working south. Furthermore, it should be noted that the catch per man for the current season is 3,725 lb. less than in 1951/52.

SHARK BAY SNAPPER

Last month the fishing boat "Villaret" brought to Fremantle what was claimed to be the biggest single snapper catch ever from Shark Bay. It was reported that 5 men using four-hook lines caught 7,000 fish, weighing approximately 40,000 lb. in 21 days. An echo sounder was successfully used to locate schools of the fish. The catch was apparently not auctioned in the market, but sold privately.

SUN FISH

Inspector G.C. Jeffery has reported that on the night of July 15 a large sun fish was harpooned and dragged up on the beach adjacent to the Whaling Station. It proved to be a fine specimen measuring approximately 6' from tip to tip of its rear fins.

FISHING BOAT DAMAGED

Just as we go to press we hear that the ketch "Betty Margaret" (skipper R. Ottersen, of Geraldton) was badly damaged on July 28 when she was driven on the breakwater during a northerly gale. She suffered severe damage.

The Theory of Deep-sea Fishing

by R.J.H. Beverton.

In April this year, a number of European countries put into force an agreement to increase the size of mesh in the trawl fisheries of the North Sea and some other areas. It is the first really definite advance in the international regulation of our sea fisheries. But the idea that fish resources might need protection, or conservation, is not new. It was first put forward about 1880 by that great naturalist Frank Buckland. At the time, Buckland had little sure evidence to go on, and his views were not received sympathetically - which is not really surprising. In those days, it seemed almost impossible to believe that the vast resources of the sea could be affected by fishing. But events and research in the past twenty years or so have shown, without doubt, that Buckland was right.

The trawl fisheries for bottom-living fish, such as plaice, haddock, and cod in the North Sea, and hake on the west coast, have provided the most conclusive test. The rapid expansion of the fleets during the early years of the present century gradually slowed down until, by the nineteen-thirties, it had ceased altogether. The immediate cause was obvious. The amount of fish caught was certainly no greater than it had been thirty years before; in some instances it was actually less. So there was scarcely enough profit in fishing to maintain the existing fleets, let along increase them, despite the development of more effective types of fishing gear and more powerful ships. It was not so much a question of fish being in danger of extermination by excessive fishing, but rather that a fairly stable balance seemed to have been reached between, on the one hand, the natural productivity of the fish stocks and, on the other, the amount of fishing. But this was only partially reassuring, because everything pointed to the balance being far from a favourable one, either in terms of the amount of fish caught or the economic state of the fishing industries.

Measuring the Mortality Rate

The first question to be answered was whether these conditions really were the direct result of excessive fishing. They might have been caused by a long-term change in environmental conditions which was having an adverse effect on the productivity of the fish stocks; a climatic change, for instance. It was here that research into the structure of the fish populations began to throw light on the problem. It was found that as, over the years, fishing had intensified the average size of fish in the catch had decreased; there were relatively more small fish and fewer large ones. The development of methods of finding the age of fish, from the annual rings of scales and earstones, showed that this decrease in size was not due to slower growth. Instead, more fish were being caught while still relatively young and before they had a chance to grow much. Knowing the age-composition of the stock also enabled the mortality rate to be measured. In plaice and haddock this turned out to be as high as fifty to sixty per cent a year from all causes together.

Now all this was pretty strong proof that fishing was indeed having an effect on the stocks; but the question remained, were these signs sufficient, in themselves, to account for the trends observed in the fisheries? What exactly was the significance of a mortality rate of, say, fifty per cent? It did not necessarily follow that there was too much fishing: a mortality rate as high as that might be essential to get the best results - even supposing that it was all due to fishing, which it almost certainly was not. Natural causes of death must have contributed something. What was needed was a theoretical basis against which observed changes in population structure, in mortality and growth, could be assessed, and distinguished from natural changes unrelated to fishing. More important still was the need to be able to predict, from information of this kind, just how a particular stock could be fished more productively and more economically. Something was needed to take the place of the experimental method that is such a powerful weapon in other sciences but which, for obvious reasons, I think, is not of much direct help when we have to deal with major international fisheries. The response to this demand was the development of the theory of fishing, as a branch of population theory.

Stable Fish Population

I mentioned the evidence that a fish population can reach stability when it is fished. This kind of stability is not rigid; rather it is a dynamic equilibrium. It is the result of a balance between the processes that tend to increase the size of the population and those that tend to decrease it; in effect, between inflow and outflow. Inflow, to the exploitable part of a fish population, consists of the recruitment to it each year of young fish, and also the growth of the individuals already in it. Outflow consists of mortality, of two main kinds: that due to natural causes, such as predation by other fish, disease, and senility, and that due to fishing - the yield taken by man, in fact. On the magnitude of these four primary factors - recruitment, growth, natural and fishing mortality - depends the size of the population, and the yield of fish that will result from any particular amount of fishing.

I think you can see now that by formulating these factors mathematically, and then combining them by the appropriate algebraic methods, it is possible to construct a theoretical model of an exploited fish population. Such a model constitutes, as it were, the framework of the theory of fishing. Of course, it is one thing to state in general terms, like this, how a model is constructed, and quite another to be certain that its properties have any meaning in reality. The primary factors must be formulated correctly for the population represented by the model, and mathematics do not always lend themselves readily to this. They have a disconcerting way of fitting one set of facts quite well and then producing totally unrealistic results in other circumstances. Also, numerical values of the primary factors in the actual population must be measured as accurately as possible - which sometimes presents considerable problems. But this is really a subject in itself, and all I can tell you now is that the main source of information is, as before, the size- and age-composition of the stock. We get this by taking day-to-day samples of the fish landed at the ports, supplemented, where necessary, by work conducted from our own research vessels.

The simplest way of using one of these theoretical models is to give the rates of recruitment, growth, and natural mortality the values that have been found in the actual population. By assuming that these will remain constant, or, at least, will fluctuate about the observed values independently of each other, it is possible to predict the average steady yields that we might expect with different fishing mortality rates - and so from different intensities of fishing. When this was done with models based on North Sea plaice, haddock, and cod, we obtained one result of particular importance. With the size of mesh in use it was found that the yield did not go on increasing as fishing was made more intense. Instead, at a certain intensity, depending on the species of fish, the steady yield reached a peak value. Here was the most productive balance between recruitment, growth, and mortality. More intense fishing than this produced a smaller yield.

The critical fishing mortalities that gave the maximum yield turned out to be decidedly lower than those observed in the actual populations during the nineteen-thirties - something in the order of half them. Here, then, was the true explanation of why these fisheries had ceased to expand, and why the yields were, if anything, less than they had been many years before. It left no doubt that the yields had indeed been reduced below their potential maximum by too intense fishing.

The Size of Mesh

The same model can be also used to predict what would happen if the size of mesh of the trawl were changed. This is done by altering the age of fish at which the fish mortality first begins to operate; the larger the mesh the greater the age, and vice-versa. In this way it was found that a larger mesh than that in use would produce a greater steady yield in all three species. This is because increasing the size of mesh would allow fish to grow more before they began to be caught, and up to a point their greater weight would more than compensate for losses from natural causes during this time. In this way the theory of fishing showed that either a reduction in fishing or a larger mesh would increase the yield of fish from all three species.

Now you may think that a theoretical model of the kind I have just described must be a very much simplified version of what actually goes on in the sea. And so, indeed, it is. One serious drawback is that the vital rates of recruitment, growth, and natural mortality are not really independent as we have assumed, either of each other or - what is more important still - of the fishing mortality rate. Think for a minute of the train of events set up in a stock if the fishing intensity fell. The immediate effect is a reduction in the fishing mortality rate, causing the density of the population to increase. But, unless food is unlimited there will be less to go round and so growth will be slower. Hence the final steady yield will tend to be lower than predicted by the simple model, in which growth is assumed to remain constant. On the other hand, the greater density will mean more spawning which, in turn, may result in more young fish being recruited later on to the fished part of the population. This will tend to make the yield greater than if recruitment is assumed to remain constant.

These are only two, though probably the most important two, of the many complex interactions that go on in a fished population. Investigating these more subtle and intricate properties is a fascinating, though often frustrating task. The main difficulty is that they cannot be detected unless fairly large changes in density have taken place, and it so happens that most of our detailed information has come, so far, from periods when the fisheries have been fairly stable. Indeed, if it were not for the great increase in density caused by the cessation of fishing during the war we would know very little about them even now. As it is, we have progressed far enough in measuring density effects and incorporating them in theoretical models to be fairly sure that the simple theory gives the broad outlines correctly. These secondary effects do tend, within limits, to compensate each other; but at the same time we know that the simple theory cannot be used to predict accurately what would happen with really drastic changes in the amount of fishing or in the mesh of nets.

So much, then, for that part of the theory of fishing that concerns the fish stocks. The other component of a commercial fishery is, of course, the fishing fleet and its associated industry. But, first, a word about the link between them, that is, the question of how much fishing - how big a fleet, for instance - is required to produce any particular fishing mortality rate in a stock. Obviously, this must be known if deductions from a theoretical model are to be translated into practical advice. In trawl fisheries the problem is fairly straightforward. As a trawl is dragged across the sea-bed it captures, roughly speaking, a constan fraction of however many fish may be in its path. Hence if, say, half as many vessels were operating we can be reasonably sure that the fishing mortality rate would also fall to about half. But in other cases, notably the drift-net fisheries for herring, the problem is more difficult. Herring swim, for much of the time, in mid-water in sharply defined shoals. The drift-net, which is simply a wall of netting hung vertically in the water, relies mainly on fish catching themselves. Its effectiveness depends very much on the behaviour of the fish, particularly on their shoaling behaviour. For instance, it is quite possible that if herring drifters are too crowded they may break shoals up and scare fish away, in which event the fishing mortality might even be less than before, instead of greater. Although much is known about the biology of the herring, complications like this mean that there is probably no simple relation between fishing mortality and fishing effort with drift-nets. This is, perhaps, the main difficulty, at the present time, in developing the theory of fishing for herring.

When we come to the fishing industries themselves, the character of the problem changes. Biology gives way to economics. Instead of recruitment, mortality, and growth, the primary factors are now the monetary value of the catch and the costs of operating a fishing fleet. Only in terms such as these is it possible to assess the benefit to the fishing industries of exploiting a stock in any particular way. For instance I have mentioned that in some fisheries, and depending on the size of mesh used, there is a certain amount of fishing that would produce the greatest steady yield. To achieve this might seem the ultimate objective of fishery regulation and, indeed, it is thought to be so by many workers in the field of fishery bionomics at the present time. Yet it would be better, economically, to fish a little less still, to sacrifice a few per cent of this maximum yield in order to save much more on the reduced costs of fishing. But economics are not everything. Fishing is a source of livelihood for many people, and it might not be desirable, for sociological reasons, to have industries too small. Moreover, a nation's need for fish as food may be great enough to make even a small loss of yield unacceptable. So it may be better, when all is considered, to absorb some of the maximum potential profit from a fishery by having a rather larger fleet than would otherwise be required on strictly economic grounds.

There is, in fact, no absolute criterion how best to exploit a fishery. What is best is essentially a matter to be worked out for each particular case; it must take into account all relevant factors - biological, economic, and social. Man has to accept, at the present time, the limited resources of sea fisheries, but he has the last word in deciding how effectively he is going to utilise them.

You may perhaps be wondering why, if the evidence of excessive fishing is so clear, the fishing industries have not themselves limited their activities long before now. Why, indeed, is it necessary to speak of fishery regulation as a thing conceived and administered, as it were, from outside? Admittedly this is due, in some measure, to the complexity of the problems involved; but the real answer lies in the fact that fishing is, by its very nature, competitive. Fish in the sea are not parcelled into enclosed groups, belonging each to its owner, like cattle in a field. What one fisherman takes another cannot; and, conversely, what one leaves is far more likely to be caught next time by his competitors than by him. It is this competitive element that causes an unregulated fishery to drive itself down, eventually, to a level of minimum profits and, in the process, to a much reduced productivity. It means also that any attempt at regulation by one fisherman alone, by one group of vessels within a fleet, or even by the fleets of one nation among many fishing the same stocks, as in the North Sea, would benefit not them but their non-regulating competitors. That is why regulation of an international fishery, if it is to be successful, must be planned and contributed to by all the nations concerned.

Co-operation between Nations

The theory of fishing, and the research on which it is based, has many problems to solve before it acquires the scope and precision that we would wish. But already it has shown, quite definitely, that larger meshes and, more especially, less intense fishing, could make some of the heavily depleted stocks in the North Sea more productive and fishing them very much more profitable. Just how far it will be possible or desirable to go in these directions remains to be seen. Certainly, any progress will, inevitably, call for some sacrifice of competition and its replacement by a measure of co-operation. That is perhaps the most significant thing about the mesh regulation that was brought in in April of this year. The actual increase in mesh for the near waters is only small, and the benefits, though real enough, will not be very great: an additional £1,000,000 worth or so a year, in the long run. But it is a tangible demonstration of the spirit of co-operation between nations - a co-operation which is essential for achieving a better utilisation of the resources of the seas.

("The Listener", London, June 3, 1954.)

Herring Survey

Spotting Spawners from the Air

The first scientific look at herring spawning from the air was carried out last spring in southeastern Alaska and B.C. waters, by a U.S. group with a Canadian observer. From the data collected, the Canadian biologist, J.C. Stevenson, contends that Alaska can support a larger herring fishery.

Biologists took to the air last spring to try out a new twist for herring surveying, and although it provided sufficient information to warrant the expense, it will probably never replace the tried-and-true method employed by the Fisheries Department in their annual studies of herring spawning grounds.

The three-week aerial survey was conducted by the U.S. Fish and Wildlife Service, with a biologist from the Pacific Biological Station sitting in to see if the method could provide any further source of information to augment the data compiled by the fisheries officers of the department. Over 10,000 miles of coastline were covered in the observations, at a speed of 150 miles per hour and at heights from 400 to 2,000 feet.

The main reason for the entry of the Fisheries Research Board of Canada into the investigations was to find out if aerial observations could somehow take the place of time and money consuming ground surveys. They felt, also, that additional information could be added to the data already assembled.

On March 21st, the team took off. They covered most of the major spawning grounds on the coasts of B.C. and southeastern Alaska.

Cam Stevenson, in his report to the Research Board, stated that herring spawnings can be easily spotted from the air. The "clouds" of milt in the water could usually be recognised at a distance of at least five miles, and even after the spawning had been completed, birds feeding on the spawn told the observers the location of the breeding grounds. Eggs could not be seen from the plane.

Mr. Stevenson compared the findings of the ground and aerial surveys and found that observations from the air were generally quite accurate in estimating the extent of spawn deposition.

("Western Fisheries", Vancouver, B.C. May, 1954.)

<u>Where Are the High Seas in U.S. Policy?</u>

Conceived by the tuna industry of Southern California, an energetic movement to develop an all-industry policy with respect to territorial waters and the high seas was carried to the four corners of the country in the month of May.

The entire project in sequence, primary in importance, seeks to provide a clear, legal basis in United States law for this country's concept of the high seas, and the rights of fishermen thereon.

The entire enterprise emerged from its formative phase in Southern California in the hands of a two-man team composed of Dr. W.M. Chapman, director of research of the American Tunaboat Association; and John Real, general manager of the Fishermen's Co-operative Association of San Pedro. These two associations of owners of tuna boats - clippers and purse seiners respectively - are broadly representative of the tuna producers.

The team first swung north to Seattle to discuss the enterprise with representatives of the salmon, halibut and trawling industry; and then turned east to Cleveland, Ohio, where it met with marshalled representatives of the New England fisheries and the Gulf of Mexico shrimp fisheries of the National Fisheries Institute convention.

These meetings brought out the thinking of the fisheries of the four corners of the United States, broadly representative of four varied elements of the industry, with varying points of view. They were generally encouraging to the enterprise, although not issuing in definite commitment to "buy" the whole program as presented without further thoughtful examination and testing.

"Triggered" in large part by the recent action of the Organisation of American States, meeting in Caracas, Venezuela, in calling for a 1955 conference to study the matter of widths of territorial waters and seaward extension of national sovereignties, the undertaking designed to crystallise and implement American policy with respect to the high seas has two phases, mentioned briefly above.

In more detail, the first aspect of the program may be phrased thus:

<u>All-Industry Policy</u>

The United States fishing industry should agree forthwith upon a policy which is compatible with general policy of the United States government, and which can be adopted and pushed by American representatives in international forums.

Such policy should contain the following elements:

1. A clear definition of territorial waters and of high seas.

2. Narrow width of territorial waters.

3. Provisions protecting international treaties now in existence; providing for abstention, under treaty, from fisheries under conditions identical with those set up in the International North Pacific Fisheries treaty; and providing for exceptions in special cases by treaty.

4. Protection of high seas fishermen of the United States in their legal operations under United States law through indemnification for damaged suffered through actions of a foreign government while they were legally so operating.

Supplementing the all-industry policy proposal, the tuna industry's discussion presented by Dr. Chapman and Mr. Real offers also a second aspect, this making actual suggestion for national legislation designed to implement the policy and to give American doctrine with respect to the high seas an actual basis in United States law.

The bill proposed fundamentally would do this:

1. Define the high seas as all the sea not included within the territorial waters of a sovereign government.

2. Define the territorial waters of the United States, and of other countries, as a belt three miles in width, with certain generally accepted exceptions and elaborations.

3. Provide that U.S. fishing vessels molested while operating legally on the high seas, as defined by the act, shall be indemnified by the United States.

4. Provide method for determinating the innocence of such a vessel and its qualification for indemnity.

("Pacific Fisherman", Portland, Oregon. June, 1954.)

Scope and Sounder

Oyster Predator Identified

In searching for the cause of abnormally high mortality rates on the Olympia oysters in portions of Southern Puget Sound, a "new" oyster predator has been discovered. Charles E. Woelke, a State of Washington biologist, wrote that mortalities on the 1953 brood year had ranged from 15 to 100%. One regular-sampled planting of commercial oyster seed substained a mortality of 50.4% by mid-December. Examination of the valves of the dead oysters revealed three types of mortalities: (a) Those which were killed by the Japanese oyster drill; (b) Those which were invaded by an unknown organism, which punctured small oval holes in the shell; (c) and those which had no apparent damage to the shells. The mortalities attributed to Type b (an unknown animal puncturing small holes in the oyster shells), caused the greatest mortality to the oysters.

Through controlled laboratory experiments, the agent responsible for the Type b mortality was found to be a "Polyclad Worm". This worm ranges from about 1/3" to 1½" in length. The numbers of these worms inhabiting certain Southern Puget Sound oyster dikes is estimated to be over 600,000 per acre.

Woelke pointed out that destruction to oysters by this type of "flatworm" is rare. However, the Florida Oyster Leach, which is also a flatworm, causes serious damage to oysters. This worm does not penetrate the shell and the phenomenon of a flatworm actually drilling through the shell was previously unknown. The hole is reportedly made by secretions from the worm's mouth. After penetrating the shell, the worm severs the muscle which closes the oyster shell. After severing the muscle, the worm enters and devours the oyster. Washington shellfish biologists are now studying methods of controlling this pest.

("Pacific Fisherman", Portland, Oregon. June, 1954.)

"Nine Lives" All-Tuna Cat Food New Star Kist Item

An all-tuna cat food has been introduced by French Sardine Co. of Terminal Island. Bearing the catchy name of "Nine Lives", the new product comes in 8 and 16-oz. cans, and is being packed in its own section of the main plant on Terminal Island.

The formula for the food was conceived in the laboratory. The equipment was developed by company personnel. Only clean, cooked raw tuna meat and some bones are used in the product, with the addition of cracked, hulled barley, soybean oil meal, white wheat, dried whey, alfalfa leaf meal, salt, linseed oil meal, sodium nitrite and water. The product is rated as 12.5% crude protein, 2% crude fat, and 1% crude fiber.

The "Nine Lives" line is designed to be entirely automatic, electrically controlled and with proportions of ingredients controlled by automatic dispensing. With the exception of the Continental Can Co. closing machine, all the machinery is custom designed.

The tuna for "Nine Lives" comes from the main cannery's preparation tables direct to the cat food line. It is discharged to the hopper, where it is automatically dispensed at a given rate per minute into a continuous blender. The other ingredients, as well as water, are also proportioned into this continuous blender at the proper ratio.

The mixed ingredients go by screw conveyor to a King piston-type filler for filling into the cans. The cans are checked, weighed, inspected before passing through the closing machine.

The new plant is equipped to turn out 1,000 cans of 1-lb. talls per day.

Before "Nine Lives" was introduced, the French Sardine Co. tested the product in an animal hospital, using a group of test animals. The experiment was carried out over a lengthy period and included comparative taste tests against other name brands. The product is based on all that is known at the present time about cat nutrition, reports Mr. R.K. Pedersen, research director.

All canned animal food in the state of California must undergo inspection by the Bureau of Cannery Inspection. A record is kept on condition and quality of materials. No reject fish is permitted to be used. It is believed that "Nine Lives" is the only cat food so far to use only tuna products.

Distribution of the product began in Salt Lake City, Phoenix and Los Angeles.

("Pacific Fisherman", Portland, Oregon. June, 1954.)

The Seven Virtues of Fish

Fish, from the point of view of one what one needs from food, has seven virtues, in the same way that the man from St. Ives had seven wives, and the world has seven wonders, and the seventh daughter of the seventh daughter has second sight.

1. Fish provides most of those things which nutritionists are always telling us we must eat: first-class protein - that is, protein of the same kind as that found in meat and milk and eggs. It is essential for the building and the repair of the body and especially for the health of the liver. It cannot be substituted for by anything else: while one can live without fat or starch, one dies without protein. Most of us today eat too little; none of us can eat too much.

The fat of fish like herring is extremely good fat. The vitamins of fish cover nearly the whole alphabet, some being richer in one vitamin and some in another, but all containing most of them. For instance, mackerel specialise in vitamins B2 and B6, salmon in pantothenic acid, cod in choline and nicotinic acid, cod's roe in vitamins B1 and E, herring in vitamins A and D and the fashionable B12.

The minerals, like the vitamins, are rich in fish. For instance, cockles contain ten times the iron of mutton and four times that of spinach, while cod and shrimps contain more copper (essential to make blood) than pork.

2. The variety of fish is its second valuable property. It is axiomatic that a good diet is a varied one. It both stimulates our appetites and ensures that we are getting everything we need and not merely too much of something and too little of something else. By eating, for example, mackerel one day, cod the next, and herring the next, we have eaten three different foods and ensured that we have had a good helping of all the different

vitamins and minerals previously mentioned.

3. Fresh fish is the only food left to us which is never contaminated or made poisonous with chemicals. Nearly all prepared foods may, and generally do, have chemicals added. Even vegetables and fruit and meat and milk may have chemicals in them because these chemicals have been used in the farm-lands.

But fish itself grows under perfect conditions; it is the only crop we harvest but do not sow. It is the only food of man not poisoned by man - merely, of course, because he cannot.

4. Breakfast in England since the war has degenerated into a miserable mess of starch and tea. That is the reason why people are so tired before lunch, and why lunch is eaten so early. Starch is not the food to start the day with. You should have a large cooked breakfast, and have something which will carry you through to lunch, however late. In other words kippers or haddock (smoked, not dyed), herring, fillets of cod with bacon, kedgeree, fish-balls, bacon and eggs.

It is shocking that the work of England is now largely done by men who have been so badly fed by their wives that they cannot work properly in the morning.

The latest report on children says that the best weight is found in children who eat meat or fish at more than two meals a day.

5. Being too fat is the most serious sign of bad nutrition seen today; serious, because the load of unnecessary fat literally crushes the life out of people.

Fish never makes people fat. It is the ideal food for slimming while not making one feel tired. Cut out puddings, and put in instead a first course of fish or an end course of fish savoury, and you may yet escape death from a stroke or heart failure.

6. The sixth virtue of fish relates to invalid diets. Often they are better based on fish than on slops.

7. The Government have been saying how urgent it is for the last four years to introduce legislation making it compulsory to add iodine to our table salt since we eat

too little iodine. Yet a good helping of cod or herring three times a week gives us all the iodine we need.

By Dr. Franklin Bicknell, DM, MRCP.

("The Fish Industry", London, June, 1954.)

History's Most-Famous Fish Is

THE TUNNY

From earliest times the tunny has been highly esteemed and relentlessly pursued for its food value.

To the people of ancient Byzantium, Spain and Italy, its capture represented an extensive and lucrative industry. The tunny has been found portrayed on samples of early pottery from several Mediterranean countries, as well as on early medallions and coins. Greek mythology accords it an honourable mention, and tunny steaks were traditional delicacies at Carthaginian wedding feasts.

Today the tunny's popularity has waned and its pursuit, on any organised scale, is confined to certain parts of the Mediterranean which is its home.

Yet, although tunny shoals frequently visit our coasts in pursuit of herring shoals, it is only hunted in English waters by the rod-angler for sport.

Its main hunting ground ranges from the south coast of France along the European coastline, right down into the Sea of Marmora, and ends in the Bosphorous at the entrance to the Black Sea.

The scumbridae family, of which the tunny is the patriarch, is a complex community made up of varying and usually warring clans, ranging from the true tunny, which can attain anything up to half a ton in weight, down to the more humble and familiar mackerel.

In between are the near relations: the pelamids and bonitos, all equally and deservedly popular for their high calorific value and heavy oil facility with which they can be preserved by tinning, salting, smoking or drying.

Because of its size and speed (the Greek word for tunny means "darting") and because of the large numbers in which it congregates, the tunny is hunted almost exclusively with nets specially designed to withstand the great stresses to which its captives subject it.

In one or two regions, however, notably off the coasts of Greece and Turkey, where the tunny does not grow beyond manageable proportions, it is caught in large numbers in ordinary nets, and also by lone fishermen using strong handlines.

The handlines are armed with a large hook which is baited with a whole mackerel. Once a shoal is located neither skill nor finesse is required. The fish are hauled in as fast as the hook can be rebaited.

Tunny normally feeds at night, but under certain weather conditions it can be found searching for food in the daytime and on the surface, and it can then be caught on lures made of lead in the shape of a small fish and embellished with two brightly coloured feathers. The lure is rubbed over with mercury to give it a mirror-like sheen. This method is used by professional fishermen and not, as might have been expected, by the enthusiasts.

To see tunny fishing practised on a highly organised scale one must go to Italy or Spain, and in particular, to Sardinia, where annual catches frequently total as many as 80,000 fish.

The most widely used system is one consisting of underwater traps built of stout cord netting. These are laid and left at spots known to be frequented by tunny shoals. One boat remains at the nets and an observer in a crow's nest keeps watch. As soon as a sufficient number of fish have entered the trap, the observer signals to the remainder of the fleet and the boats then drop their nets inside the trap.

A far more complicated system is employed by the Italian fishermen. They lay a whole series of net traps, held in position by concrete "anchors", and each leading into the other to form a submarine corridor, and finally into one large net chamber. Along the bottom of this last section is laid another strong net that can be raised and relowered.

The fish enter the trap and then travel through each successive section of the corridor until they reach the last chamber. At intervals the bottom net is raised and the fish brought to the surface.

The weight of each haul makes it impossible for the catch to be hoisted straight into the boats, so instead the fish are "gaffed" as they reach the surface.

This process creates a great deal of excitement, as much among the fishermen as among the fish. In their efforts to escape the fish often take prodigious leaps into the air, frequently only to land in the very hold for which they are destined. Usually, by the time a catch has been safely taken aboard, the sea, the boats and even the fishermen themselves, are red with blood.

As in the case of the whale, little if any of the carcass is allowed to go to waste. Ashore, it is cut up and the flesh either sold fresh or put aside for preservation by any of the many processes to which it lends itself. Even the offal and bones are saved, and, after the oil has been extracted from them, they are powdered down for use as fertiliser.

Sometimes when the market is not favourable to the fishermen, the fish are kept alive in the underwater chambers until conditions improve.

There are probably more ways for preserving tunny than for any other fish.

In Greece and Turkey a very popular delicacy is laquerda - raw salted tunny which is eaten as hors-d'eouvre and, because of its thirst-creating properties, highly esteemed as an accompaniment to drinks at parties.

It can also be smoked when it acquires a strong resemblance, in flavour if not in hue, to smoked salmon.

by Ronald S. Hutton

("The Fishing News", London, June 25, 1954.)