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MERCURY IN SHARK
IN
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A Preliminary Report

BY

D. A. HANCOCK, J. S. EDMONDS

AND

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PERTH, WESTERN AUSTRALIA

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MERCURY IN SHARK IN WESTERN AUSTRALIA—A PRELIMINARY REPORT

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ABSTRACT

The National Health and Medical Research Council of Australia has recommended a maximum permissible concentration of 0·5 p.p.m. in the flesh of fish offered for sale. Mercury concentrations in Western Australian shark have been examined in relation to the recommendation, and the assumptions on which it was based.

Linear and curvilinear regressions relating mercury concentration and size were used in conjunction with catch data to estimate the average concentration in the three major species in the Western Australian fishery. The three major species are whiskery, bronze whaler and gummy sharks. The average mercury concentration for the three species was found to be approximately 0·75 p.p.m. The relevance of this to Health regulations is discussed, and the need for information on consumption of shark stressed.

I INTRODUCTION

A. Background

Mercury has long been known to be a poisonous hazard to those people, felt hatters and dentists for example, working in its close proximity, but because of its very low levels in most foodstuffs and drinking waters, it has not been regarded as a poison with epidemiological significance. Mercury is known to have been entering the aquatic environment through continental erosion, possibly accelerated by agricultural practice, since long before the advent of large scale industrialisation. However, prior to the demonstration of its involvement in the poisoning of persons at Minamata, Japan (Kurland *et al.*, 1960) there was no stimulus to study the detailed behaviour of mercury from both natural and artificial sources in the aquatic environment.

It is now known that inorganic mercury is methylated by bacterial action under anaerobic or aerobic conditions prevailing in some sediments, and the resultant methylmercury enters aquatic food chains and is concentrated in some fish consumed by man. Methylmercury is highly toxic to mammals because of its ability to bond covalently to enzyme sulphydryl functions and its lipid solubility. Detailed studies of its toxicology have now been published (Methylmercury in fish, 1971).

The outbreaks of methylmercury poisoning in Japan (Kurland *et al.*, 1960) and the subsequent discovery of high mercury levels in fish-eating birds in Sweden (Borg *et al.*, 1966) caused some industrial nations to examine locally consumed fish and the waters from which they are obtained. The results showed that, although localised industrial discharge, particularly into embayments and freshwater lakes, produced equally localised health problems, fish from areas that could not be regarded as polluted and on which man could have had only an insignificant effect, approached or sometimes exceeded the concentration of mercury suggested by Swedish studies to be safe. For example in 1970 levels of mercury were discovered in Pacific swordfish and tuna which the Food and Drug Administration of the United States considered made them unfit for human consumption. Plans for exploitation of a potential fishery for Pacific dogfish off the coast of British Columbia, Canada, were abandoned on the discovery of mercury concentrations in excess of 0·5 p.p.m.* in these fish (Forrester *et al.*, 1972).

Subsequent comparison between museum specimens of Pacific tuna and swordfish caught many years previously (96 years in the case of tuna and 28 years in the case of swordfish) and recent samples showed no significant difference in mercury concentrations (Miller *et al.*, 1972). A non-fatal case of mercury poisoning of a woman eating a swordfish diet reported by Kahn (1971) remains the only case cited of possible mercury poisoning from the consumption of fish where industrial pollution has not been implicated.

The U.S.A. and Canada adopted a guideline of 0·5 p.p.m. as a maximum concentration of mercury in fish for human consumption. Sweden selected a maximum of 1·0 p.p.m. although certain other conditions were placed on the intake of fish from certain areas and by persons thought to be particularly at risk. Japan, a country where fish has an unusual importance in the general diet, adopted a maximum concentration of 0·4 p.p.m. of which 0·3 p.p.m. can be organic mercury.

The results of a survey conducted in the United Kingdom, published in 1971 showed fish to contribute more mercury to the average diet than any other food source (Ministry of Agriculture, Fisheries and Food, U.K., 1971). However, although the situation is being kept under constant observation, no maximum permissible level for mercury in fish has been set in that country. The World Health Organisation (WHO), presumably taking into account the varying importance of fish in the diets of different countries, does not stipulate a maximum permissible concentration of mercury in fish but has established a provisional tolerable weekly intake of mercury of 0·3 mg per person of which not more than 0·2 mg should be methylmercury (FAO/WHO, 1972).

The National Health and Medical Research Council of Australia (N.H. and M.R.C.), following an examination of the results of information available from Australia and overseas, has chosen a maximum permissible concentration of 0·5 p.p.m. for mercury in fish (National

* Figures for mercury concentration throughout this Bulletin refer to parts per million (wet weight).

Health and Medical Research Council, 1973) while retaining 0·03 p.p.m. as the maximum level in all other foodstuffs. The standard for mercury in fish recommended by the N.H. and M.R.C. has been adopted by all Australian States, with the exception of South Australia where the maximum permissible concentration is 1·0 p.p.m. The application of this N.H. and M.R.C. regulation in the State of Victoria led to the condemnation of a shipment of sharks from New Zealand. Subsequent examination of sharks caught in south eastern Australian waters for sale in the substantial Victorian market and the finding that the average mercury level increased with the size of shark, led to a ban on the landing of school (snapper) sharks (*Galeorhinus australis*) over 41 inches in length in Victoria (State of Victoria, 1973).

B. Studies in Western Australia.

The finding of mercury concentrations in excess of 0·5 p.p.m. in shark in Victoria and the imposition of a partial ban on the sale of school (snapper) shark in that State led to an investigation of mercury levels in species of Western Australian shark. In 1973 a study was commenced by officers of the Departments of Fisheries and Wildlife and of Public Health to determine:

(a) Those species of shark contributing to the commercial catch and their relative importance with regard to weight and value.

(b) The mercury concentrations in the edible flesh of those species of shark and any relationship between mercury content and size for each species.

(c) The size composition of the commercial catch.

The purpose of the study was to identify the relationship between mercury concentrations in individual sharks and the maximum permissible concentration under Department of Public Health regulations, and also to examine average mercury levels in relation to provisional tolerable intakes of methylmercury (FAO/WHO, 1972).

An average value (weighted average) can be calculated of the mercury concentration in each species of shark and of shark landings as a whole. This average value could then, if adequate information were available, be extended to include other species of fish to provide an average level of mercury for all fish consumed in Western Australia.

Average and extreme levels of mercury will both assume importance in conjunction with likely intake of fish in the average or extreme diet, when assessing their relevance to Health regulations (Hancock, 1976).

II METHODS

Information on total annual landings of fish in Western Australia for 1972–73 and the import and export of fish to and from the State was obtained from the August 1974 publication of the Western Australian Office of the Australian Bureau of Statistics. These statistics contain figures for total shark landed but without identifying individual shark species. Details of species contributing to the commercial shark catch were obtained from A. J. Langford Fish Markets at Perth and Southern Ocean Fish Processors at Albany. Log sheets to be completed by fishermen were of limited value due to the disinclination of some fishermen to disclose the nature of their catches. The size composition of the commercial catch was estimated by officers of the Fisheries Department accompanying shark fishermen to sea and recording their catches, recording the size and species of shark landed at the various ports, and also of shark passing through Perth Metropolitan Markets.

Mercury concentrations are commonly referred to total lengths or weights of fish, but the commercial practice of bringing shark ashore headed and gutted made it necessary to take alternative measurements of the landed carcass that could subsequently be related to their mercury content. Many of the earlier shark measurements, particularly those made at sea, gave only total lengths and weights, and a method for converting total length to a more practical partial measurement was required. **Partial length** is defined as the distance between the anterior origin of the anterior dorsal fin and the dorsal precaudal pit (Figure 1). Sufficient individual fish had partial lengths and total lengths recorded for partial length/total length relationships to be calculated. The ease of measuring length rather than weight made it preferable to relate mercury concentration to partial length rather than partial weight. **Partial weight** is defined as the weight of the headed, gutted carcass as is usually landed and always handled by the fish markets, and is a less precise measurement than partial length. Weighted averages of mercury concentration, i.e. the estimated average mercury level in p.p.m. of fish in the commercial catch, were based on partial weights—where these were not recorded it was necessary to obtain the relevant variable from a partial length/partial weight equation.

Samples of flesh for mercury analysis were taken initially at sea, and subsequently at Perth Metropolitan Markets. Samples were deliberately spread throughout the observed size range for each species in order to attempt balanced representation of the different sizes in the regression of mercury concentration on size. From each shark, a small (*ca.* 50 g) sample was cut from the dorsal muscle anterior to the dorsal fin, and stored in an individual sealed glass jar at –18°C until analysis.

All mercury analyses were undertaken by courtesy of the W.A. Government Chemical Laboratories. Samples (*ca.* 2 g) of shark flesh were digested in a mixture of nitric and sulphuric acids at 130°C before removal of the nitric acid. The mercury present in the digest was reduced to elemental form with stannous chloride and estimated by flameless atomic absorption spectrophotometry using a Varian Model 1200 instrument. Recoveries of 90–100% were obtained.

III RESULTS

A. Shark landings and markets in Western Australia.

In 1973–74 shark constituted 10·9% of the total commercial catch of "wet" fish in Western Australia. When imported fresh and frozen fish were taken into consideration, shark constituted only 8·8% of the total "wet" fish utilised (1973–74). However as some of the commercial catch (in particular pilchards, whitebait, Perth herring, Australian herring and mullet) was used as bait, the percentage of shark in the total of "wet" fish used

for human consumption in Western Australia would have been slightly in excess of 8·8%. It was not, however, likely to have exceeded 10%.*

Data obtained from the fish markets on the composition of the Western Australian shark catch for the year April 1973 to March 1974 inclusive, indicated a total catch of 310,887 kg dressed weight compared with 702,523 kg whole weight recorded by the Australian Bureau of Statistics for the same period. Conversion of the market catch to whole weight by the conversion factor of 1·59 used by the Bureau suggests that some 70% of the shark recorded as caught by professional fishermen are handled by the markets at Perth and Albany, the remainder being sold directly to other metropolitan and rural marketing outlets. There is at present no firm evidence as to whether the species composition of the proportion handled by the markets is different from that of the total catch and the assumption that they are the same is made in the discussion which follows. In order to find those regions most important to the fishery the coastline and coastal waters of Western Australia were divided into six areas (Figure 2):—

1. Esperance .... Eucla to Hopetoun
2. Albany .... Hopetoun to Augusta
3. Busselton .... Augusta to Bunbury
4. Fremantle .... Bunbury to Lancelin
5. Geraldton .... Jurien and Geraldton
6. Exmouth

Information obtained from the fish markets is summarized in Tables 1–4.

It is evident from these Tables, and from information in subsequent years (D. I. Heald, pers. comm.), that whiskery† and bronze whaler sharks are the most important, each contributing about 30% of the total weight of sharks passing through the major markets with gummy sharks at a level of around 10% (Table 2). Thus most of the research sampling effort has been directed at these species, not only because of their importance but also because of their availability, and the results presented in this preliminary report are chiefly based on these species. Information on mercury levels in minor species of shark in the Western Australian catch will be presented at a later date.

B. Measurements of size and mercury concentration.

Details of individual shark measurements and mercury concentrations are given as Appendix 1. Regression equations given in Tables 5–7 for partial length/total length, partial length/partial weight, and mercury concentration/partial length relationships are based on samples obtained from various areas at different times of the year. These were as representative of the total fishery as was possible at the time. However, additional observations would be required to establish any differences between these relationships for different areas and different times of year.

* These figures are maximal because they do not include the considerable but unknown quantity of fish species taken by amateur fishermen in W.A.

† Scientific names of species have been listed in Table 1.

In the first instance the mercury concentration/partial length relationship was derived for each species using a linear regression (Table 7). However, since the variance of the mercury level increases with partial length, a logarithmic transformation of the data was also carried out to reduce the dependence of the variance on partial length. This gave the curvilinear equation which is also shown in Table 7. The slopes obtained from both techniques were found to be significantly different from zero at the 0·01 level for each species. However, the estimates of the mean mercury concentrations from the curvilinear regression equation are biased since the logarithmic transformation tends to give more weight to the smaller mercury values than to the larger values. A correction for this bias in the curvilinear equation $y = ax^b$, where y is the mercury level, x is the partial length and a, b are constants, can be obtained by multiplying the right hand side by $exp\ (s^2/2)$ where s^2 is the mean square deviation from the logarithmically transformed regression (Baskerville, 1973). Usually this approximation will be very close to the unbiased estimate of the mean mercury concentration (Beauchamp and Olson, 1973). Confidence limits were obtained on the corrected estimates of the mean mercury concentrations using Cox's Direct Method (Land, 1972). All three regressions were used in the calculations of average mercury level which follow.

The results of corrected curvilinear regressions for the three species are presented in Figure 3. The wide confidence intervals clearly demonstrate the high degree of variability of individual mercury concentrations around the mean value for any selected size of fish which includes variation arising from the method of mercury analysis. Uncorrected curvilinear regressions are also shown in Figure 3 to allow comparison with other published data (Forrester *et al.*, 1972, for spiny dogfish; Walker, 1976, for shark).

C. Weighting the results to represent the total catch.

From Appendix 1 it can be seen that the mean mercury concentrations, before "weighting" to take account of the size distribution in the total catch, for the three species of shark examined were as follows:—

Whiskery (165 samples)	—	0·59 p.p.m.
Bronze Whaler (146 samples)	—	0·71 p.p.m.
Gummy (110 samples)	—	0·44 p.p.m.

However, it must be restressed that those shark analysed for mercury (Appendix 1 and Figure 3) do not constitute a random sample but were selected to give mercury levels over the whole range of sizes to enable the most representative regression equations to be obtained.

In order to derive figures for average mercury levels in the total catch of shark sold for human consumption, it was therefore necessary to relate the results given in Figure 3 to the size composition of the catch. As stated earlier, information on size structure was obtained by officers going to sea and measuring all shark caught on those days, measuring all shark landed by some boats on some days, and by measuring all shark passing through the markets on some days. Measurements obtained by officers at sea are from the same sharks from which the various relationships (partial length/partial weight

etc.) described above were derived and as such are equally representative of the total fishery. However, measurements of shark from the markets were taken during June, September and October 1974 and thus represent part of the year only. It is possible that the size structure of the catch will be different at other times of the year not only because of natural variation with time but also because the fishermen in the various areas may be supplying the markets at different times and thus any difference due to locality will need to be considered.

Both linear and curvilinear regression equations were used to predict average mercury concentrations for the three species in the shark catch and the results presented in Tables 8–10.

The weighted average in each case was obtained by

$$\frac{\Sigma_i \ (Hg_i) \ (w_i)}{\Sigma_i \ (w_i)}$$

where w = partial weight, and takes account of the relative weights of shark contributing to the total size composition and Hg = mean mercury concentration.

Because of the difference in source of data the weighted average of the mercury content derived from each, i.e. field and market samples, are reported separately and both sources are used to give a combined figure. It will be seen that there is little difference in value for the weighted average whichever source of data is used.

An overall average value of mercury concentration in these species in the total Western Australian shark catch was obtained using the relative weights of whiskery, bronze whaler and gummy sharks in the annual catch. The comparative figures obtained were 0·75 p.p.m. from linear regression, 0·67 p.p.m. from uncorrected curvilinear regression and 0·77 p.p.m. from corrected curvilinear regression.

IV DISCUSSION

A. Summary and Conclusions.

The mercury concentration in some individual sharks in the marketed catch of Western Australia exceeds the 0·5 p.p.m. recommended as the maximum permissible level by the N.H. and M.R.C. Although there is a relationship between size of shark and mercury concentration, the wide 95 per cent. confidence interval for the data shows that an individual shark could have any concentration of mercury within wide limits.

The data presented in Appendix 1 represent many hours of observation aboard fishing vessels and at the ports, but despite this it can be seen that most areas and seasons have been inadequately sampled. Moreover, it had to be assumed in the preceding section that the species composition of the 70 per cent. or so of the total Western Australian shark catch that is handled by the markets at Perth and Albany was representative of the total catch. This is not necessarily the case. The other major buyers who purchase directly from shark fishermen are fish shops and hotels. If these establishments have a preference for certain species of shark, the overall picture will be modified. Table 2 shows that much of the catch from the Esperance and Geraldton areas does not pass through the two major markets, and a knowledge of the species landed in those places will be relevant to future final estimates of average mercury levels.

A survey of shark being bought and sold by fish shops and hotels would be a necessary part of future work to ascertain in more detail the fate of sharks landed in Western Australia. Other topics for further study are differences in mercury concentrations between sexes within a single species of shark and differences in mercury concentrations related to fishing area and time of the year.

Clearly a much more detailed investigation would be required before consideration can be given to the type of prohibitive regulations imposed in Victoria. Such legislation in Western Australia would be extremely damaging to a section of the fishing industry.

However, not withstanding the fact that Health regulations specify a maximum permissible concentration, which would imply a prohibition for sale of individual fish containing in excess of 0·5 p.p.m. of mercury, the health problem will need to be put into perspective against the background of quantities of mercury actually consumed. This approach has also been used in New Zealand (Robertson, Waugh and Mol, 1975).

The N.H. and M.R.C.'s recommended maximum permissible concentration of 0·5 p.p.m. in fish corresponds to a sustained weekly consumption of 410 g of fish with a mercury concentration *averaging* 0·5 p.p.m. (This assumes that the mercury is present solely as methylmercury; preliminary analyses of Western Australian sharks suggest that methylmercury may account for 60–100 per cent. of total mercury). In examining the effectiveness of, or need for, existing regulations, an understanding of the role of fish in the human diet will therefore be of great importance.

Limited surveys of dietary habits in Australia have shown that the average daily consumption of fish and shellfish products is 15–16 g per person per day (just under 4oz per week), of which less than 60 per cent. is fresh or frozen fish (Australian Year Book, 1974). Considering the fact that shark represents about 10 per cent. of all fresh or frozen fish marketed in Western Australia, this would indicate an average daily consumption of shark in that State of about 0·8 g (0·2oz per week) per person. However, apart from this very general estimate, there is a serious lack of detailed information on the dietary habits of Western Australians.

It is significant that extensive dietary studies were undertaken in Sweden before the maximum permitted concentration of 1·0 p.p.m. of mercury in fish was introduced in that country and it was on the basis of comprehensive dietary studies that the United Kingdom decided not to impose heavy metal standards in seafoods (Ministry of Agriculture, Fisheries and Food, U.K., 1973).

However, direct extrapolation of approaches adopted by other countries and States cannot be expected to provide an acceptable long term solution for Western Australia. Studies of Western Australian dietary habits will therefore be of fundamental importance to the formulation of legislative action appropriate to any local situation. Such studies are now being undertaken on an Australia-wide basis under the guidance of a special working group of the Australian Fisheries Council (Anon. 1975).

The working group will also be considering all new information on the toxicological and biochemical consequences of consumption of mercury in fish, and its relevance to Australian health regulations.

B. Future requirements for research.

1. Although the relationship between size of shark and average mercury level has been established in a general way, more observations will be required before the influence of fishing area and season, with, of lesser importance, sex of shark, can be established.
2. There is some chance that bias has been introduced into the results by the lack of information on total landings of different species of shark relative to fishing areas and seasons. Additional information is required on the species composition of sharks landed at fishing ports and their distribution onto the wholesale and retail markets.
3. A knowledge of the mercury levels of minor species of shark would contribute to a fuller understanding of the shark/mercury problem, but since the contribution of any of the individual species to the total catch is unlikely to exceed 10 per cent., this information should not substantially change the average mercury level calculated from information on the three major species of shark.
4. Certain assumptions have been made on the contribution of shark to the Western Australian diet. However, considerably more information is required to establish average and maximum weekly intakes of shark.
5. If individuals who consume excessive quantities of shark are located, studies of the mercury levels in their blood and hair should be undertaken and they should be examined for symptoms of mercury poisoning.

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TABLE 1

The percentage by weight of the various species of shark at the main W.A. markets (April 1973–March 1974 inclusive). (Scientific names are those in current use, but may be subject to revision.)

Species	%
Whiskery (*Furgaleus ventralis*)....	33·8
Bronze whaler (mainly *Carcharhinus obscurus*)	31·1
Gummy (*Emissola antarctica*)	10·4
Carpet (*Orectolobus* spp)	7·6
Hammerhead (*Sphyrna lewini*) and Pencil or western school (*Notogaleus rhinophares*)	6·2
Thickskin or sand shark (*Carcharhinus dorsalis*)	5·9
Grey Nurse (*Carcharias arenarius*)	3·3
Others	1·1
Black tip (*Carcharhinus calamaria*)	0·5

TABLE 2

The percentage contribution by weight of the six sea areas to the commercial catch (April 1973–March 1974 inclusive).

(a) Major markets

Area	Esperance	Albany	Busselton	Fremantle	Geraldton	Exmouth	Unknown
per cent.	3·0	41·4	26·9	21·0	2·4	0·5	4·7

(b) Total recorded catch (Australian Bureau of Statistics)

per cent.	20·8	26·3	24·2	13·7	14·4	0·6	

TABLE 3

The percentage composition by weight of the catch from each of the six sea areas.

Area/Species	Esperance	Albany	Busselton	Fremantle	Geraldton	Exmouth	Unknown
Whiskery	45·1	31·1	40·0	33·5	27·5	14·6	21·2
Bronze Whaler	31·0	24·8	33·0	36·4	39·2	60·0	44·4
Gummy	13·4	16·9	8·5	3·1	0·8	0·0	1·8
Carpet	1·0	8·7	5·2	9·3	8·3	0·0	8·9
Hammerhead and pencil	0·4	10·9	3·8	2·5	1·7	0·0	2·0
Thickskin	0·3	3·8	5·3	8·8	13·5	7·9	15·6
Grey Nurse	3·2	2·2	3·0	5·0	8·0	0·0	4·0
Others	5·4	1·4	0·6	0·4	0·8	11·6	1·1
Black tip	0·0	0·2	0·4	1·0	0·2	5·9	0·9

TABLE 4

The percentage weight of the total catch of each species caught in each sea area.

Area/Species	Esperance	Albany	Busselton	Fremantle	Geraldton	Exmouth	Unknown
Whiskery	4·0	38·1	31·9	20·9	2·0	0·2	2·9
Bronze Whaler	3·0	33·0	28·6	24·6	3·0	1·0	6·7
Gummy	3·8	67·0	30·0	6·2	0·2	0·0	0·8
Carpet	0·4	47·3	18·3	25·8	2·6	0·0	5·5
Hammerhead and Pencil	0·2	72·9	16·4	8·4	0·7	0·0	1·5
Thickskin	0·2	26·2	24·1	31·1	5·5	0·7	12·2
Grey Nurse	2·9	27·9	25·2	32·4	5·9	0·0	5·8
Others	14·5	50·7	15·3	7·3	1·7	5·6	4·7
Black tip	0·0	17·8	23·6	42·1	1·2	6·5	8·7

TABLE 5

Partial Length/Total Length Relationships.

Species	No. of Values	Regression Equations	Significance Level
Whiskery	87	PL = 1·005 + 0·52 TL	0·01
Bronze Whaler	27	PL = 1·98 + 0·40 TL	0·01
Gummy	46	PL = 3·08 + 0·58 TL	0·01

TABLE 6

Partial Length/Partial Weight Relationships

Species	No. of Values	Regression Equations	Significance Level
Whiskery	61	$PW = (5{\cdot}82 \times 10^{-5})\ (PL)^{2{\cdot}77}$	0·01
Bronze Whaler	90	$PW = (1{\cdot}45 \times 10^{-4})\ (PL)^{2{\cdot}74}$	0·01
Gummy	49	$PW = (1{\cdot}36 \times 10^{-5})\ (PL)^{3{\cdot}06}$	0·01

TABLE 7

Mercury Concentration/Partial Length Relationships

Species	No. of Values	Regression Equations	*t* value for regression coefficient
Whiskery	165	Linear:	
		$Hg = -1{\cdot}280 + 0{\cdot}0288\ PL$	6·46
		Log-log:	
		$Hg = (1{\cdot}561 \times 10^{-6})\ PL^{3{\cdot}03}$	6·79
		Adjusted log-log:	
		$Hg = (1{\cdot}813 \times 10^{-6})\ PL^{3{\cdot}03}$	6·79
Bronze Whaler	146	Linear:	
		$Hg = 0{\cdot}307 + 0{\cdot}0177\ PL$	13·60
		Log-log:	
		$Hg = (9{\cdot}05 \times 10^{-4})\ PL^{1{\cdot}61}$	14·40
		Adjusted log-log:	
		$Hg = (1{\cdot}021 \times 10^{-3})\ PL^{1{\cdot}61}$	14·40
Gummy	110	Linear:	
		$Hg = -0{\cdot}551 + 0{\cdot}0146\ PL$	5·50
		Log-log:	
		$Hg = (5{\cdot}157 \times 10^{-5})\ PL^{2{\cdot}11}$	6·63
		Adjusted log-log:	
		$Hg = (5{\cdot}830 \times 10^{-5})\ PL^{2{\cdot}11}$	6·63

TABLE 8

Weighted averages of mercury concentrations in three species of Western Australian shark based on mercury concentrations predicted from the linear relationship:

Mercury concentration $= a + b \times$ partial length.

Species	Field Sample		Market Sample		Combined	
	No. of values	Weighted average (p.p.m.)	No. of values	Weighted average (p.p.m.)	No. of values	Weighted average (p.p.m.)
Whiskery....	334	0·668	222	0·649	556	0·660
Bronze Whaler	170	0·942	166	0·956	336	0·949
Gummy	437	0·488	94	0·400	531	0·472

TABLE 9

Weighted averages of mercury concentrations in three species of Western Australian shark based on mercury concentrations predicted from the curvilinear regression:

Mercury concentration $= a \times$ partial length.^{b}

Species	Field Sample		Market Sample		Combined	
	No. of values	Weighted average (p.p.m.)	No. of values	Weighted average (p.p.m.)	No. of values	Weighted average (p.p.m.)
Whiskery	334	0·569	222	0·550	556	0·561
Bronze Whaler	170	0·888	166	0·886	336	0·887
Gummy	437	0·421	94	0·350	531	0·408

TABLE 10

Weighted averages of mercury concentrations in three species of Western Australian shark based on mercury concentrations predicted from the curvilinear regression (adjusted for logarithmic transformation):

Mercury concentration $= a \times$ partial length$^{b} \times \exp s^2/2$).

Species	Field Sample		Market Sample		Combined	
	No. of values	Weighted average (p.p.m.)	No. of values	Weighted average (p.p.m.)	No. of values	Weighted average (p.p.m.)
Whiskery	334	0·661	222	0·639	556	0·651
Bronze Whaler	170	1·002	166	0·999	336	1·001
Gummy	437	0·476	94	0·396	531	0·461

FIGURES

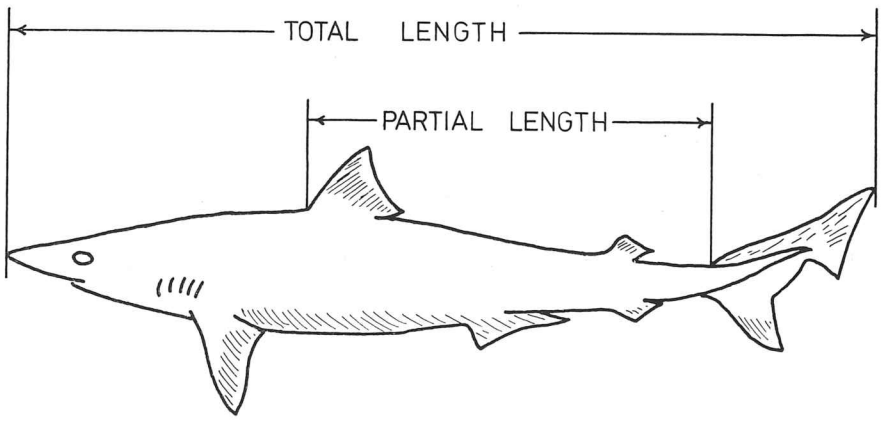

Figure 1—Diagram of shark indicating distances measured for total length and partial length.

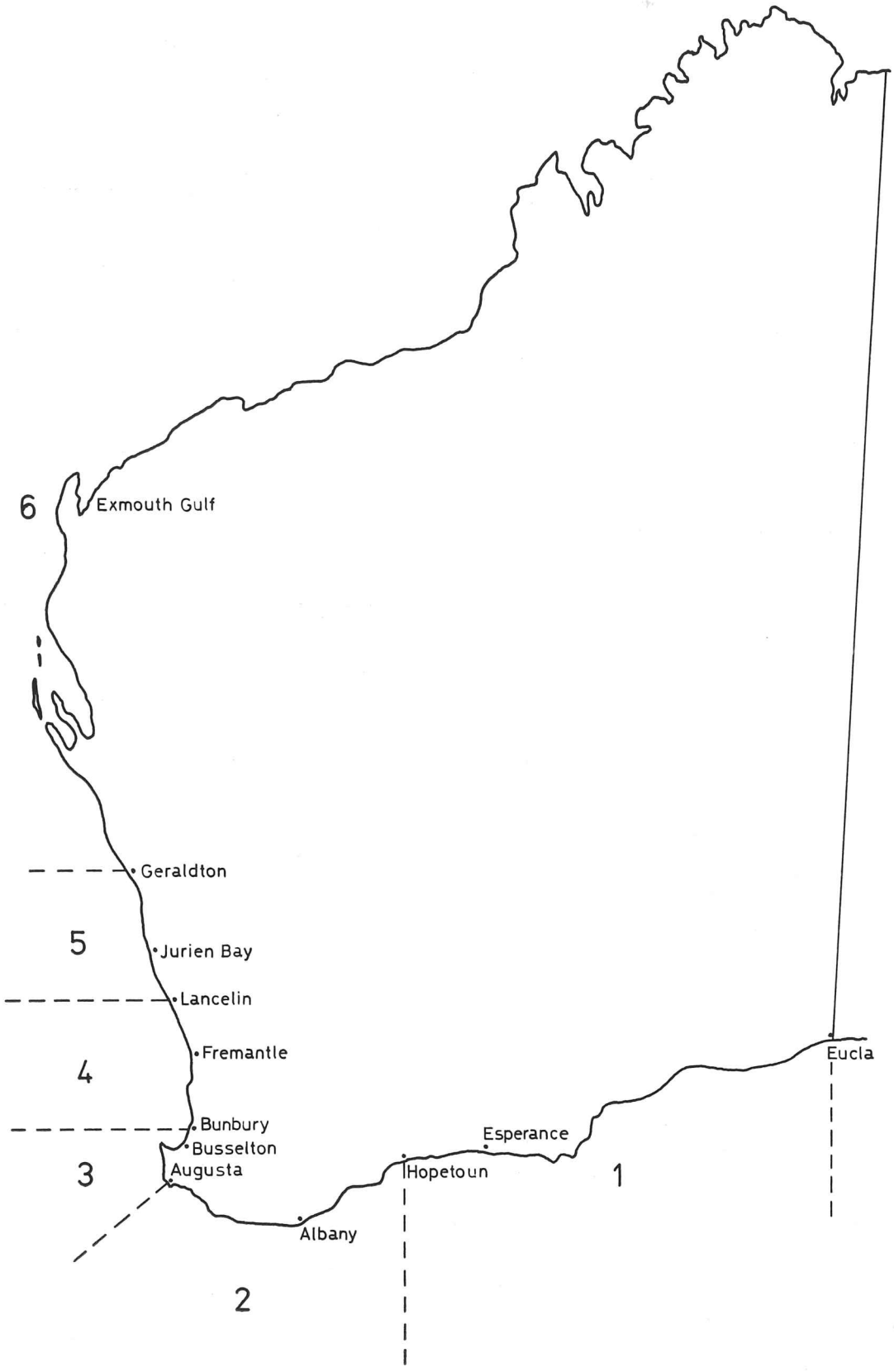

Figure 2—Map of Western Australian coast showing shark fishing areas (see text).

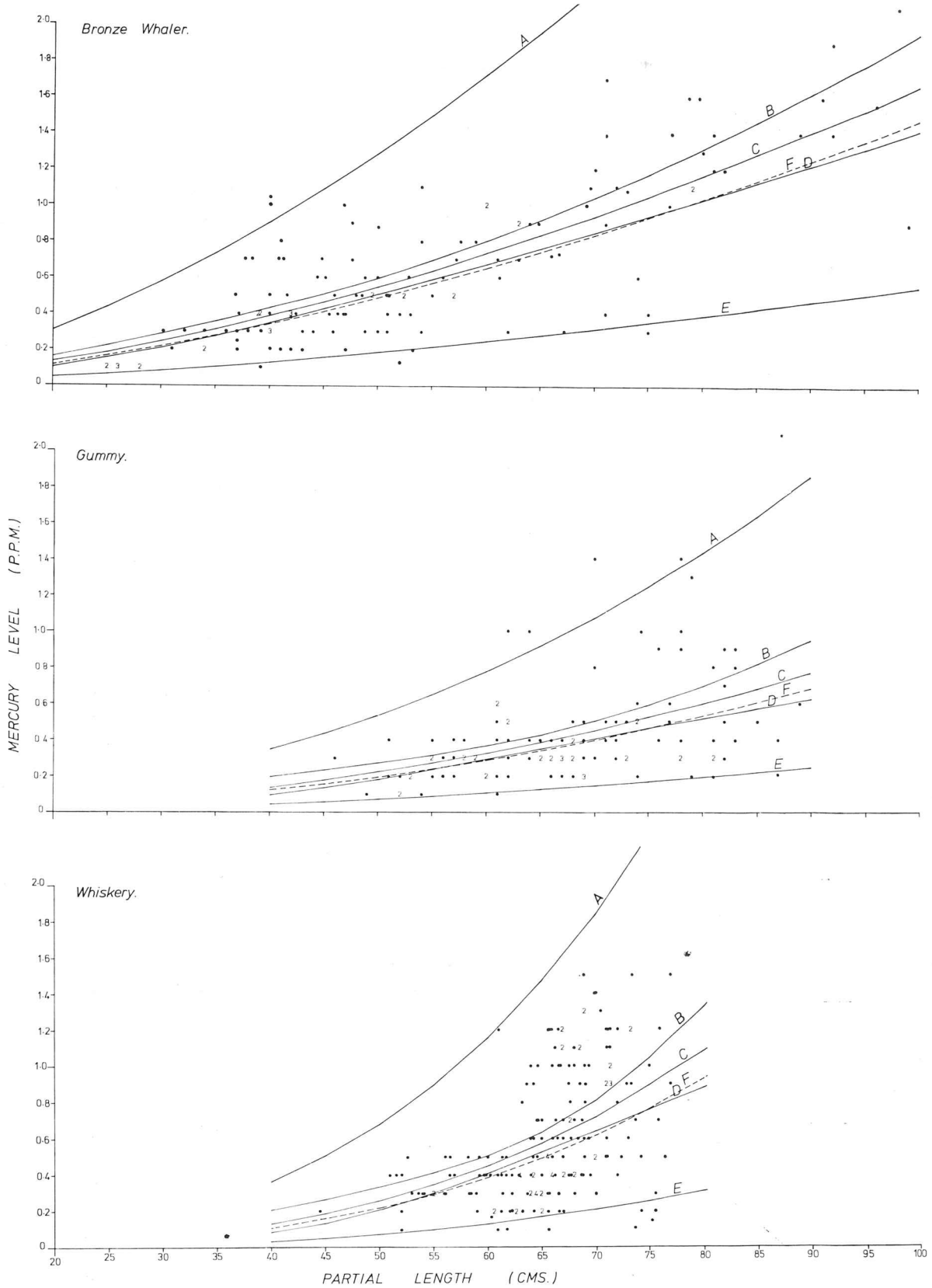

Figure 3—Mercury concentration/partial length regressions for bronze whaler, gummy and whiskery *C* the mean; *D* the lower 95% confidence limit for the mean; *E* the lower 95% confidence limit for the data. *C* the mean; *D* the lower 95% confidence limit for the mean; *E* the lower 95% confidence limit for the data. *A-E* refer to the corrected regression, $Hg = PL^b \exp(s^2/2)$. *F* is the mean for the uncorrected regression $Hg = aPL^b$. Each dot represents a single datum point. The digits, 2, 3, 4, indicate where that number of data points coincide.

APPENDIX 1

Measurements and mercury concentrations of sharks by species, ports and dates.

* Partial lengths in parentheses have been estimated from total lengths.
† Partial weights in parentheses have been estimated from partial lengths.
‡ Male (M), Female (F), Unidentified (?).

Port	Locality (see text)	Date	Mercury (p.p.m.)	Sex‡	Partial length* (cm)	Partial weight† (kg)	Total length (cm)
Gummy—Field Samples							
Mundrabilla	1	11/7/73	0·2	F	(68)	5·8	121
		11/7/73	0·2	F	(81)	9·3	143
		11/7/73	0·9	F	(82)	10·8	146
		11/7/73	0·5	F	(82)	10·5	145
		11/7/73	0·3	F	(78)	7·8	138
		11/7/73	0·3	F	(82)	10·5	146
		11/7/73	0·3	F	(81)	9·3	143
		11/7/73	0·3	M	(78)	9·3	139
		11/7/73	0·4	F	(87)	10·5	154
		11/7/73	0·3	F	(81)	9·5	143
		11/7/73	0·9	F	(78)	9·3	138
		11/7/73	0·3	F	(73)	8·3	130
		11/7/73	0·3	M	(68)	6·3	122
		11/7/73	0·6	F	(89)	14·5	157
		11/7/73	0·5	F	(85)	12·5	150
		11/7/73	2·1	F	(87)	12·5	154
Mundrabilla	1	10/7/73	0·4	F	(65)	(5·5)	116
		10/7/73	0·2	F	(79)	(8·6)	141
		10/7/73	0·4	F	(68)	(5·9)	122
		10/7/73	0·4	F	(83)	(10·0)	147
		10/7/73	0·1	M	(54)	(2·7)	98
		10/7/73	0·2	F	(69)	(5·7)	123
		10/7/73	0·2	F	(67)	(5·2)	120
		10/7/73	0·4	F	(81)	(9·2)	143
		10/7/73	0·4	F	(64)	(4·5)	114
		10/7/73	0·5	F	(77)	(7·9)	137
		10/7/73	0·1	M	(61)	(2·6)	109
		10/7/73	0·2	F	(74)	(5·0)	132
		10/7/73	0·4	F	(78)	(8·2)	138
		10/7/73	0·5	M	(61)	(3·9)	110
Esperance	1	24/11/73	0·2	F	61	4·5	113
		24/11/73	0·3	F	64	5·0	114
		24/11/73	0·2	F	69	6·3	123
		24/11/73	0·4	F	71	6·5	124
		24/11/73	0·5	F	71	6·3	128
		24/11/73	0·4	F	67	7·0	129
		24/11/73	0·3	F	69	5·0	130
		24/11/73	0·3	F	72	7·3	134
Cheynes Beach	2	4/4/74	0·9	F	(76)	(7·6)	135
		4/4/74	0·3	F	(73)	(6·7)	130
		4/4/74	0·9	F	(83)	(9·9)	147
		4/4/74	0·2	F	(69)	(5·7)	123
		4/4/74	0·3	F	(59)	(3·5)	107
		4/4/74	0·6	F	(74)	(7·0)	132
Cheynes Beach	2	30/6/73	0·1	F	(52)	2·3	94
Cheynes Beach	2	5/7/73	0·2	F	(53)	2·3	95
		5/7/73	1·4	M	(70)	(5·9)	125
		5/7/73	0·2	M	(57)	(3·2)	103
		5/7/73	0·2	F	(55)	2·8	100
		5/7/73	1·0	M	(62)	(3·6)	112
		5/7/73	0·3	M	(58)	(3·2)	104
		5/7/73	0·2	F	(62)	(3·6)	112
		5/7/73	0·3	F	(65)	(4·1)	116
		5/7/73	0·4	F	(61)	(3·2)	109
		5/7/73	0·5	F	(72)	(6·4)	128
		5/7/73	0·3	F	(59)	(3·6)	106
		5/7/73	1·0	M	(64)	(3·6)	114
		5/7/73	0·2	F	(51)	2·3	93
		5/7/73	0·5	F	(69)	(5·5)	123
		5/7/73	0·3	F	(57)	(3·2)	102
		5/7/73	0·3	F	(67)	(5·2)	120

Port	Locality (see text)	Date	Mercury (p.p.m.)	Sex‡	Partial length* (cm)	Partial weight† (kg)	Total length (cm)
Gummy—*continued*							
Cheynes Beach	2	15/11/73	0·8	M	70	(5·5)	132
		15/11/73	1·0	F	78	(8·6)	148
		15/11/73	1·4	F	78	(10·0)	151
Cheynes Beach	2	13/11/73	0·3	M	55	(2·8)	102
		13/11/73	0·6	M	61	(3·9)	109
		13/11/73	0·3	M	67	(5·2)	114
		13/11/73	0·3	F	46	(1·6)	84
		13/11/73	0·4	F	51	(2·2)	95
		13/11/73	0·4	F	55	(2·8)	101
		13/11/73	0·3	F	55	(2·8)	104
		13/11/73	0·3	F	56	(3·0)	103
		13/11/73	0·4	F	57	(3·2)	106
		13/11/73	0·4	F	58	(3·3)	107
		13/11/73	0·6	F	61	(3·9)	109
		13/11/73	0·4	F	(62)	(4·1)	111
		13/11/73	0·8	F	(81)	(9·2)	144
Albany	2	16/11/73	0·5	F	74	(7·0)	136
		16/11/73	0·7	F	82	(9·6)	142
Busselton	3	28/11/73	0·6	F	77	12·0	152
Busselton	3	27/4/73	0·3	F	(66)	(4·9)	118
		27/4/73	0·4	F	(72)	(6·5)	128
		27/4/73	0·4	F	(76)	(7·6)	135
		27/4/73	0·3	F	(68)	(5·4)	122
		27/4/73	0·3	F	(65)	(4·7)	117
Busselton/Bunbury	3	27/4/73	0·5	F	(73)	(6·7)	131
		27/4/73	0·5	F	(74)	(7·0)	132
		27/4/73	0·5	F	(68)	(5·4)	121
		27/4/73	0·4	F	(62)	(4·1)	112
		27/4/73	0·3	F	(67)	(5·2)	120
		27/4/73	0·3	F	(70)	(5·9)	125
		27/4/73	0·2	F	(66)	(4·9)	119
		27/4/73	0·2	F	(60)	(3·7)	108
		27/4/73	0·4	M	(68)	(5·4)	122
		27/4/73	0·4	F	(66)	(4·9)	118
Gummy—Market Samples							
	2	3/12/74	0·1	....	49	1·5	....
	4	4/12/74	0·5	....	62	5·1	....
	4	4/12/74	0·4	....	69	6·1	....
	4	4/12/74	0·2	....	53	2·8	....
	4	4/12/74	0·3	....	67	4·7	....
	4	28/2/75	0·2	....	60	3·0	....
	4	28/2/75	0·2	....	52	2·0	....
	4	28/2/75	0·2	....	56	3·0	....
	4	28/2/75	0·3	....	66	3·0	....
	4	28/2/75	0·1	....	52	2·5	....
	3	28/2/75	0·8	....	83	(10·0)	....
	2	5/3/75	0·3	....	55	2·7	....
	2	6/3/75	1·3	....	79	(8·6)	....
	4	7/3/75	0·3	....	58	3·5	....
	?	21/3/75	1·0	....	76	8·2	....
Bronze Whaler—Field Samples							
Mundrabilla	1	9/7/73	0·3	M	(67)	17·8	163
		9/7/73	0·2	F	(53)	(7·8)	128
		9/7/73	0·5	M	(52)	(7·5)	126
		9/7/73	0·5	F	(48)	(5·9)	115
Esperance	1	24/11/73	0·6	M	(44)	4·0	106
		24/11/73	0·9	F	(63)	12·0	155

Port	Locality (see text)	Date	Mercury (p.p.m.)	Sex‡	Partial length* (cm)	Partial weight† (kg)	Total length (cm)
Bronze Whaler—*continued*							
Cheynes Beach	2	4/4/73	0·7	M	(38)	(3·2)	91
		4/4/73	0·7	M	(41)	(3·8)	97
		4/4/73	0·5	M	(42)	(3·9)	99
		4/4/73	0·7	M	(48)	(5·7)	114
		4/4/73	0·6	F	(45)	(5·0)	108
		4/4/73	0·4	M	(51)	(6·9)	122
		4/4/73	0·6	M	(49)	(6·1)	117
		4/4/73	0·7	F	(38)	(3·0)	89
		4/4/73	0·3	F	(49)	(6·1)	117
		4/4/73	0·3	M	(51)	(6·9)	122
		4/4/73	2·3	F	(96)	(39·2)	235
		4/4/73	0·7	F	(41)	(3·8)	173
Albany	2	4/11/73	0·8	F	(58)	(9·6)	139
		4/11/73	0·5	F	(52)	(7·5)	125
		4/11/73	1·1	M	(54)	(8·1)	130
Albany	2	16/11/73	0·6	M	(53)	(7·6)	127
		16/11/73	0·9	M	(65)	(13·3)	157
		16/11/73	1·4	F	(77)	(21·5)	188
		13/11/73	0·5	M	(37)	(2·3)	87
		13/11/73	0·9	M	(48)	(5·5)	114
Albany	2	30/6/73	0·5	F	(40)	(3·3)	95
		30/6/73	1·0	F	(40)	(3·5)	95
		30/6/73	0·4	F	(37)	(2·8)	88
		30/6/75	0·3	M	(50)	(6·6)	120
		30/6/73	0·5	?	(50)	(6·4)	119
Albany	2	.... 28/2/73	0·2	F	(42)	6·0	100
		28/2/73	0·4	M	(39)	4·0	92
		28/3/73	0·4	F	(39)	4·5	92
		28/3/73	0·4	?	(46)	5·0	109
		28/3/73	0·5	F	(50)	9·0	119
		28/3/73	0·3	F	(44)	5·0	105
		24/5/73	0·9	F	(64)	(12·9)	155
Busselton	3	28/11/73	0·3	M	(32)	3·0	98
		28/11/73	0·4	M	(47)	4·5	112
		28/11/73	1·1	M	(70)	17·5	169
		28/11/73	1·1	M	(72)	18·0	175
		28/11/73	0·6	F	(61)	11·0	148
Busselton	3	29/11/73	0·8	M	(54)	8·0	130
		29/11/73	1·6	M	(79)	20·0	191
		29/11/73	1·6	M	(80)	27·5	194
		25/11/73	2·2	F	60	(10·8)	143
Busselton	3	27/4/73	1·0	M	(69)	(15·9)	168
		27/4/73	0·4	M	(42)	(4·1)	100
		27/4/73	0·3	F	(30)	(1·6)	93
		27/4/73	0·4	F	(46)	(5·4)	111
		27/4/73	0·6	M	(50)	(6·6)	120
		27/4/73	0·3	M	(46)	(5·1)	109
		27/4/73	0·3	M	(39)	(3·3)	92
		27/4/73	0·7	F	(45)	(4·8)	107
		27/4/73	0·3	F	(42)	(4·2)	101
		27/4/73	0·1	M	(39)	(3·3)	92
Bunbury	3	20/10/73	1·0	F	(47)	(5·5)	112
Fremantle	4	31/1/74	0·5	M	(46)	(5·8)	110
		31/1/74	0·5	M	(48)	5·5	116
		31/1/74	0·4	M	(52)	6·5	125
		31/1/74	0·5	F	(51)	5·5	122
		31/1/74	0·7	F	(57)	9·5	138

Port	Locality (see text)	Date	Mercury (p.p.m.)	Sex‡	Partial length* (cm)	Partial weight† (kg)	Total length (cm)
Bronze Whaler—Market Samples	2	15/8/74	0·7	....	66	15·2	....
	2	16/8/74	0·7	....	67	13·6	....
	2	16/8/74	1·6	....	71	17·6	....
	2	16/8/74	1·0	....	40	2·4	....
	2	16/8/74	0·6	....	42	3·2	....
	2	16/8/74	0·1	....	52	5·7	....
	2	16/8/74	0·3	....	62	9·0	....
	2	16/8/74	1·1	....	73	20·7	....
	2	16/8/74	0·2	....	37	2·2	....
	4	16/8/74	0·9	....	50	5·9	....
	4	16/8/74	1·4	....	92	36·0	....
	4	23/9/74	1·6	....	110	66·5	....
	2	3/12/74	1·8	....	96	40·0	....
	3	3/12/74	2·1	....	98	41·0	....
	1	4/12/74	1·0	....	111	74·0	....
	4	4/12/74	0·5	....	57	7·2	....
	4	4/12/74	0·2	....	47	4·9	....
	4	4/12/74	0·4	....	47	4·8	....
	4	4/12/74	2·6	....	118	60·0	....
	4	4/12/74	1·7	....	106	52·0	....
	4	4/12/74	1·6	....	91	37·0	....
	4	4/12/74	0·8	....	59	5·4	....
	4	4/12/74	0·9	....	63	6·5	....
	4	4/12/74	1·2	....	81	51·0	....
	4	6/12/74	0·6	....	105	58·0	....
	4	6/12/74	1·0	....	60	11·0	....
	3	6/12/74	0·4	....	40	3·0	....
	2	9/12/74	0·3	....	40	2·1	....
	2	9/12/74	0·8	....	41	2·4	....
	2	9/12/74	0·3	....	38	2·0	....
	2	9/12/74	0·3	....	40	2·6	....
	4	13/12/74	1·4	....	81	27·0	....
	4	13/12/74	0·9	....	99	40·0	....
	4	13/12/74	1·0	....	60	10·3	....
	4	13/12/74	0·7	....	63	12·2	....
	4	13/12/74	0·6	....	74	16·3	....
	4	13/12/74	1·2	....	70	14·8	....
	3	13/12/74	0·6	....	103	66·0	....
	4	28/2/75	0·2	....	40	2·0	....
	4	28/2/75	0·3	....	36	2·0	....
	4	28/2/75	0·2	....	43	3·0	....
	4	28/2/75	0·5	....	55	7·5	....
	4	28/2/75	0·4	....	75	22·0	....
	4	28/2/75	0·3	....	75	20·5	....
	4	4/3/75	0·3	....	43	3·2	....
	4	4/3/75	0·4	....	42	2·8	....
	4	4/3/75	0·5	....	57	8·3	....
	4	4/3/75	0·6	....	56	7·0	....
	4	5/3/75	1·3	....	80	25·3	....
	4	5/3/75	2·0	....	102	38·7	....
	4	5/3/75	1·7	....	71	13·0	....
	2	5/3/75	0·9	....	71	7·2	....
	2	5/3/75	0·3	....	54	3·7	....
	2	5/3/75	0·4	....	53	2·2	....
	2	5/3/75	0·5	....	51	2·5	....
	2	5/3/75	1·4	....	89	34·0	....
	2	5/3/75	1·1	....	79	19·0	....

Port	Locality (see text)	Date	Mercury (p.p.m.)	Sex‡	Partial length* (cm)	Partial weight† (kg)	Total length (cm)
Bronze Whaler—Market Samples—*continued*							
	4	5/3/75	0·3	....	34	2·0	....
	2	6/3/75	1·2	....	82	19·0	....
	2	6/3/75	1·5	....	101	41·0	....
	4	7/3/75	0·7	....	61	8·9	....
	4	7/3/75	1·1	....	79	16·1	....
	4	7/3/75	0·2	....	37	2·0	....
	4	7/3/75	0·2	....	34	1·8	....
	4	7/3/75	0·2	....	31	1·9	....
	4	7/3/75	0·4	....	39	2·2	....
	4	7/3/75	0·2	....	34	1·8	....
	4	7/3/75	0·3	....	37	1·8	....
	4	7/3/75	0·3	....	40	2·5	....
	4	7/3/75	0·2	....	41	3·1	....
	4	7/3/75	0·1	....	28	0·6	....
	4	7/3/75	0·1	....	28	0·6	....
	4	7/3/75	0·1	....	26	0·5	....
	4	7/3/75	0·1	....	25	0·5	....
	4	7/3/75	0·1	....	26	0·5	....
	4	7/3/75	0·1	....	26	0·5	....
	4	7/3/75	0·1	....	25	0·6	....
	4	7/3/75	1·0	....	77	20·0	....
	4	7/3/75	1·9	....	92	38·0	....
	4	7/3/75	0·3	....	108	68·0	....
	4	7/3/75	1·5	....	108	47·0	....
	4	7/3/75	1·3	....	101	35·0	....
	4	7/3/75	0·4	....	71	16·0	....
Whiskery—Field Samples							
Mundrabilla	1	9/7/73	1·2	M	(73)	(8·5)	140
		9/7/73	0·5	M	(70)	8·5	133
		9/7/73	0·5	F	(72)	9·0	139
		9/7/73	0·7	F	(76)	10·5	146
		9/7/73	0·2	M	(76)	10·0	145
		9/7/73	0·2	M	(74)	10·5	142
		9/7/73	1·2	M	(67)	7·0	126
		9/7/73	0·9	M	(73)	9·8	139
		9/7/73	0·5	M	(77)	10·0	147
		9/7/73	0·4	F	(69)	8·8	132
		9/7/73	2·6	M	(73)	9·3	140
Mundrabilla	1	10/7/73	0·6	F	(68)	(7·5)	130
Esperance	1	24/11/73	1·1	M	71	9·0	141
		24/11/73	1·5	M	77	9·0	144
		24/11/73	1·0	F	64	6·0	126
		24/11/73	0·7	F	67	7·5	132
Cheynes Beach	2	4/4/73	0·2	M	(45)	2·0	80
		4/4/73	0·3	F	(55)	4·5	105
		4/4/73	0·3	F	(56)	5·0	107
		4/4/73	0·3	F	(55)	4·5	105
		4/4/73	1·1	F	(66)	9·5	127
		4/4/73	0·3	M	(56)	4·8	104
		4/4/73	0·5	M	(65)	7·0	122
Cheynes Beach	2	13/11/73	0·5	M	(61)	(5·2)	115
		13/11/73	0·8	M	(63)	(5·6)	119
		13/11/73	0·5	M	(64)	(5·9)	121
		13/11/73	0·7	M	(65)	(5·9)	122
		13/11/73	0·6	M	(69)	(7·2)	131
		13/11/73	0·6	M	(70)	(7·5)	133
		13/11/73	0·4	F	(52)	(3·3)	99
		13/11/73	0·3	F	(54)	(3·6)	102
		13/11/73	0·4	F	(65)	(6·0)	124

Port	Locality (see text)	Date	Mercury (p.p.m.)	Sex‡	Partial length* (cm)	Partial weight† (kg)	Total length (cm)
Whiskery—*continued*							
Albany	2	28/2/73	1·2	F	(71)	(7·7)	136
		28/2/73	1·5	M	(69)	(7·1)	131
		28/2/73	0·5	F	(56)	(4·0)	107
		28/2/73	0·4	M	(64)	(5·9)	121
		28/2/73	0·4	F	(60)	(4·8)	114
		28/2/73	0·5	F	(59)	(4·7)	113
		28/2/73	1·0	M	(71)	(7·8)	136
		28/2/73	0·4	F	(62)	(5·4)	119
		28/2/73	0·4	F	(60)	(4·9)	115
		28/2/73	1·0	F	(69)	(7·3)	133
		28/2/73	0·5	F	(66)	(6·3)	126
		28/2/73	1·2	M	(73)	(8·5)	140
		28/2/73	0·5	F	(66)	(6·3)	126
		28/2/73	0·4	F	(60)	(4·8)	114
		28/2/73	0·3	F	(66)	(6·3)	126
		28/2/73	0·5	F	(66)	(6·3)	126
		28/2/73	0·5	F	(58)	(4·5)	111
		28/2/73	0·4	F	(61)	(5·2)	117
Albany	2	24/5/73	0·5	F	(62)	(5·3)	118
		24/5/73	0·3	M	(61)	(5·2)	115
		24/5/73	0·3	M	(64)	(5·8)	120
		24/5/73	0·7	F	(65)	(5·9)	124
Albany	2	30/6/73	0·5	F	(57)	(4·1)	108
		5–7/7/73	1·1	M	(67)	5·8	127
		5–7/7/73	0·3	M	(58)	3·5	109
		5–7/7/73	0·3	M	(65)	5·0	122
		5–7/7/73	0·4	F	(51)	2·3	97
		5–7/7/73	0·5	F	(53)	2·8	100
		5–7/7/73	0·7	M	(74)	8·5	141
		5–7/7/73	0·3	M	(65)	5·5	122
		5–7/7/73	0·4	F	(59)	4·0	113
		5–7/7/73	0·5	F	(69)	6·8	132
		5–7/7/73	0·4	M	(61)	4·5	114
		5–7/7/73	0·6	F	(68)	(7·0)	131
		5–7/7/73	0·4	?	(57)	(4·1)	108
		5–7/7/73	1·2	?	(61)	(5·1)	116
Albany	2	4/11/73	0·5	F	(66)	(6·3)	126
		4/11/73	0·9	F	(64)	(5·9)	123
		4/11/73	0·6	F	(69)	(7·3)	133
		4/11/73	1·1	M	(68)	(6·9)	129
		4/11/73	0·5	M	(70)	(7·5)	133
		4/11/73	0·3	M	(59)	(4·6)	110
		4/11/73	1·1	M	(69)	(7·0)	130
		4/11/73	0·4	M	(69)	(7·3)	132
		4/11/73	1·3	M	(70)	(7·5)	134
Albany	2	13/11/73	1·2	M	66	5·0	125
		13/11/73	1·0	M	68	5·8	126
		13/11/73	1·0	M	69	6·3	128
		13/11/73	0·9	M	69	6·8	128
		13/11/73	0·5	M	71	7·3	135
		13/11/73	1·2	M	76	9·0	136
		13/11/73	0·9	M	77	7·5	140
		13/11/73	0·4	F	63	5·8	120
		13/11/73	0·6	F	64	5·5	123
		13/11/73	0·5	F	66	6·3	126
		13/11/73	0·8	F	69	7·3	130
Albany	2	16/11/73	0·3	M	(54)	(3·7)	100
		16/11/73	0·4	M	(57)	(4·1)	105
		16/11/73	0·4	F	(52)	(3·2)	98
Busselton/Bunbury	3	27/4/73	0·2	F	(61)	(5·2)	117
		27/4/73	0·2	M	(63)	(5·5)	118
		27/4/73	0·2	M	(62)	(5·4)	117
		27/4/73	0·2	M	(66)	(6·3)	124
		27/4/73	0·2	M	(64)	(5·9)	121
		27/4/73	0·2	F	(63)	(5·6)	121
		27/4/73	0·3	F	(58)	(4·5)	111

Port	Locality (see text)	Date	Mercury (p.p.m.)	Sex‡	Partial length* (cm)	Partial weight† (kg)	Total length (cm)
Whiskery—*continued*							
Busselton/Bunbury—*continued*							
		27/4/73	0·4	M	(68)	(6·8)	128
		27/4/73	0·2	M	(67)	(6·5)	126
		27/4/73	0·2	F	(61)	(5·0)	116
		27/4/73	0·2	F	(61)	(5·0)	116
		27/4/73	0·2	M	(65)	(6·1)	123
		27/4/73	0·4	F	(68)	(6·8)	130
		27/4/73	0·3	M	(67)	(6·5)	126
		27/4/73	0·2	M	(65)	(6·1)	123
		27/4/73	0·3	M	(76)	(9·2)	145
		27/4/73	0·3	M	(66)	(6·3)	124
		27/4/73	0·7	M	(68)	(6·9)	129
		27/4/73	1·2	M	(71)	(7·8)	136
		27/4/73	0·2	M	(67)	(6·6)	127
		27/4/73	0·3	M	(65)	(6·0)	122
		27/4/73	0·4	M	(67)	(6·6)	127
		27/4/73	0·1	M	(62)	(5·3)	116
		27/4/73	0·1	M	(61)	(5·1)	114
		27/4/73	0·2	M	(63)	(5·5)	118
Busselton	3	28/11/73	0·4	M	68	6·0	127
		28/11/73	0·9	M	71	7·5	130
		28/11/73	1·1	M	67	6·5	130
		28/11/73	1·3	M	69	7·0	131
		28/11/73	1·4	M	70	7·0	133
		28/11/73	0·9	M	71	7·5	136
		28/11/73	1·0	F	66	7·5	128
Busselton 13 mls W of Canal Rocks	3	29/11/73	1·7	M	57	7·5	113
		29/11/73	0·6	M	65	6·0	126
		29/11/73	1·2	M	72	7·0	135
		29/11/73	1·0	M	75	7·0	136
		29/11/73	0·5	M	67	7·5	142
		29/11/73	0·4	F	63	5·0	118
		29/11/73	0·4	F	63	5·5	123
		29/11/73	0·7	F	65	5·5	127
		29/11/73	0·7	F	68	6·5	130
		29/11/73	0·4	F	66	7·0	132
Bunbury	3	20/10/73	0·9	F	(64)	(5·7)	122
		20/10/73	1·0	F	(65)	(5·9)	124
		20/10/73	1·1	M	(71)	(7·8)	136
Fremantle	4	31/1/74	0·3	F	64	6·0	119
		31/1/74	0·4	F	66	(6·4)	127
Whiskery—Market Samples							
	4	23/9/74	0·8	....	72	6·2	....
		23/9/74	0·3	....	70	6·2	....
		23/9/74	1·2	....	67	6·2	....
		23/9/74	0·3	....	54	3·9	....
		23/9/74	0·4	....	66	6·2	....
		23/9/74	0·4	....	63	4·7	....
		23/9/74	0·4	....	72	6·4	....
		23/9/74	0·4	....	66	6·2	....
		23/9/74	0·2	....	62	5·2	....
	4	4/12/74	0·6	....	67	6·2	....
		4/12/74	0·5	....	60	5·6	....
		4/12/74	0·3	....	64	7·0	....
		4/12/74	0·6	....	66	8·0	....
		4/12/74	0·4	....	68	8·3	....
		13/12/74	0·4	....	55	2·9	....
		13/12/74	0·6	....	71	6·0	....
	4	5/3/75	0·6	....	73	6·6	....
		5/3/75	0·4	....	65	5·3	....
		5/3/75	0·2	....	59	4·7	....

Port	Locality (see text)	Date	Mercury (p.p.m.)	Sex‡	Partial length* (cm)	Partial weight† (kg)	Total length (cm)
Whiskery—Market Samples—*continued*							
		5/3/75	0·4	....	64	5·2	....
		5/3/75	0·3	....	65	5·4	....
		5/3/75	0·3	....	68	5·4	....
		5/3/75	0·3	....	65	5·3	....
		5/3/75	1·2	....	67	6·3	....
	4	7/3/75	0·2	....	52	2·7	....
		7/3/75	0·3	....	53	2·6	....
		7/3/75	0·1	....	52	2·9	....

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