Concentrations of Heavy Metals and Organochlorines in Marine Mammals of Northern Waters: Overview and Evaluation

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ABSTRACT

Wagemann, R., and D.C.G. Muir. 1984. Concentrations of heavy metals and organochlorines in marine mammals of northern waters: overview and evaluation. Can. Tech. Rep. Fish. Aquat. Sci. 1279: v + 97 p.

Published data on heavy metal and organochlorine concentrations in tissues of cetaceans and pinnipeds, mainly from northern waters, were compiled. The data were subjected to multiple comparison by Scheffé's method, and assessed for significant differences.

Most cetaceans had mercury concentrations (wet weight basis) of 0.02-1.6 µg/g in muscle tissue, 1-2 µg/g in renal tissue, and 3-20 µg/g in the liver. Of all cetaceans some dolphins, pilot whales, and short-finned pilot whales had the highest recorded mercury levels in their tissues. Systematic differences in mercury levels among different species of animals were not apparent.

Most mean mercury concentrations (89% of the compiled data) in the liver of seals were below 65 µg/g, and below 3.4 µg/g and 0.94 µg/g in renal and muscle tissue, respectively. Among seals there was no differentiation of mercury concentration according to species of animals, but age seemed to be one of the factors determining the level of mercury in tissues. A limited number of other metals data (Zn, Cu, Pb, Se) are also given and discussed.

Mean cadmium concentrations in renal tissue of whales 28-64 µg/g were higher than in the same tissue of most seals and porpoises. Cadmium concentrations in kidneys of striped dolphins (25 µg/g on average) were comparable to the concentrations in whales. In both cetaceans and seals cadmium was consistently higher in renal tissue than in hepatic tissue by a factor of 2-5.

Statistical comparison of total DDT (ΣDDT) concentrations in cetaceans revealed four distinct groups. Dolphins from the California coast had higher ΣDDT levels than dolphins from the Mediterranean coast of France or porpoises from the Bay of Fundy. The latter group had significantly higher ΣDDT than all other groups. PCB levels followed a similar trend, but only two groups (coast of France and all other data) could be discerned.

Levels of ΣDDT and PCB in narwhal blubber (Pond Inlet, N.W.T., Canada) averaged 3.51 and 10.09 µg/g, respectively, with males having significantly higher levels than females. Results were not correlated with length of the animals. The residue levels in narwhals could not be distinguished statistically from other organochlorine data for cetaceans from Greenland or the North Atlantic.

Comparison of concentrations of PCBs in pinnipeds (blubber) revealed four distinct groups. Seals from the Baltic and the North Sea coast of the Netherlands had significantly higher PCB levels than all other animals. Levels of PCBs in seals from Canadian waters were significantly lower than those from the Baltic except for harbour seals in the Bay of Fundy. Five distinct groups of pinnipeds could be delineated for ΣDDT residues, with sea lions from the California coast having the highest levels, and seals from the Canadian Arctic the lowest.

Key words: marine mammals; heavy metals; chlorinated hydrocarbons; PCB; DDT; literature reviews; northern waters; cetaceans; pinnipeds; mercury; cadmium.

RESUME

Wagemann, R., and D.C.G. Muir. 1984. Concentrations of heavy metals and organochlorines in marine mammals of northern waters: overview and evaluation. Can. Tech. Rep. Fish. Aquat. Sci. 1279: v + 97 p.

Un ensemble de données disponibles sur les concentrations de métaux lourds et d'agents organochlorés trouvées dans des tissus de cétacés et de pinnipèdes des eaux septentrionales ont été rassemblées et une étude comparée de ces données d'après la méthode de Scheffé a été entreprise.

La plupart des cétacés avaient des niveaux de mercure (poids humide) de 0.02 à 1.6 µg/g dans leur tissu musculaire, de 1 à 2 µg/g dans le tissu rénal, et de 3 à 20 µg/g dans le tissu hépatique. Les tissus de certains dauphins, ainsi que ceux des globicéphales noirs de l'Atlantique et de globicéphales à nageoires courtes, contenaient du mercure aux niveaux les plus élevés enregistrés à ce jour. Les différences de niveaux entre ces animaux ne peuvent être attribuées à leur appartenance à une espèce plutôt qu'à une autre.

La plupart des niveaux moyens de mercure (soit 89% des données) étaient inférieurs à 65 µg/g dans le tissu hépatique, à 3.4 µg/g dans les tissus rénaux et à 0.94 µg/g dans le tissu musculaire. En comparant les espèces de phoques une à une, on n'a trouvé aucune différence dans les niveaux de mercure de leurs tissus. Cependent, on a constaté que l'âge semblait être un des facteurs déterminants de la concentration de mercure. Les résultats d'analyses supplémentaires sur un certain nombre de métaux, tel que le Zn, le Cu, le Pb et le Se, sont aussi présentés dans cet article.

Les concentrations moyennes en cadmium des tissus rénaux de baleines variaient entre 28 et 64 µg/g. Cependant elles étaient plus élevées chez la plupart des phoques et des marsouins. Les concentrations en cadmium du foie du dauphin bleu (Stenella coeruleoalba) étaient comparables à celles des baleines (25 µg/g en moyenne). Chez les cétacés et les pinnipèdes étudiés, le degré de concentration en cadmium était systématiquement plus élevé dans le tissu rénal que dans le tissu hépatique, dans un rapport de 2 à 5.

La comparaison statistique des concentrations totales en DDT (ΣDDT) constatées dans le

pannicule des cétacés, a révélé l'existence de quatre groupes distincts. Le pannicule des dauphins provenant des côtes Californiennes contenaient des concentrations de ΣDDT plus élevées que celles provenant des dauphins des côtes méditerranéennes de France ou de la baie de Fundy tandis qu'un quatrième groupe hétérogène contenait les niveaux les plus faibles. Les concentrations de PCB suivant la même tendance, avec deux groupes distincts cependant (un provenant des côtes de France, l'autre du restant des données).

Les niveaux de ΣDDT et PCB dans le pannicule des narvals (Pond Inlet, T.N.-O.) atteignaient en moyenne 3.51 et 10.09 µg/g, respectivement, le niveau des mâles étant sensiblement plus élevé que celui des femelles. Les résultats n'indiquaient pas de correspondance entre la teneur en DDT et la longueur totale des animaux. On n'a trouvé aucune différence significative entre les niveaux d'agents organochlorés obtenus chez le narval et les niveaux obtenus chez les cétacés du Groenland ou de l'Atlantique Nord.

La comparaison des concentrations d'agents organochlorés entres les divers pinnipèdes (pannicule) a révélé que les phoques des côtes des Pays-Bas baignées par la mer du Nord ont une teneur en PCB nettement plus élevée que tous les autres animaux étudiés. Les niveaux de PCB des phoques habitant les eaux canadiennes étaient sensiblement moins élevés que ceux de la mer Baltique, sauf les phoques communs de la baie de Fundy. On a pu distinguer cinq groupes de pinnipèdes sur la base de leurs concentrations respectives en ΣDDT, les otaries de Californie ayant les concentrations les plus élevées et les phoques de l'Arctique, les concentrations les plus basses.

Mots-clés: mammifères marins; métaux lourds; carbohydrates chlorinés; BPC; DDT; recherches bibliographiques; eaux du nord; cétacés; pinnipèdes; mercure; cadmium.

INTRODUCTION

A large body of data on mercury and chlorinated aromatic hydrocarbons in pinnipeds has been published over the past ten years. Reviews and qualitative comparisons of residue levels in various pinniped species from different geographic locations have been made (Holden 1978a, 1975). There is nevertheless a need for further updating of the existing data base and review of the literature. The published data on pollutant burdens in tissues of cetaceans is less extensive than for pinnipeds. An asssessment of some of this data has been made (Gaskin 1982). We have attempted a systematic documentation of the data base for pinnipeds and cetaceans in northern waters (up to mid 1983) and compared, statistically, heavy metal and organochlorine concentrations in various tissues largely from northern waters. The objective was to provide a readily accessible overview of most existing heavy metals and organochlorine data for marine mammals from northern waters, and to assess these data for any significant differences or similarities from which conclusions about hot spots of pollution might be drawn. A multiple means comparison of the data using Scheffé's method (Scheffé 1959) has been employed in the hope of obtaining a better perspective on the degree of hazard to marine mammals in Canadian waters, as well as other areas, from continued accumulation of heavy metals and chlorinated aromatic hydrocarbons. A further reason for doing such an analysis was simply to avoid the tendency of attributing significance, through visual inspection of data plots, to differences where there might be none.

This method of analysis (Scheffé 1959) was chosen because it is applicable to unequal sample sizes which was the situation faced here and because it is the most conservative such test. It was assumed that the populations were normally distributed. However, departures from normality have been reported for fish (Giesy and Wiener 1977), and this is probably also true for some mammalian tissues. It was, of course, not possible to test the data post publication for normality. The postulated significance levels must therefore be viewed with this in mind.

We recognized the possibility that the available data was not of uniform quality. It is well known that at the trace level, measurements are subject to considerable interlaboratory variability (Morrison 1976; Holden 1981; Holden et al. 1983). Since the data base considered here spans more than a decade, during which time methodologies and instrumentation may have changed, variability in the quality of data would also be expected from this source. A meaningful assessment of the data in this regard was impossible, and the available data were simply taken at face value. Concentrations reported here are all expressed on a wet tissue basis.

RESULTS AND DISCUSSION

MERCURY IN CETACEANS

A reasonably large number of mercury concentrations in tissues of cetaceans from northern waters has been published to date (Table 1). We made a statistical comparison of the concentration means (wherever standard deviations were available) using the Scheffé multiple comparison method (see Appendix) on the various groups of animals. In a few instances where the range but not the standard deviation was given, we estimated the latter from the range in the usual way (Beyer 1966). Means derived from fewer than three samples were not used in the analysis. The results of this analysis are shown in Fig. 1, 2 and 3 for mercury in liver, muscle and kidney, respectively. The bars in these figures are not error bars in the usual sense; they only indicate the outcome of the Scheffé test. The means were compared in all cases at the $\alpha = 0.10$ level of significance. Wherever the bars overlap, the corresponding means do not differ significantly, and only those groups differ significantly from each other whose bars do not overlap.

The average mercury concentrations in the liver of cetaceans (i.e. not individuals) ranged from 3-205 µg/g, but only the short-finned pilot whales, and striped dolphins (not shown in Fig. 1, off scale) having the highest mercury concentration, differed significantly from all other groups which did not differ amongst themselves despite the wide range of their means (3-20 µg/g) (Fig. 1). There is no distinct segregation (at $\alpha = 0.10$) between porpoises, narwhals and belugas, for example, as far as mercury in liver is concerned. Since most of the data in this order are for harbour porpoises from the east coast of the U.S.A. (ME) and Canada (N.S.), a global, regional comparison of Hg-levels was not possible. However, one harbour porpoise from the North Sea (index no. 32, Table 1) had a mercury level in the liver comparable to the highest levels in porpoises from the Atlantic coast in North America. Mercury levels in the liver of cetaceans and seals apparently are determined to a large extent by the age of the animal (Gaskin et al. 1979; Sergeant 1980), but this did not become overly apparent from the available data base. The fact that most groups consisted of only a few individuals also tended to make the analysis less discriminating.

There is undoubtedly a limit to the concentration of mercury (or any toxic metal) that an animal can tolerate in its tissues notwithstanding the beneficial effect that selenium may exert in this regard. For mercury in mammalian hepatic tissues this limit appears to be within the range of 100-400 µg/g, wet weight, (MARC 1980). Dead or ill seals and sea lions found in the wild with mercury levels in their livers within this range (Reijnders 1980; van de Ven et al. 1979; Buhler and Mate 1973; Henriksson and Karppanen 1969) would seem to be a manifestation of these critical limits. The mean concentration in the liver of the 1979-group of narwhals (index no. 13, Table 1) is approximately 6 µg/g, and the highest concentration in any individual of this group was 13 µg/g. Some short finned pilot whales have 100-360 µg/g of mercury (index no. 6, 15, 16, Table 1) and a group of striped dolphins from the east coast of Japan had up to 485 µg/g (205 µg/g on average, index no. 98, Table 1), a seemingly critically high concentration of mercury in liver.

Mercury levels in muscle tissue of cetaceans were segregated by Scheffé's procedure into three distinct groups (Fig. 2). The blue-white and striped dolphins (index no. 48, 98, Table 1) having the highest mercury concentration (6.73 and 7.02 μg/g, not shown in Fig. 2) were significantly different from all other groups. Most groups had mercury levels in muscle tissue in the range of 0.02-1.6 μg/g (Fig. 2). Pilot whales (index no. 8, 6, Table 1), with the second highest concentration (4 μg/g) are significantly different from dolphins and all other groups which do not differ significantly among themselves in their mercury levels (Fig. 2). It is noteworthy that baleen whales (sei, fin, minke) have the lowest concentration of mercury in their tissues. This may be a consequence of their diet as has been pointed out by Sergeant and Armstrong (1973), and a possible source of variable mercury levels among certain seal species. For cetaceans the available data are too few to show that neither location of catch nor species differences correlated with concentration of Hg in any tissues.

Mercury in renal tissue of cetaceans is highest (8.65 μg/g, Fig. 3) for short-finned pilot whales and striped dolphins (8.71 μg/g, not shown in Fig. 3, index no. 6, 98, Table 1) and next highest (3.56 μg/g) for some harbour porpoises from the coast of New Brunswick, Canada (index no. 27, Table 1). These groups differ significantly from each other and from all other groups (Fig. 3). Aside from these groups, cetaceans have mercury concentrations in renal tissue in the range of 1-2 μg/g. Quite consistently the pilot whales, short-finned pilot whales, and dolphins have the highest mercury levels in liver, muscle and kidney. The available data are not extensive enough to discriminate between various localities.

Hepatic tissue of cetaceans has consistently higher mercury levels than muscle or renal tissue by approximately a factor of five, while renal and muscle tissues have comparable mercury levels.

OTHER METALS IN CETACEANS

Concentrations of Zn, Cu, and Pb in cetaceans have been measured to date only in narwhals, harbour porpoises and the striped dolphin as far as we know (Table 2), but these data are insufficient for an extensive group-comparison by the Scheffé method. Concentrations of Cd and Se have been determined also in other cetaceans (Tables 2 and 3). The 1979-sample of narwhals has, of all the marine mammals recorded here, the highest average cadmium concentration in renal tissue (63.5 μg/g, Table 3) except one seal which had a slightly higher concentration (65.9 μg/g, index no. 126, Table 9). These narwhals were all caught in the same general area near Pond Inlet on Baffin Island. The 1979-group of narwhals do not differ significantly from the 1977 group of narwhals at 30.5 μg/g of Cd in their renal tissue (index no. 12, Table 3) at the $\alpha = 0.10$ level of significance, mainly because the concentration of cadmium in the tissues of narwhal varied more greatly from animal to animal than for any other metal. The only other whales in which cadmium concentrations have been measured are the short-finned pilot whale and the minke whale (a single animal in each case) with 42 μg/g and 28 μg/g of cadmium in their renal tissues, respectively (Table 3). Striped dolphins from the eastern coast of Japan (index no. 98) had similarly high cadmium concentrations in renal tissue (25 μg/g, average), apparently a consequence of the very high cadmium concentration in the squid which these dolphins ate (Honda et al. 1983). Why cadmium levels in renal tissue of whales should be as high as they are is an open question. It is known that the half-life of cadmium in the mammalian kidney varies greatly with species (e.g. three years for mice and ten years for man; Matsubara-Khan 1974; MARC 1980). Possibly the half-life of cadmium in whales is extremely long, which would mean that these animals are essentially incapable of eliminating this metal. Consistently the concentration of cadmium is higher in the kidney than in the liver by a factor of 2-4.

Selenium concentrations do not differ significantly among narwhals in any of the tissues examined (index no. 12, 13, Table 4). Some concentrations of Se in the liver are available for short-finned pilot whales (index no. 15, 16, Table 4), and these are significantly higher than in narwhals. As noted before, these animals also have much higher mercury concentrations in their tissues than narwhals.

The 1979-narwhal data had been subjected to regression analysis (Wagemann et al. 1983), which revealed that the length of narwhals correlated positively very strongly with the mercury concentration in kidney, muscle and blubber, and with cadmium also positively (although somewhat less strongly) in muscle and kidney. The correlations between length and the concentration of other metals were generally negative for at least one sex, which would imply (to the extent that length of an animal and its age are related) that concentrations of Cu, Zn, and Pb are diminishing with time in the respective tissues, while Hg is accumulating in kidney, muscle, and blubber, and Cd is accumulating in kidney and muscle.

Mercury correlated strongly, positively with selenium in liver and kidney, and in liver also with cadmium. Zinc correlated positively with cadmium in the liver and kidney (Wagemann et al. 1983). Which particular metals are associated with each other clearly depends on the type of tissue; however one pair of elements namely, mercury and selenium, consistently correlated positively in liver and kidney. This is an interesting association since the latter element is reported to have an ameliorating influence on the toxicity of mercury in fish (Ganther et al. 1972), and also appears to govern the accumulation and affect the toxicity of mercury in mammalian tissues (Parizek et al. 1971; El Bergearmi et al. 1973; Potter and Matrone 1974; Chen et al. 1975; Hansen and Kristensen 1979). The atomic concentration ratio Hg/Se is claimed to be most frequently near 1, for hepatic tissue. This ratio has been reported to range from 1-9 for hepatic tissue in seals (Koeman et al. 1975, 1973). In narwhals (1979-group), this ratio was found to be in the range of: 0.22-1.70 for liver, 0.066-0.56 for renal tissue, 0.039-

1.37 for blubber, and 0.23-1.37 for muscle (Wagemann et al. 1983). The average atomic ratio (Hg/Se) was: 0.59 for liver, 0.21 for kidney, 0.15 for blubber and, 0.75 for muscle, of the 1979-group of narwhals.

MERCURY IN PINNIPEDS

We have compiled most published data on concentrations of mercury in various tissues of pinnipeds from northern waters (Table 5) with the notable exception of any data for the palaearctic region, which are not readily available. The outcomes of the multiple comparison by Scheffé's procedure are shown in Fig. 4, 5, 6, for liver, muscle and kidney respectively. Comparisons were also made of mercury in blubber and other metals in various tissues but these are not shown since the data were not plentiful. Although this work deals largely with animals from northern waters, some harbour seals from the California coast, U.S.A. were included for purposes of reference (index no. 179, Table 5). California harbour seals with 269 μg/g of mercury in the liver had nearly as high a concentration as harbour seals from the Dutch coast (293 μg/g). These concentrations while significantly higher than the average concentration in hepatic tissue of most groups of seals (Fig. 4), are not significantly higher than the average concentration of 230 μg/g and 138 μg/g in ringed seals from the Baltic area (index no. 110, 101, Table 5), or the average concentration of 143 μg/g in some bearded seals (index no. 236, Table 5) from Victoria Island, E. Arctic, Canada. No single species appears to be significantly different from all other species in mercury concentration in the liver. Only the few groups of animals with the highest concentrations irrespective of species were significantly different from some groups with the lowest concentration (Fig. 4), and this was seemingly more a consequence of age differences than species differences. One notable result of the analysis is the lack of differentiation among species. Although we did not make a detailed analysis of the influence of age on mercury concentration in the liver, other workers have found a correlation between mercury concentrations in seals and their age (Sergeant 1980; Smith and Armstrong 1978; Drescher et al. 1977; Heppleston and French 1973). The influence of age on concentration does become somewhat apparent in Fig. 4, where the lowest concentration range (0.23-10 μg/g) is comprised only of young seals (i.e. less than 6 years old) and the highest concentration range (90-270 μg/g) is seemingly comprised only of animals that are older than 7 years. The intermediate concentration range (10-90 μg/g) includes animals of all ages. Although harp seals have some of the lowest mercury concentrations in the liver, some ringed seals have similarly low concentrations (Fig. 4). The lack of differentiation among the various groups generally, must to some extent also be the result of small sample sizes from which the means were derived.

Although visual observation of Fig. 4, 5, and 6 reveals no striking correspondences between mercury concentrations in liver and muscle or liver and kidney, such correspondences do exist. When the average mercury concentrations in the liver were linearly regressed on the average mercury concentrations in muscle or renal tissues (of the same group) the correlation coefficients were in each case significant at $\alpha = 0.05$. Still better fits were obtained with curvilinear regression, of the type $y = ae^{bx}$ where x is the mercury concentration in the liver and y is the mercury concentration in either muscle or renal tissue. The following constants were obtained (dry-wt. basis): for muscle-liver, $a = 0.2765$, $b = 0.0187$; for kidney-liver, $a = 1.471$, $b = 0.0130$.

In the absence of a sufficiently large and good data base any answer to the question of what is a normal or conversely an abnormally high concentration of heavy metals in tissues of seals can only be tentative. The great majority of seals (89% of all such averages) have mercury concentrations in the liver less than 65 μg/g (Fig. 4). If infrequency of occurrence of a datum can be taken as an indication of its abnormality, then mercury levels in the liver of seals in excess of 65 μg/g could be considered as lying outside the normal range irrespective of the age of the animal. The corresponding limits in muscle and kidney tissue when calculated from the above-mentioned regression equations using 65 μg/g for liver, are 0.94 μg/g and 3.4 μg/g, respectively. Concentrations greater than these values could therefore, by the same criterion, be considered as being abnormally high for these tissues irrespective of age.

Ringed seals from the Baltic area have, at 82 μg/g of Hg in muscle (index no. 101, Table 5) the highest concentration recorded here for muscle and this is significantly higher than the concentration in any other group (Fig. 5). The second and third highest mean concentration at 3.5 μg/g, and 2.5 μg/g in muscle (index no. 110, 116, Table 5) also for ringed seals from the Baltic are significantly higher than in most other groups (Fig. 5). Unfortunately, muscle concentrations were not reported for the seals from the Dutch Wadden Sea (index no. 324C, 324D) which had very high concentrations of mercury in their livers. Probably these seals also had high concentrations of mercury in muscle tissue. Two groups of seals which were among those with the lowest concentrations (index no. 237, 108, Fig. 5) had significantly lower concentrations than some other groups. The remaining groups which make up the majority of data in Fig. 5, and which span the concentration range (in terms of means) from 0.1-1.4 μg/g in muscle, did not differ significantly among themselves. Only 24% of all groups in Fig. 5, have concentration means higher than 0.94 μg/g.

In seal renal tissue, the highest mean concentrations of mercury were 17.0, 7.5 and 7.4 μg/g (index no. 324D, 324C, 110, Table 5), and these were significantly higher than in groups with the lowest concentration (0.14-2.6 μg/g, Fig. 6). The remaining groups span the range from 2.4-5.2 μg/g without differing significantly among themselves, nor do they differ from the highest concentrations. As expected, the groups with the highest concentration of mercury in renal tissue were the same as those that had very high concentrations of mercury in muscle and liver.

OTHER METALS IN PINNIPEDS

The mean concentration of zinc in the liver of all seals ranged from 34-81 μg/g. The highest concentration differed significantly from all others except the second and third highest namely, 59 and 57 μg/g (index no. 203, 205, Table 6). All remaining groups had concentration means in the range from 34-56 μg/g, and these did not differ significantly among themselves. The highest zinc concentration in liver was 109 μg/g in a Weddell seal from the Antarctic (index no. 249). As would be expected, the same animal had also a high concentration of zinc in muscle (84 μg/g). The mean concentrations of zinc in muscle tissue ranged from 20-34 μg/g (index no. 127, 208, Table 6), and in renal tissue from 19-46 μg/g (index no. 198, 128, Table 6). Concentrations of some individuals (rather than group means) do fall outside this range. No group differs from any other significantly in concentration neither in muscle nor in kidney.

A single leopard seal fetus from the Antarctic (index no 148) had at 53 μg/g copper in the liver the highest concentration. A group of leopard seals of unknown age (but probably young) from the Antarctic (index no. 246, Table 7) had nearly as high a concentration of copper in the liver (44.6 μg/g). Some grey seals from the North Sea (index no. 163, Table 7) had the third highest concentration (28 μg/g). Only these two groups differed significantly from other groups. All other groups had copper concentrations in the liver in the range of 5.7-15 μg/g, and these did not differ among themselves. Young animals seem to have higher concentrations than old ones, Table 7. Only four concentration means of copper in muscle and kidney were available for comparison. These range from 0.65-3.2 μg/g in muscle, and 2.5-10.6 μg/g in the kidney. In the latter organ only the highest mean (index no. 129, Table 7) was significantly different from others, and in muscle the highest and lowest means were each different from the rest.

In the liver the majority of lead concentration means were in the range of 0.15-0.60 μg/g (Table 8) with no significant differences among groups within that range regardless of species. The three highest concentration means (2.3, 5, 10 μg/g, Table 8) were each significantly different from all other means. For muscle only three lead concentration means were available two of which (0.04, 1.2 μg/g; Table 8) differed significantly from each other. In kidney tissue the concentrations (means) ranged from 0.32-1.17 μg/g (Table 8) with some significant differences occurring among groups, but the total number of groups available for comparison was only five.

Some ringed seals from Greenland (index no. 130, Table 9) with a mean of 17.0 μg/g of cadmium in the liver had a significantly higher concentrations than any other group. All other groups had mean concentrations of cadmium in the liver in the range of 0.018-7.32 μg/g (Table 9), and none of them differed significantly among themselves. In muscle tissue the cadmium mean concentrations span the range from 0.029-0.15 μg/g (Table 9), but only the highest mean differed from some others. In renal tissue, despite the wide range of cadmium concentrations (0.10-37.4 μg/g, Table 9) there was no significant difference between any of the means. This seems to be again mainly a consequence of the large variation in cadmium levels among individual animals (large standard deviations), seemingly peculiar to this metal. The cadmium concentration is consistently higher, by a factor of 2 to 5, in renal tissue than in hepatic tissue. It appears that on the whole cadmium in renal and hepatic tissues of seals is lower than in the corresponding tissues of some whales.

Only one concentration mean of selenium in muscle tissue (0.57 μg/g, Table 10) was reported in the literature (index no. 246). In the liver all but three groups have concentration means in the range of 1.80-36.0 μg/g (Table 10), and these groups do not differ significantly among themselves. A group of ringed seals from the Baltic area (index no. 110, Table 10) at 81 μg/g, and two other groups of harbour seals from the Danish and Dutch coasts (index no. 324C, 324D), at 112 and 109 μg/g respectively, had the highest selenium concentration in the liver, and these were significantly higher than the means of most other groups. As pointed out previously, these same groups of seals also had the highest levels of mercury.

CHLORINATED HYDROCARBONS IN CETACEANS

There are a growing number of reports in the literature on levels of polychlorinated biphenyls (PCBs), 1,1-bis(4-chlorophenyl)-2,2,2-trichloro-ethane (DDT) and its dechlorinated metabolites (ΣDDT) and other organochlorine pesticide residues in cetaceans. Gaskin (1982) has reviewed many of these reports and compared levels of these contaminants in animals from different geographical areas. Tables 11 and 12 list published results for PCBs and ΣDDT where two or more specimens were reported and includes results from the analysis of narwhal blubber samples from our laboratory (index No. 13A and 13B). Statistical comparisons of the mean concentrations of PCBs and ΣDDT in cetacean blubber were made using Scheffé's test (at the α=0.10 level of significance) for all results consisting of 5 or more animals. In some cases results of male and female specimens which were reported separately by the authors (e.g. index no. 59, 60, 54, 55, Tables 11 and 12) were pooled to increase the size of the group and hence the sensitivity of the comparison.

Cetaceans are differentiated into four distinct groups on the basis of ΣDDT levels in blubber using Scheffé's test (Fig. 7). Dolphins from the coast of California (1968-76) have the highest levels of ΣDDT reported for cetaceans (index no. 85, 87), significantly higher than all other reports. Dolphins from the coast of France (index no. 79) and porpoises from the Bay of Fundy (sampled in 1969-70) had significantly higher ΣDDT levels than all remaining specimens (Fig. 7) which included baleen whales and all Arctic species. Fewer results were available for comparision of PCB than DDT concentrations by use of Scheffé's test but a similar trend was

evident (Fig. 8) although only two distinct groups are apparent. Dolphins from the coast of France (index no. 79) had significantly higher PCB levels than cetaceans from Greenland and from several locations in the North Pacific ocean. Two bottlenose dolphin specimens not included in the statistical comparison (index no. 85) had PCB levels averaging 435 μg/g in blubber which are among the highest reported levels for this contaminant in cetaceans. Levels of PCBs (but not ΣDDT) in porpoises from the North Sea (index no. 76, 23) and the Bay of Fundy were relatively high (79-114 μg/g blubber) but could not be distinguished statistically from all other results. The high levels of PCBs and DDT in dolphins reported by Alzieu and Duguy (1979) pertain primarily to animals from the Mediterranean coast of France. These authors observed mean concentrations of 47.7 μg/g PCBs in dolphin (Stenella caeruleoalba) fat (lyophilized) from the Atlantic coast (one specimen) and 122-259 μg/g in the same species from the Mediterranean. The results in Fig. 7 and 8 are from a combined sample reported by the authors (index no. 78, 79, 80, Tables 11 and 12).

The results of PCB and ΣDDT residues in cetaceans, although fewer than reports on the same contaminants in pinnipeds, provide interesting information on the geographic distribution of these residues (Gaskin 1982). ΣDDT levels were extremely high in cetaceans from the coast of California and Bay of Fundy sampled in the late 1960's and early 1970's presumably reflecting large scale agricultural and forestry uses as well as manufacturing (in California). Both ΣDDT and PCB levels are high in cetaceans from the French coast while animals from the North Sea (The Netherlands coast and the U.K.; in blubber, index no. 86, 23, 51) had 2-fold higher PCB than ΣDDT levels. Narwhals from the Baffin Island area also have about 2-fold greater PCB than ΣDDT levels (index no. 13). Belugas in the Mackenzie River Delta had similar ΣDDT levels in blubber to those in the Eastern Arctic but far lower PCB levels (i.e. a detection limit of 0.5 μg/g was not exceeded, Addison and Brodie (1973)) (index no. 54) indicating that food chain contamination by PCBs is much greater in the North Atlantic than in the Beaufort Sea. Cetaceans in Japanese waters had similar PCB and ΣDDT levels and could not be distinguished statistically from Arctic-dwelling species (Fig. 7 and 8).

Levels of PCBs and ΣDDT in baleen whales (index no. 14, 57, 58A, 59, 60, 67, Tables 11 and 12) are lower than those of other species inhabiting roughly the same geographic location. This reflects the diet of Balaenoptera which consists primarily of crustaceans. Euphausiid, squid and fish-eating cetaceans can be roughly ranked according to increasing chlorinated hydrocarbon levels corresponding to their positions on the food chain (Gaskin 1982).

Comparison of ΣDDT levels in animals sampled over a 5-10 year period may not reflect decreasing levels of this contaminant following banning of this insecticide in the early 1970's. Decreases in ΣDDT concentrations in blubber over a five year period from the late 1960's to the mid-1970's have been observed in seals from the Farne Islands (Holden 1978b), but no significant decrease in ΣDDT levels in porpoises sampled in the Bay of Fundy between 1968 and 1977 has been observed. In fact mean levels actually increased slightly between 1975 and 1977 (Gaskin 1982). Unfortunately there are, as of this writing, no other reports of continuous monitoring of cetacean populations for chlorinated hydrocarbons. Given the continued use of DDT in many developing countries, and its persistence in the environment it appears valid to compare ΣDDT levels of various populations without taking into account the date of sampling.

PCB and ΣDDT concentrations in liver, kidney and muscle of cetaceans are also reported in Table 11 and 12 but there were insufficient numbers to make statistical comparison worthwhile. The importance of blubber as an indicator tissue in cetaceans is illustrated by Tanabe et al. (1981) who determined whole body burdens of PCB, ΣDDT, HCB and hexachlorocyclohexane isomers (HCH) in 5 striped dolphins ranging in age from 3 mo. to 36.5 yr. Greater than 93% of the chlorinated hydrocarbon residues were present in blubber regardless of age or sex. Muscle contained <7% of the residues although it comprised 55% of body weight while all other tissues contained <1% of the body burden.

Correlation of ΣDDT and PCB levels with age of pinnipeds has been frequently attempted but few correlations have been made with cetaceans because of lack of age data. Gaskin et al. (1983) reported a significant positive correlation of PCB levels in male harbour porpoise blubber with age. A negative correlation (not significant at P=0.01) of age with PCB levels in female blubber was observed. Taruski et al. (1975) found higher organochlorine levels in "mature" compared to "immature" animals. Gaskin et al. (1971) reported lower levels of ΣDDT in suckling male porpoises than mature males. However, pregnant and lactating females had significantly lower concentrations of ΣDDT in blubber and liver than males or immature females. Concentrations of ΣDDT and PCB in narwhal blubber (index no. 13A, 13B) were not correlated with length of the animals, but stepwise regression analysis of log ΣDDT and log PCB concentrations on sex (0 = males; 1 = females) and length (cm) indicated correlations with gender (r=-0.65 and -0.54 for log ΣDDT and log PCB respectively). Correlations were not improved using the cross-product (sex)x(length). ΣDDT concentrations could be expressed by the regression equation log ΣDDT=-0.606(sex) + 0.647 (R^2=0.42) while PCB concentrations could be expressed as log PCB = -0.247(sex) + 1.054 (R^2=0.30). Gaskin et al. (1983) reported a significant correlation of PCB levels in porpoise blubber with length for males only. Body size is unlikely to correlate well with organochlorine concentration except perhaps in young animals because it increases asymptotically with time, however, it is frequently the only data for cetaceans. Higher ΣDDT and PCB levels are generally observed in male than in female cetaceans and this difference has been thoroughly documented in pinnipeds (Helle et al. 1976b). The differences in organochlorine concentrations with sex are readily explained by excretion of these compounds via lactation, as demonstrated in seals (Addison and Brodie 1977).

Other chlorinated hydrocarbon residues frequently reported in cetaceans include HCB, HCH isomers, chlordane, oxychlordane, trans-nonachlor, dieldrin and o,p-DDT isomers. In general, these compounds are present at levels 100 to 1000-fold lower than PCB or ΣDDT making assessment of their effects difficult.Recent reports of relatively high toxaphene and chlordane residues (10 - 11 μg/g blubber) in grey seals from the Baltic Sea (Jansson et al. 1979) and chlordane in Canadian polar bears (Norstrom, Canadian Wildlife Service, Ottawa, personal communication) suggest that these pesticides may be increasing in concentration in wildlife. O'Shea et al. (1980) reported toxaphene residues averaging 0.13 μg/g in dolphins and porpoises from California and Japan.

There is little information on what concentrations of PCB or ΣDDT in cetaceans may present a health risk to the animals or may lead to reproductive failure (Holden 1978a; Gaskin 1982). Alzieu and Duguy (1979) have suggested on the basis of dolphin results that concentrations of PCBs in liver of 20 mg/kg (lyophilized tissue) may present a health risk to the animals. This would correspond to a level of 50 - 200 μg/g (wet weight) in blubber based on their results. Concentrations of PCBs in ringed seals in the 50-100 μg/g range have been linked to the low reproductive rate of grey, harbour and ringed seals in the Baltic (Helle et al. 1976a; Jensen et al. 1979). Premature parturition in California sea lions has been linked to ΣDDT levels in the 626-1039 μg/g range and PCB levels in the 85-145 μg/g range (DeLong et al. 1973). Porpoises in the North Sea (index no. 76, 23), the Mediterranean coast of France (index no. 79), the Bay of Fundy (index no. 92A) and the California coast have PCB levels in the 50-200 μg/g range which may put these populations at risk.

CHLORINATED HYDROCARBONS IN PINNIPEDS

A large body of literature exists on concentrations of chlorinated hydrocarbons in pinnipeds. Holden (1972, 1975, 1978a) has reviewed the literature and compared results reported for pinnipeds in various geographical areas. Tables 13 and 14 list most of the published reports of ΣDDT and PCBs, respectively, for pinnipeds in northern waters up to mid 1983. Reports on single animals and those in southerly waters were omitted. Mean concentrations of ΣDDT and PCBs in blubber were compared at the α=0.10 level of significance, by use of Scheffé's test as described for cetaceans. Means derived from fewer than seven animals were omitted in order to improve the comparison. Exceptionally high PCB levels in five harbour seals from the North Sea (index no. 288) were included in the PCB comparison and in several cases results from the same species in the same locale, that were reported separately by the authors (eg. adult males and females) were pooled to increase sample size (index no. 106, 310, 214, 216).

Five distinct groups could be delineated by Scheffé's test on ΣDDT levels in pinniped blubber (Fig. 9). Sea lions from the California coast, sampled in the early 1970's, had significantly higher ΣDDT levels than all other pinnipeds (index no. 325, 326A). Two groups of seals from the Baltic Sea and Gulf of Bothnia (index no. 281, 280, 252) had significantly higher ΣDDT than all pinnipeds except California sea lions. Harbour seals from the North Sea (index no. 212, 296) had ΣDDT levels that were not significantly different from those of harp, grey and ringed seals in the Gulf of St. Lawrence (index no. 313, 310, 226), Sable island (index no. 282, 283), Greenland (index no. 106, 214, 322) or Scotland (index no. 212, 296, 286A). A fifth group consisted of female ringed seals from the Baltic area (index no. 251, 253-255) and harbour seals from the Gulf of Maine (index no. 165) which differed significantly from the high and low groups with ΣDDT concentrations in the 50-110 μg/g range (Fig. 9).

Average PCB concentrations in pinniped blubber that were compared statistically ranged from 0.96-1470 μg/g (generally reported on a wet weight basis) (Fig. 10). Four distinct groups emerge from the statistical comparison. Harbour seals from the North Sea coast of the Netherlands and Germany sampled in 1970-71 (index no. 288) and again in 1975-76 (index no. 324B) had the highest average PCB levels reported for any marine mammals. The 1970-71 samples were significantly higher than all other results while the 1975-76 results could not be distinguished statistically from grey, harbour, and ringed seals from the Baltic (index no. 252-255). One factor not taken into account in the statistical comparison was the date of sample collection. Most samples used in the comparison were collected between 1968 and 1977. Use of DDT was curtailed in Europe and North America by the early 1970's. Consistent decreases in ΣDDT levels in blubber (from 20 μg/g to 6 μg/g) have been noted in grey seals from the Farne Islands sampled between 1968 and 1975 (Holden 1978b). Harp seals from the Gulf of St. Lawrence sampled in 1973 were found to have lower levels of ΣDDT and PCB than those sampled in 1971 (Jones et al. 1976). Other reports suggest that PCB levels in seals did not decrease during the 1970's. Holden (1978b) reported virtually identical PCB levels in grey seals from the Farne Islands between 1968 and 1975. Sergeant (1980) reported PCB levels in harp seals (index no. 324, Table 14) sampled in 1979 that were very similar to those reported by Addison et al. (1973) for samples collected in 1971 (index no. 310, 311).

As noted with organochlorine residues in cetaceans, the PCB and ΣDDT residues in pinnipeds can provide information on the geographic distribution of these contaminants. Sea lions from the California coast (sampled in 1970) had extraordinarily high ΣDDT levels (index no. 325, 326A) but they had PCB levels that were about 10-fold lower and similar to those in seals from the Baltic Sea (Fig. 10). The high ΣDDT levels in sea lions and dolphins from the California coast reflect high contamination with DDT in this region. PCB levels were up to 4-fold higher in dolphins than in sea lions. Harbour seals from the North Sea coast of the Netherlands had high PCB levels but their ΣDDT concentrations could not be distinguished statistically from ringed and grey seals in the Baltic or

harbour seals from the Bay of Fundy (Fig. 9). ΣDDT levels were also higher than PCB in seals from the Gulf of Bothnia and Bothnian Bay (index no. 215-255). Pinnipeds in the Canadian Arctic and Greenland had PCB and ΣDDT levels generally less than 10 μg/g in blubber (Fig. 9 and 10) which suggests these contaminants are widely dispersed, but no consistent trends in PCB/ΣDDT ratios were apparent. Seals and walrus from Greenland had 4 to 7-fold greater PCB levels than ΣDDT (Clausen 1978; Born et al. 1981) as did ringed seals from Holman Island (Addison and Smith 1974). However, other seal samples from the Canadian Arctic and Greenland (mainly ringed seals, index. no. 256, 257, 106, 107) had similar or slightly higher (up to 2-fold) levels of ΣDDT than PCB (Bowes and Jonkel 1975; Johansen et al. 1980).

The age range of the animals is included in Fig. 9 and 10, as stated by the authors, since there have been several reports correlating age of male pinnipeds with organochlorine residue levels (Addison and Smith 1974; Helle et al. 1976b; Born et al. 1981). Mature males generally have the highest organochlorine levels within a pinniped population. Female pinnipeds have generally lower PCB and ΣDDT levels presumably due to mobilization and excretion of organochlorines during lactation and their residue levels do not correlate with age. Parturition is not thought to be a major pathway of loss of organochlorines since the foetus in both pinnipeds and cetaceans contains less than 1% of the residue present in maternal blubber (Donkin et al. 1981; Tanabe et al. 1981). Addison and Brodie (1977) demonstrated that during lactation, grey seals may excrete an amount of ΣDDT and PCBs similar to that which they would likely ingest from a fish diet.

Other organochlorine residues frequently reported in pinniped tissues include HCB, HCH isomers and dieldrin. Like the DDT residues, dieldrin has been found to be decreasing in blubber of grey seals from Scotland sampled between 1965 and 1974 (Holden 1978a). Improvements in analysis of chlorinated hydrocarbons by use of capilliary columns and gas chromatography-mass spectrometry have brought about identification of other chlorinated compounds including chlordane isomers (Kerkhoff and De Boer 1982), mirex (Ten Noever de Brauw et al. 1973), toxaphene (Jansson et al. 1979) and polychlorinated terphenyls (PCT) (Renberg et al. 1978). Toxaphene and Σchlordane residues in Baltic grey seal blubber were similar (10-11 μg/g) but were only 1-2% of the DDT and PCB levels in the same sample. PCT levels in blubber of three Baltic grey seals ranged from 0.5-1.0 μg/g or 0.5-1.4% of PCB levels. The high PCB levels in seal blubber have led to attempts to identify polychlorinated dibenzofurans (PCDFs) which are contaminants in PCB fluids and are formed during pyrolysis or incomplete combustion of PCBs (Bowes et al. 1973; Rappe and Buser 1980). Rappe et al. (1981) confirmed the presence of a series of PCDFs totalling 40 pg/g in Baltic grey seal blubber. The major components identified were penta- and hepta- CDFs as well as the toxic 2,3,7,8-CDF isomer (1 pg/g). The PCDF components were present at about 2.5×10^6 - fold less than PCB levels in the blubber. Individual PCB isomers have generally not been monitored in pinniped blubber to date and authors have reported residues based on comparison with commercial formulations such as Arochlor 1254/1260 or Phenochlor DP-6. Donkin et al. (1981) used a microwave plasma detector to monitor chlorinated hydrocarbons in seal tissues and identified PCB isomers based on Cl/C ratios. They reported that hexa- and heptachlorobiphenyls were the major PCB isomers present (actual congeners were not identified) representing about 87% of total PCB residues in grey seal blubber. Donkin et al. (1981) also determined total organohalogens in seal blubber extracts by microcoulometry and found that total residue measured by GLC (as PCB, ΣDDT and dieldrin) averaged 66.9% of that the organo-halogens present. A major portion of the remaining organochlorine residue in blubber was likely in the form of metabolites of PCBs and DDT. Jensen and Jansson (1976) reported that methylsulfone metabolites of PCB and DDE were present at about 20 μg/g in the Baltic seal blubber which contained 150 μg/g PCB and 138 μg/g DDE. Phenolic metabolites of PCBs and DDE have also been identified in field-collected seal excreta (Jansson et al. 1975; Sundstrom et al. 1975).

High levels of PCBs (>100 μg/g in blubber) have been linked to premature parturition in sea lions (DeLong et al. 1973) and reproductive failure in seals from the Baltic (Helle et al. 1976b) and the Dutch Wadden Sea (Duinker et al. 1979) but the cause and effect relationships are not well established. Helle et al. (1976b) analysed 109 female seals (mainly ringed seals) of reproductive age from the Baltic area and found a high frequency of pathological changes in the uterus which explained the low rate of reproduction. They also found that ΣDDT and PCB concentrations were significantly higher in the group showing pathological changes than in those which did not show such changes. On reviewing the results of Helle et al. (1976b) (index no. 251), Holden (1978a) noted that the differences in residue levels between non-pregnant and pregnant females seemed insufficient to explain the observed failure to reproduce. Nonpregnant females can be expected to have higher organochlorine levels since loss of residues via lactation does not occur. The finding of PCDFs in Baltic seal blubber including the toxic TCDF isomer and further monitoring in other seal populations may help explain the connection between organochlorine levels and reproductive failure. PCDFs and PCDDs are known to have a depressive effect on reproductive capacity in mammals, and on the viability of offspring of exposed mothers (McConnell 1980). A survey of PCDFs and PCDDs in seal populations would be useful to determine ratios of these micro contaminants with PCBs and to identify populations having high PCDF and PCDD exposure.

CONCLUDING REMARKS

We have attempted to extract some concentration norms for toxicant burdens in marine mammals from the existing data base. Only for mercury and chlorinated hydrocarbons in pinnipeds were the data numerous enough to approach

this goal. But even there, the available data were sufficiently unsystematic from a geographic and chronological point of view to preclude the certain delineation of the various factors separately, i.e. geographic location, date of sampling, and age of animals. Statistically, the size of samples (consisting frequently of only 1-5 animals) was more often than not too small, and this should be remedied in future data gatherings. Vital information such as the sex and age of animals, as well as the standard deviation of the set of data comprising the sample, was frequently lacking. Such data do not lend themselves well to statistical treatment. The aging of whales, particularly narwhals and belugas, is a problem that should be addressed in view of the connection between age and toxicant burden. The data base for toxicant burdens in cetaceans is presently too small to allow the extraction of concentration norms for these animals. In view of the rapidly increasing development of hitherto pristine areas, and the anticipated banning in the future of the killing of a number of whale species, the gathering of such data is pressing.

Aside from the difficulties mentioned, there is a further limitation imposed by the nature of the data; namely, that "total" heavy metal concentrations are by themselves insufficient to assess either the health status of the animals, or the effective toxicity of the toxicant in question. Yet, these "total substance" concentrations are important and necessary as they are the only direct indicator of the actual burden that an animal carries. Without such "total" concentrations any other metal species concentration datum is by itself incomplete and insufficient. Total concentrations can provide a much needed benchmark for what is to be regarded as a "normal" or an "abnormal" heavy metal burden for animals in the wild. The interpretation of such burdens in terms of the well-being of the animal must, of course, be sought through other types of data.

The available data base for marine mammals is almost devoid of any reference to antagonistic or synergistic effects of metals other than mercury and selenium. Only in two studies to date (Honda et al. 1983; Wagemann et al. 1983) have elements other than these two also been measured, and interrelationships shown to exist. Whether these relationships are of such generality as to be found in all cetaceans is still an open question.

The data base for organochlorine residues consists mainly of ΣDDT and PCB results. DDT use has been largely eliminated and many past uses of PCB's curtailed during the 1970's in many regions adjacent to marine mammal habitats in northern waters. Future analysis will hopefully focus on other organochlorines in wide use until recently, such as chlordane, HCH, toxaphene as well as PCDD's and PCDF's. Further work on the phenolic and methylsulfone metabolites of PCB's, DDT and other chlorinated aromatics would also be useful since this may provide an insight into rates of elimination of these contaminants, and estimates of total body burdens of each compound.

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Table 1. Reference concentrations of Hg (wet weight basis) in different tissues of Cetaceans.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length (m) / Age (yrs)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
1	Sei Whale *(Balaenoptera borealis)*	South Pacific	1972	Muscle[+]	9	M&F	14.3	0.03 ± 0.02	0.02 - 0.07	Nagakura et al. (1974)
2	Sperm Whale *(Physeter catodon)*	North Pacific	1972	Muscle[+]	7	M&F	11.4	1.31 ± 0.17	1.08 - 1.56	Nagakura et al. (1974)
3	Sperm Whale *(Physeter catodon)*	Antarctic Ocean	1972	Muscle[+]	6	M&F	12.0	1.33 ± 0.20	0.93 - 1.48	Nagakura et al. (1974)
4	Fin Whale *(Balaenoptera physalus)*	South Pacific	1948	Muscle[+]	8	M&F	20.2	0.02 ± 0.01	0.01 - 0.03	Nagakura et al. (1974)
6	Short Finned Pilot Whale *(Globicephala macrorhyncha)*	St. Lucia, West Indies	1972	Liver	4	F	4.3	105.6 ± 65.2	19.2 - 157.0	Gaskin et al. (1974)
				Muscle[+]	4	F	4.3	3.99 ± 1.07	2.76 - 5.36	
				Kidney	3	F	4.3	8.65 ± 2.50	6.0 - 11.0	
7	Short Finned Pilot Whale *(Globicephala macrorhyncha)*	St. Lucia, West Indies	1972	Liver	1	M	4.2	21.40 -	-	Gaskin et al. (1974)
				Muscle[+]	1	M	4.2	4.0 -	-	
				Kidney	1	M	4.2	14.0 -	-	
15	Short Finned Pilot Whale *(Globicephala macrorhyncha)*	Cumberland Island Georgia, USA	1977	Liver	1	F[A]	3.7	145.0 ± 10.5[C]	-	Stoneburner (1978)
				Kidney	1	F[A]	3.7	13.02 ± 2.02[C]	-	
16	Short Finned Pilot Whale *(Globicephala macrorhyncha)*	Cumberland Island Georgia, USA	1977	Liver	2	F[B]	3.7	361.0 ± 131.5	268 - 454	Stoneburner (1978)
				Kidney	2	F[B]	3.7	39.75 ± 22.56	23.8 - 55.7	
17	Short Finned Pilot Whale *(Globicephala macrorhyncha)*	Cumberland Island Georgia, USA	1977	Liver	1	M	3.9	56.90 ± 3.75	-	Stoneburner (1978)
				Kidney	1	M	3.9	4.79 ± 0.98	-	

Table 1. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean length (m) / age (yrs)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
8	Pilot Whale *(Globicephala melaena)*	Wakayama, Japan	1975	Muscle+	12	-	3.4 / -	4.16 ± 0.72	3.01 - 5.18	Arima and Nagakura (1979)
5	Beluga Whale *(Delphinapterus leucas)*	Hudson Bay, Canada	1969	Liver Muscle+ Kidney	1 1 1	- - -	- - -	8.87 0.97 2.44	- - -	Bligh and Armstrong (1971)
9	Beluga Whale *(Delphinapterus leucas)*	Hudson Bay, Canada	1971	Muscle+	43	-	-	0.53	-	Bligh and Armstrong (1971)
11	Beluga Whale *(Delphinapterus leucas)*	Mackenzie Delta Kugmalit Bay, W. Arctic Canada	1972	Liver Muscle+	7 7	M&F M&F	3.6 / - 3.6 / -	6.26 ± 3.71 0.71 ± 0.14	2.45 - 12.1 0.60 - 1.0	Lutz and Armstrong (unpublished)
20	Beluga Whale *(Delphinapterus leucas)*	Mackenzie Delta and Estuary, W. Arctic Canada	1977	Liver Muscle+ Blubber	8 11 11	M&F M&F M&F	- - -	30.62 ± 20.53 2.12 ± 1.15 0.08 ± 0.09	8.48 - 56.3 0.14 - 4.33 <0.01 - 0.28	Imperial Oil (1978)
22	Beluga Whale *(Delphinapterus leucas)*	Baltic Sea	1977	Liver Muscle+	1 1	- -	2.7 / - 2.7 / -	4.4 1.6	- -	Huschenbeth (1977)
10	Narwhal *(Monodon monoceros)*	Eastern Arctic	1971	Muscle+	2	-	-	0.64	-	Bligh and (Armstrong (1971)
12	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, Canada	1977	Liver Muscle+ Kidney Blubber	6 6 6 6	- - - -	- - - -	5.98 ± 3.13 0.84 ± 0.32 1.18 ± 0.57 <0.01	2.05 - 8.87 0.45 - 1.26 0.63 - 2.1 <0.01 -	Fallis (unpublished)
13	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, Canada	1979	Liver Muscle+ Kidney Blubber	37 58 54 44	M&F M&F M&F M&F	3.7 / - 4.3 / - 3.8 / - 4.2 / -	6.10 ± 3.13 0.85 ± 0.04 1.71 ± 0.14 0.03 ± 0.01	0.57 - 13.1 0.22 - 1.59 0.37 - 5.69 <0.005 - 0.06	Wagemann et al. (1983)

Table 1. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean length (m) / age (yrs)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
14	Minke Whale *(Balaenoptera acutorostrata)*	Umanak, W. Greenland	1972	Liver	4	-	- / -	0.15 ± 0.08 †	0.09 - 0.25	Johansen et al. (1980)
				Muscle+	9	-	- / -	0.11 ± 0.05 †	0.06 - 0.21	
18	Minke Whale *(Balaenoptera acutorostrata)*	Disko Bay, W. Greenland	1978	Liver	6	-	- / -	0.18 ± 0.13 †	0.07 - 0.41	Johansen et al. (1980)
				Muscle+	6	-	- / -	0.15 ± 0.06 †	0.09 - 0.25	
23	Bottlenose Whale *(Hypoeroodon ampullatus)*	North Sea	1977	Liver	1	-	5.7 / -	0.38 -	-	Huschenbeth (1977)
				Muscle+	1	-	5.7 / -	0.33 -	-	
24	Harbour Porpoise *(Phocoena phocoena)*	St. Johns Newfoundland, E. Canada	1973	Muscle+	1	F	0.95 / 0.5	0.25 -	-	Gaskin et al. (1979)
25	Harbour Porpoise *(Phocoena phocoena)*	Deer Island New Brunswick, E. Canada	1969	Liver	10	M	1.3 / 4.1	7.26 ± 8.67	-	Gaskin et al. (1979)
				Muscle+	24	M	1.3 / 4.1	0.59 ± 0.40	-	
				Kidney	11	M	1.3 / 4.1	1.30 ± 0.86	-	
26	Harbour Porpoise *(Phocoena phocoena)*	Deer Island New Brunswick, E. Canada	1972 1974	Liver	10	M	3.7 / 1.3	3.91 ± 3.73	-	Gaskin et al. (1979)
				Muscle+	15	M	3.7 / 1.3	0.75 ± 0.43	-	
				Kidney	6	M	3.7 / 1.3	1.04 ± 0.23	-	
27	Harbour Porpoise *(Phocoena phocoena)*	Deer Island New Brunswick, E. Canada	1975 1976	Liver	21	M	4.3 / 1.4	16.48 ± 11.07	-	Gaskin et al. (1979)
				Muscle+	21	M	4.3 / 1.4	1.26 ± 0.57	-	
				Kidney	6	M	4.3 / 1.4	3.56 ± 1.02	-	
28	Harbour Porpoise *(Phocoena phocoena)*	Deer Island New Brunswick, E. Canada	1969 1973	Liver	16	F	2.5 / 1.3	17.91 ± 38.16	-	Gaskin et al. (1979)
				Muscle+	35	F	2.5 / 1.3	0.88 ± 0.57	-	
				Kidney	13	F	2.5 / 1.3	1.56 ± 1.30	-	
29	Harbour Porpoise *(Phocoena phocoena)*	Deer Island New Brunswick, E. Canada	1974 1977	Liver	5	F	2.8 / 1.4	10.96 -	-	Gaskin et al. (1979)
				Muscle+	7	F	2.8 / 1.4	1.24 ± 0.52	-	
				Kidney	5	F	2.8 / 1.4	2.92 -	-	

Table 1. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean length (m) / age (yrs)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
30	Harbour Porpoise *(Phocoena phocoena)*	Baltic Sea	1977	Liver + Muscle	1 1	- -	0.80 / - 0.80 / -	0.70 - 0.15 -	- -	Huschenbeth (1977)
31	Harbour Porpoise *(Phocoena phocoena)*	Baltic Sea	1977	Liver + Muscle	1 1	- -	1.3 / - 1.3 / -	2.5 - 0.92 -	- -	Huschenbeth (1977)
32	Harbour Porpoise *(Phocoena phocoena)*	North Sea	1977	Liver + Muscle	1 1	- -	1.5 / - 1.5 / -	28.0 - 3.3 -	- -	Huschenbeth (1977)
33	Harbour Porpoise *(Phocoena phocoena)*	Bay of Fundy, E. Canada	1969 1971	Liver + Muscle	- -	M M	- - - -	- - 0.75 -	0.89 - 18.3 0.21 - 1.92	Gaskin et al. (1972)
34	Harbour Porpoise *(Phocoena phocoena)*	Bay of Fundy, E. Canada	1969 1971	Liver + Muscle	- -	F F	- - - -	- - 1.02 -	0.55 - 91.3 0.26 - 2.58	Gaskin et al. (1972)
35	Harbour Porpoise *(Phocoena phocoena)*	Grand Manan Isle New Brunswick, E. Canada	1971	Liver + Muscle Kidney	4 8 4	M M M	1.3 / 3.1 1.3 / 3.1 1.3 / 3.1	3.29 ± 3.30 0.66 ± 0.25 1.14 ± 0.36	-	Gaskin et al. (1979)
36	Harbour Porpoise *(Phocoena phocoena)*	Grand Manan Isle New Brunswick, E. Canada	1972	Liver + Muscle Kidney	3 3 1	F F F	1.6 / 5.0 1.6 / 5.0 1.6 / 5.0	11.3 ± 9.18 1.56 ± 0.86 2.40 -	- - -	Gaskin et al. (1979)
37	Harbour Porpoise *(Phocoena phocoena)*	Digby, Nova Scotia E. Canada	1970	Liver + Muscle Kidney	8 11 7	M M M	1.3 / 3.9 1.3 / 3.9 1.3 / 3.9	3.96 ± 4.58 0.86 ± 0.56 1.27 ± 0.90	- - -	Gaskin et al. (1979)
38	Harbour Porpoise *(Phocoena phocoena)*	Digby, Nova Scotia E. Canada	1970	Liver + Muscle Kidney	4 9 2	F F F	1.5 / 5.2 1.5 / 5.2 1.5 / 5.2	30.7 ± 26.2 1.48 ± 0.69 1.81 ± 0.97	- - -	Gaskin et al. (1979)
39	Harbour Porpoise *(Phocoena phocoena)*	Atlantic Coast of Nova Scotia Canada	1970	Liver + Muscle Kidney	5 5 4	M&F M&F M&F	1.5 / 4.6 1.5 / 4.6 1.5 / 4.6	19.6 ± 1.99 0.99 ± 0.47 1.49 ± 0.66	- - -	Gaskin et al. (1979)

Table 1. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean length (m) / age (yrs)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
40	Harbour Porpoise *(Phocoena phocoena)*	Boothbay Harbour Maine, USA	-	Liver Kidney	1 1	F F	1.0 / 1 1.0 / 1	1.13 - 0.68 -	- -	Gaskin et al. (1979)
41	Harbour Porpoise *(Phocoena phocoena)*	Naragansett Bay Rhode Island, USA	1971 1972	Liver Muscle+ Kidney	1 2 1	F F F	1.2 / 1 1.2 / 1 1.2 / 1	2.54 - 0.71 ± 0.60 2.74 -	- - -	Gaskin et al. (1979)
42	Harbour Porpoise *(Phocoena phocoena)*	Prince Edward Island, E. Canada		Muscle+	1	M	1.5 / 5	1.12 -	-	Gaskin et al. (1979)
95	Harbour Porpoise *(Phocoena phocoena)*	Coast of Denmark	1972-1973	Liver Muscle	4 4	M&F M&F	- / 1-3 - / 1-3	22 - 1.9 -	1.5 - 69 0.8 - 3.2	Andersen and Robsdorff (1976)
96	Harbour Porpoise *(Phocoena phocoena)*	E. Coast of Scotland	1974	Liver Kidney	17 17	M M	- - - -	3.42 ± 3.32 1.23 ± 0.66	0.29 - 10.6 0.47 - 2.82	Falconer et al. (1983)
97	Harbour Porpoise *(Phocoena phocoena)*	E. Coast of Scotland	1974	Liver Kidney	6 6	F F	- - - -	6.03 ± 5.89 1.02 ± 0.63	0.28 - 15.9 0.23 - 1.79	Falconer et al. (1983)
43	Finless Black Porpoise *(Neophocaena phocaenoides)*	Kanagawa, Japan	1973	Muscle+	1	-	0.72 / fetus	0.16 -	-	Arima and Nagakura (1979)
44	Long Snouted Dolphin *(Stenella longirostris)*	St. Lucia, Lesser Antilles	1972	Liver Muscle+ Kidney	1 1 1	F F F	1.8 / - 1.8 / - 1.8 / -	6.0 - 1.33 - 2.28 -	- - -	Gaskin et al. (1974)
45	Long Snouted Dolphin *(Stenella longirostris)*	St. Lucia, Lesser Antilles	1972	Liver Muscle+ Kidney	1 1 1	M M M	1.9 / - 1.9 / - 1.9 / -	13.0 - 0.87 - 2.68 -	- - -	Gaskin et al. (1974)
46	White Dotted Dolphin *(Stenella attenuata)*	Wakayama, Japan	1972	Muscle+	1	-	1.7 / 4-5	1.66 -	-	Arima and Nagakura (1979)

Table 1. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length (m) / Age (yrs)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
47	White Dotted Dolphin *(Stenella attenuata)*	Wakayama, Japan	1973	Muscle+	1	-	0.86 / fetus	0.61 -	-	Arima and Nagakura (1979)
48	Blue-White Dolphin T *(Stenella caeruleoalba)*	Shizouka, Japan	1974	Muscle+	10	-	2.2 / ∿15	6.73 ± 4.51	2.28 - 9.43	Arima and Nagakura (1979)
49	Blue-White Dolphin T *(Stenella caeruleoalba)*	Shizouka, Japan	1973	Muscle+	1	-	0.94 / fetus	0.95 -	-	Arima and Nagakura (1979)
50	Pacific Bottlenose Dolphin *(Tursiops gilli)*	Shizouka, Japan	1973	Muscle+	1	-	3.1 / ∿22	51.8 -	-	Arima and Nagakura (1979)
98	Striped Dolphin T *(Stenella caeruleoalba)*	E. Coast of Japan, Izu Peninsula	1977-1980	Liver	45	M&F	- -	2.05 ± 1.38	1.70 - 4.85	Honda et al. (1983)
				Muscle	51	M&F	- -	7.02 ± 4.06	0.46 - 15.7	
				Kidney	20	M&F	- -	8.71 ± 6.07	0.91 - 17.6	

* - Different tissues belong to the same animal or groups of animals which have the same Index No.

\+ - Dorsal meat

† - S.D. estimated from the range

A - Gravid

B - Non-gravid

c - S.D. from repeated analysis of the same sample

∿ - Approximately

T - Blue-White and Striped Dolphins are used interchangeably, depending on the name used in the original literature.

Table 2. Reference concentrations of Zn, Cu, Pb (wet weight basis) in different tissues of Cetaceans.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean length (m) / age (yrs)	Zn µg/g mean ± S.D.	Zn µg/g Range	Source
12	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, Canada	1977	Liver	6	-	- / -	26.47 ± 4.35	21.2 - 31.1	Fallis (unpublished)
				Muscle+	6	-	- / -	21.65 ± 8.15	15.6 - 29.6	
				Kidney	6	-	- / -	33.90 ± 7.97	24.8 - 44.8	
				Blubber	6	-	- / -	0.58 ± 0.13	0.37 - 0.75	
13	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, Canada	1979	Liver	37	M&F	3.7 / -	38.8 ± 9.85	23.98 - 63.61	Wagemann et al. (1983)
				Muscle+	58	M&F	3.8 / -	17.8 ± 3.06	12.43 - 28.41	
				Kidney	54	M&F	3.8 / -	41.1 ± 9.11	3.83 - 85.80	
				Blubber	44	M&F	3.8 / -	1.12 ± 0.65	0.25 - 2.58	
19	Narwhal *(Monodon monoceros)*	Admiralty Inlet, E. Arctic Canada	1975	Liver	26	-	- / -	38.37 ± 14.03	15.5 - 87.9	Fallis (unpublished)
				Muscle	27	-	- / -	21.22 ± 6.16	13.8 - 40.4	
				Blubber	11	-	- / -	3.93 ± 3.91	0.58 - 11.80	
30	Harbour Porpoise *(Phocoena phocoena)*	Baltic Sea	1977	Liver	1	F	0.80 / -	50.0	-	Harms et al. (1978)
				Muscle	1	F	- / -	21.0	-	
31	Harbour Porpoise *(Phocoena phocoena)*	Baltic Sea	1977	Liver	1	M	1.26 / -	34.0	-	Harms et al. (1978)
				Muscle	1	M	- / -	12.4	-	
				Kidney	1	M	- / -	20.0	-	
32	Harbour Porpoise *(Phocoena phocoena)*	North Sea	1977	Liver	1	F	1.53 / -	49.0	-	Harms et al. (1978)
				Muscle	1	F	- / -	14.4	-	
				Kidney	1			24.4	-	
95	Harbour Porpoise *(Phocoena phocoena)*	Coast of Denmark	1972 1973	Liver	4	M&F	- / 1-3	59	- 45 - 72	Andersen and Robsdorff (1976)
				Muscle	4	M&F	- / 1-3	19	- 18 - 21	
96	Harbour Porpoise *(Phocoena phocoena)*	E. Coast of Scotland	1974	Liver	17	M	- / -	43.2 ± 12.2	18.4 - 67.6	Falconer et al. (1983)
				Kidney	17	M	- / -	23.8 ± 2.96	19.5 - 33.1	
97	Harbour Porpoise *(Phocoena phocoena)*	E. Coast of Scotland	1974	Liver	6	F	- / -	43.7 ± 5.68	36.7 - 51.9	Falconer et al. (1983)
				Kidney	6	F	- / -	23.1 ± 2.01	20.3 - 25.3	
98	Striped Dolphin *(Stenella caeruleoalba)*	E. Coast of Japan Izu Peninsula	1977- 1980	Liver	57	M&F	- / -	44.5 ± 13.2	26.5 - 109	Honda et al. (1983)
				Muscle	59	M&F	- / -	11.4 ± 2.45	6.86- 20.4	
				Kidney	30	M&F	- / -	30.1 ± 4.67	22.8 - 41.2	

Table 2. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean length/age (m) (yrs)	Cu µg/g mean ± S.D.	Cu µg/g Range	Source
13	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, Canada	1979	Liver	37	M&F	3.7 / -	5.27 ± 2.20	1.98 - 20.31	Wagemann et al. (1983)
				Muscle+	58	M&F	4.3 / -	0.66 ± 0.15	0.45 - 1.15	
				Kidney	54	M&F	3.8 / -	2.34 ± 0.43	1.81 - 3.49	
				Blubber	44	M&F	3.8 / -	0.08 ± 0.07	<0.01 - 0.38	
30	Harbour Porpoise *(Phocoena phocoena)*	Baltic Sea	1977	Liver	1	F	0.80/ -	15.0 -	-	Harms et al. (1978)
				Muscle	1	F		2.7 -	-	
31	Harbour Porpoise *(Phocoena phocoena)*	Baltic Sea	1977	Liver	1	M	1.26/ -	4.0 -	-	Harms et al. (1978)
				Muscle	1	M	- -	1.8 -	-	
				Kidney	1	M	- -	3.1 -	-	
32	Harbour Porpoise *(Phocoena phocoena)*	North Sea	1977	Liver	1	F	1.53/ -	6.0 -	-	Harms et al. (1978)
				Muscle	1	F	- -	2.1 -	-	
				Kidney	1	F	- -	3.2 -	-	
95	Harbour Porpoise *(Phocoena phocoena)*	Coast of Denmark	1972-1973	Liver	4	M&F	- / 1-3	4.5 -	2.6 - 8.3	Andersen and Robsdorff (1976)
				Muscle	4	M&F	- / 1-3	- -	-	
96	Harbour Porpoise *(Phocoena phocoena)*	E. Coast of Scotland	1974	Liver	17	M	- -	7.29 ± 2.94	2.74 - 12.80	Falconer et al. (1983)
				Kidney	17	M	- -	3.83 ± 0.52	2.64 - 4.77	
97	Harbour Porpoise *(Phocoena phocoena)*	E. Coast of Scotland	1974	Liver	6	F	- -	7.21 ± 2.64	2.65 - 10.30	Falconer et al. (1983)
				Kidney	6	F	- -	3.59 ± 0.26	3.16 - 3.88	
98	Striped Dolphin *(Stenella caeruleoalba)*	E. Coast of Japan Izu Peninsula	1977-1980	Liver	57	M&F	- -	8.09 ± 1.87	3.57 - 15.2	Honda et al. (1983)
				Muscle	59	M&F	- -	2.04 ± 0.36	1.78 - 3.37	
				Kidney	30	M&F	- -	3.13 ± 1.25	1.46 - 6.05	

Table 2. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean length (m) / age (yrs)	Pb µg/g mean ± S.D.	Pb µg/g Range	Source
12	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, Canada	1977	Liver	6	-	- / -	0.17 ± 0.13	<0.05 - 0.32	Fallis (unpublished)
				Muscle+	6	-	- / -	0.11 ± 0.06	0.08 - 0.32	
				Kidney	6	-	- / -	0.21 ± 0.27	0.07 - 0.76	
				Blubber	6	-	- / -	0.31 ± 0.34	<0.05 - 0.75	
13	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, Canada	1979	Liver	37	M&F	3.7 / -	0.03 ± 0.01	0.01 - 0.06	Wagemann et al. (1983)
				Muscle+	58	M&F	4.3 / -	0.01 ± 0.01	0.003 - 0.037	
				Kidney	54	M&F	3.8 / -	0.02 ± 0.01	0.006 - 0.079	
				Blubber	44	M&F	3.8 / -	0.02 ± 0.01	<0.01 - 0.09	
19	Narwhal *(Monodon monoceros)*	Admiralty Inlet, E. Arctic Canada	1975	Liver	26	-	- / -	0.11 ± 0.13	<0.04 - 0.57	Fallis (unpublished)
				Muscle+	27	-	- / -	0.05 ± 0.07	<0.04 - 0.34	
				Blubber	11	-	- / -	0.27 ± 0.78	<0.04 - 2.62	
30	Harbour Porpoise *(Phocoena phocoena)*	Baltic Sea	1977	Liver	1	F	0.80 / -	0.17 -	-	Harms et al. (1978)
				Muscle	1	F	- / -	0.03 -	-	
31	Harbour Porpoise *(Phocoena phocoena)*	Baltic Sea	1977	Liver	1	M	1.26 / -	0.43 -	-	Harms et al. (1978)
				Muscle	1	M	- / -	0.07 -	-	
				Kidney	1	M	- / -	0.15 -	-	
32	Harbour Porpoise *(Phocoena phocoena)*	North Sea	1977	Liver	1	F	1.53 / -	0.35 -	-	Harms et al. (1978)
				Muscle	1	F	- / -	0.05 -	-	
				Kidney	1	F	- / -	0.17 -	-	
95	Harbour Porpoise *(Phocoena phocoena)*	Coast of Denmark	1972-1973	Liver	4	M&F	- / 1-3	3.5 -	1.9 - 5.3	Andersen and Robsdorff (1976)
				Muscle	4	M&F	- / 1-3	3.3 -	1.6 - 4.7	
98	Striped Dolphin *(Stenella caeruleoalba)*	E. Coast of Japan Izu Peninsula	1977-1980	Liver	57	M&F	- / -	0.22 ± 0.14	0.03 - 0.64	Honda et al. (1983)
				Muscle	59	M&F	- / -	0.18 ± 0.072	0.04 - 0.26	
				Kidney	30	M&F	- / -	0.17 ± 0.17	0.01 - 0.71	

* - Different tissues belong to the same animal or groups of animals which have the same Index No.

\+ - Dorsal meat

Table 3. Reference concentrations of Cd (wet weight basis) in different tissues of Cetaceans.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length (m)	Cd µg/g mean ± S.D.	Cd µg/g Range	Source
12	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, Canada	1977	Liver	6	-	-	7.76 ± 6.63	1.82 - 19.3	Fallis (unpublished)
				Muscle+	6	-	-	0.11 ± 0.11	0.03 - 0.32	
				Kidney	6	-	-	30.51 ± 21.41	4.86 - 50.50	
				Blubber	6	-	-	0.02 ± 0.02	0.02 - 0.05	
13	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, Canada	1979	Liver	37	M&F	3.7	32.02 ± 33.2	1.28 - 130.8	Wagemann et al. (1983)
				Muscle+	58	M&F	4.3	0.19 ± 0.22	0.01 - 1.12	
				Kidney	54	M&F	3.8	63.5 ± 41.0	1.0 - 205.4	
				Blubber	44	M&F	3.8	0.05 ± 0.05	0.01 - 0.25	
19	Narwhal *(Monodon monoceros)*	Admiralty Inlet, E. Arctic Canada	1975	Liver	26	-	-	30.41 ± 25.67	0.59 - 95.5	Fallis (unpublished)
				Muscle+	27	-	-	0.24 ± 0.24	<0.01 - 0.94	
				Blubber	11	-	-	0.04 ± 0.03	<0.01 - 0.10	
15	Short Finned Pilot Whale *(Globicephala macrorhyncha)*	Cumberland Island, Georgia, USA	1977	Liver	1	F^A	3.7	12.70 ± 1.36[C]	-	Stoneburner (1978)
				Kidney	1	F^A	3.7	41.80 ± 4.29[C]	-	
				Blubber	1	F^A	3.7	0.48 ± 0.04[C]	-	
16	Short Finned Pilot Whale *(Globicephala macrorhyncha)*	Cumberland Island, Georgia, USA	1977	Liver	2	F^B	3.7	15.80 ± 5.66	11.80 - 19.80	Stoneburner (1978)
				Kidney	2	F^B	3.7	27.95 ± 1.20	27.1 - 28.8	
				Blubber	2	F^B	3.7	0.67 ± 0.11	0.59 - 0.75	
17	Minke Whale *(Balaenoptera acutorostrata)*	Disko Bay, W. Greenland	1978	Liver	1	M	3.9	11.30 ± 0.14[C]	-	Stoneburner (1978)
				Kidney	1	M	3.9	27.8 ± 1.74[C]	-	
				Blubber	1	M	3.9	0.34 ± 0.02[C]	-	
30	Harbour Porpoise *(Phocoena phocoena)*	Baltic Sea	1977	Liver	1	F	0.80	0.023 -	-	Harms et al. (1978)
				Muscle	1	F	-	0.002 -	-	
31	Harbour Porpoise *(Phocoena phocoena)*	Baltic	1977	Liver	1	M	1.26	0.025 -	-	Harms et al. (1978)
				Muscle	1	M	-	0.002 -	-	
				Kidney	1	M	-	0.077 -	-	

Table 3. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean length (m)	Cd µg/g mean ± S.D.	Cd µg/g Range	Source
32	Harbour Porpoise *(Phocoena phocoena)*	North Sea	1977	Liver	1	F	1.53	0.19 -	-	Harms et al. (1978)
				Muscle	1	F	-	0.006 -	-	
				Kidney	1	F	-	0.95 -	-	
96	Harbour Porpoise *(Phocoena phocoena)*	E. Coast of Scotland	1974	Liver	17	M	-	0.15 ± 0.13	<0.05 - 0.94	Falconer et al. (1983)
				Kidney	17	M	-	1.11 ± 0.80	0.17 - 2.91	
97	Harbour Porpoise *(Phocoena phocoena)*	E. Coast of Scotland	1974	Liver	6	F	-	0.27 ± 0.34	<0.05 - 0.94	Falconer et al. (1983)
				Kidney	6	F	-	2.68 ± 2.83	0.24 - 7.42	
98	Striped Dolphin *(Stenella caeruleoalba)*	E. Coast of Japan, Izu Peninsula	1977-1980	Liver	57	M&F	-	6.26 ± 2.32	0.04 - 11.1	Honda et al. (1983)
				Muscle	59	M&F	-	0.10 ± 0.064	0.01 - 0.25	
				Kidney	30	M&F	-	24.8 ± 16.2	0.06 - 69.6	

* - Different tissues belong to the same animal or groups of animals which have the same Index No.

\+ - Dorsal meat

A - Gravid

B - Non-gravid

c - S.D. from 3 analyses of the same specimen.

Table 4. Reference concentrations of Se (wet weight basis) in different tissues of Cetaceans.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length (m) / Age (yrs)	Se µg/g mean ± S.D.	Se µg/g Range	Source
8	Pilot Whale *(Globicephala malaena)*	Wakayama, Japan	1975	Muscle[+]	12	-	- / -	0.88 ± 0.23	0.61 - 1.30	Arima and Nagakura (1979)
12	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, Canada	1977	Liver	6	-	- / -	5.54 ± 4.65	2.33 - 14.8	Fallis (unpublished)
				Muscle[+]	6	-	- / -	0.37 ± 0.09	0.25 - 0.51	
				Kidney	6	-	- / -	2.59 ± 0.49	1.99 - 3.42	
				Blubber	6	-	- / -	0.03 ± 0.04	< 0.02 - 0.11	
13	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, Canada	1979	Liver	37	M&F	3.7 / -	4.06 ± 1.84	0.62 - 7.98	Wagemann et al. (1983)
				Muscle[+]	58	M&F	4.3 / -	0.44 ± 0.10	0.31 - 0.85	
				Kidney	54	M&F	3.8 / -	3.15 ± 0.85	1.73 - 4.87	
				Blubber	44	M&F	3.8 / -	0.07 ± 0.06	<0.01 - 0.28	
15	Short Finned Pilot Whale *(Globicephala macrorhyncha)*	Cumberland Island Georgia, USA	1977	Liver	1	F[A]	3.7 / -	61.60 ± 1.58[C]	-	Stoneburner (1978)
				Kidney	1	F[A]	3.7 / -	10.01 ± 1.28[C]	-	
16	Short Finned Pilot Whale *(Globicephala macrorhyncha)*	Cumberland Island Georgia, USA	1977	Liver	2	F[B]	3.7 / -	46.15 ± 18.74	32.90 - 59.40	Stoneburner (1978)
				Kidney	2	F[B]	3.7 / -	7.82 ± 2.45	6.09 - 9.55	
17	Short Finned Pilot Whale *(Globicephala macrorhyncha)*	Cumberland Island Georgia, USA	1977	Liver	1	M	3.9 / -	22.80 ± 0.54[C]	-	Stoneburner (1978)
43	Finless Black Porpoise *(Neophocaena phocaenoides)*	Kanagawa, Japan	1973	Muscle[+]	1	-	0.72 / fetus	0.21 -	-	Arima and Nagakura (1979)

Table 4. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length (m) / Age (yrs)	Se µg/g mean ± S.D.	Se µg/g Range	Source
46	White Dotted Dolphin *(Stenella attenuata)*	Wakayama, Japan	1972	Muscle+	1	-	1.7 / 4-5	0.68 -	-	Arima and Nagakura (1979)
47	White Dotted Dolphin *(Stenella attenuata)*	Wakayama, Japan	1973	Muscle+	1	-	0.86 / fetus	0.30 -	-	Arima and Nagakura (1979)
48	Blue White Dolphin *(Stenella caeruleoalba)*	Shizuoka, Japan	1974	Muscle+	10	-	2.2 / ∿15	1.12 ± 0.68	0.51 - 2.48	Arima and Nagakura (1979)
49	Blue White Dolphin *(Stenella caeruleoalba)*	Shizuoka, Japan	1973	Muscle+	1	-	0.94 / fetus	0.22 -	-	Arima and Nagakura (1979)
50	Pacific Bottlenose *(Tursiops gilli)*	Shizuoka, Japan	1973	Muscle+	1	-	3.1 / ∿22	13.9 -	-	Arima and Nagakura (1979)

* - Different tissues belong to the same animal or groups of animals which have the same Index No.

\+ - Dorsal meat

∿ - Approximately

A - Gravid

B - Non-gravid

c - S.D. from 3 analyses of the same specimen.

Table 5. Reference concentrations of Hg (wet weight basis) in different tissues of Pinnipeds.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean age (yrs) / weight (kg)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
101	Ringed Seal *(Phoca hispida)*	Baltic Area	1967	Liver	3	M	adult / 46.7	137.8 ± 68.26	74.0 - 210	Henriksson and Karppanen (1969)
				Muscle+	3	M	adult / 46.7	81.5 ± 101.0	14.2 - 196.9	
102	Ringed Seal *(Phoca hispida)*	North Sea	1975	Liver	1	F	- -	0.64 -	-	Harms et al. (1978)
104	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1975	Liver	5	-	- -	3.27 ± 0.75	1.41 - 5.18	Fallis (unpublished)
105	Ringed Seal *(Phoca hispida)*	Upernavik, W. Greenland	1973	Liver	10	-	- -	2.40 ± 1.49†	0.32 - 4.90	Johansen et al. (1980)
				Muscle+	10	-	- -	0.23 ± 0.16†	<0.05 - 0.51	
106	Ringed Seal *(Phoca hispida)*	Upernavik, W. Greenland	1974	Liver	7	-	- -	0.34 ± 0.38†	<0.05 - 1.20	Johansen et al. (1980)
				Muscle+	7	-	- -	0.09 ± 0.04†	<0.05 - 0.12	
107	Ringed Seal *(Phoca hispida)*	Daneborg, E. Greenland	1974	Liver	7	-	- -	2.9 ± 2.5†	1.4 - 8.1	Johansen et al. (1980)
				Muscle+	7	-	- -	0.42 ± 0.06†	0.25 - 0.42	
108	Ringed Seal *(Phoca hispida)*	Upernavik, W. Greenland	1976	Liver	31	-	- -	2.1 ± 4.1	0.14 - 11.9	Johansen et al. (1980)
				Muscle+	31	-	- -	0.18 ± 0.18†	0.02 - 0.55	
109	Ringed Seal *(Phoca hispida)*	Bothnian Bay, W. Finland	1974	Liver	12	-	- -	91.0 ± 88.7†	14 - 300	Kari and Kauranen (1978)
				Muscle+	8	-	- -	1.10 ± 0.22†	0.47 - 1.60	
				Kidney	2	-	- -	4.0 ± 2.1†	2.8 - 5.2	
110	Ringed Seal *(Phoca hispida)*	Saimaa, S.E. Finland	1974	Liver	3	-	- -	230 ± 259†	72 - 510	Kari and Kauranen (1978)
			1975	Muscle+	3	-	- -	3.5 ± 2.8†	1.3 - 6.1	
				Kidney	3	-	- -	7.4 ± 6.6†	1.9 - 13	
				Blubber	2	-	- -	0.30 ± 0.23†	0.14 - 0.46	

Table 5. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean age (yrs) / weight (kg)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
112	Ringed Seal *(Phoca hispida)*	Finnish Bay; Between Kotka and Hogland	1968	Liver Muscle+ Kidney	9 9 9	F F F	adult / - adult / - adult / -	12.47 ± 8.83 0.91 ± 0.56 2.36 ± 1.40	2.5 - 27.6 0.4 - 2.3 1.1 - 4.8	Henriksson and Karpannen (1969)
113	Ringed Seal *(Phoca hispida)*	Finnish Bay; Between Kotka and Hogland	1968	Liver Muscle+ Kidney	7 7 7	M M M	adult / - adult / - adult / -	10.96 ± 6.30 0.99 ± 0.69 5.20 ± 1.59	5.7 - 23.3 <0.1 - 2.3 1.6 - 6.4	Henriksson and Karpannen (1969)
114	Ringed Seal *(Phoca hispida)*	Baltic Area, Väistönselkä	1968	Liver Muscle+ Kidney	1 1 1	F F F	juvenile/ 11.2 juvenile/ 11.2 juvenile/ 11.2	1.3 - 0.3 - 2.1 -	- - -	Henriksson and Karpannen (1969)
115	Ringed Seal *(Phoca hispida)*	Baltic Area, Seurasaari	1968	Liver Muscle+ Kidney	1 1 1	M M M	juvenile/ 22.6 juvenile/ 22.6 juvenile/ 22.6	3.3 - 0.2 - 2.7 -	- - -	Henriksson and Karpannen (1969)
116	Ringed Seal *(Phoca hispida)*	Baltic Area	1967	Liver Muscle+ Kidney	3 3 1	F F F	juvenile/ 29.2 juvenile/ 29.2 juvenile/ 28	9.83 ± 11.93 2.53 ± 1.65 5.7	2.4 - 23.6 0.7 - 3.9	Henriksson and Karpannen (1969)
117	Ringed Seal *(Phoca hispida)*	Aston Bay Somerset Island, E. Arctic Canada	1975	Liver Muscle+	88 89	-	- - - -	19.33 ± 18.44 0.44 ± 0.16	- -	Smith and Armstrong (1978)
118	Ringed Seal *(Phoca hispida)*	Barrow Strait, E. Arctic Canada	1976	Liver Muscle+	27 27	-	10.2 / - 10.2 / -	16.14 ± 13.84 0.91 ± 0.38	- -	Smith and Armstrong (1978)
119	Ringed Seal *(Phoca hispida)*	Arctic Bay N.E. Baffin Island E. Arctic Canada	1976	Liver Muscle+	36 37	-	0.3 / - 0.3 / -	0.32 ± 0.08 0.08 ± 0.07	- -	Smith and Armstrong (1978)

Table 5. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean age (yrs) / weight (kg)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
120	Ringed Seal *(Phoca hispida)*	S.E. Beaufort Sea W. Arctic Canada	1972	Liver Muscle+	13 13	- -	1.3 / - 1.3 / -	1.0 ± 1.16 0.23 ± 0.11	- -	Smith and Armstrong (1978)
121	Ringed Seal *(Phoca hispida)*	W.Victoria Island W. Arctic Canada	1972	Liver Muscle+	83 83	- -	12.8 / - 12.8 / -	27.5 ± 30.1 0.72 ± 0.33	- -	Smith and Armstrong (1978)
122	Ringed Seal *(Phoca hispida)*	Pond Inlet N.E. Baffin Island, E. Arctic Canada	1976	Liver Muscle+	33 33	- -	5.2 / - 5.2 / -	3.76 ± 3.42 0.31 ± 0.17	- -	Smith and Armstrong (1978)
124	Ringed Seal *(Phoca hispida)*	W.Victoria Island W. Arctic Canada	1977	Liver	112	-	8.1 / -	25.54 ± 15.0	-	Smith and Armstrong (1978)
127	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1977	Muscle+ Kidney	7 1	- -	- - - -	0.33 ± 0.06 2.32 -	0.16 - 0.57 -	Fallis (unpublished)
132	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1975	Liver Kidney	9 10	M&F M&F	0-3 / 54 0-3 / 59	11.45 ± 6.25 1.95 ± 0.66	1.0 - 25.0 1.10 - 3.30	McKie et al. (1980)
133	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1975	Liver Kidney	8 7	M&F M&F	4-6 / 92 4-6 / 92	21.39 ± 16.22 2.43 ± 0.71	4.10 - 54.0 1.37 - 3.38	McKie et al. (1980)
134	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1975	Liver Kidney	3 3	M M	7-9 / 163 7-9 / 163	36.77 ± 10.81 2.96 ± 0.56	24.4 - 44.4 2.33 - 3.70	McKie et al. (1980)
135	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1976	Liver Kidney	11 11	M&F M&F	0-3 / 67 0-3 / 67	24.4 ± 27.45 2.45 ± 1.18	3.14 - 89.3 0.84 - 4.56	McKie et al. (1980)

Table 5. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean age (yrs) / weight (kg)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
136	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1976	Liver Kidney	7 7	M&F M&F	4-6 / 98 4-6 / 98	31.8 ± 24.2 2.38 ± 0.66	2.64 - 77.3 1.48 - 3.32	McKie et al. (1980)
137	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1976	Liver Kidney	5 5	M M	7-9 / 142 7-9 / 142	36.6 ± 17.6 3.72 ± 1.16	11.7 - 48.1 2.55 - 5.64	McKie et al. (1980)
138	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1977	Liver Kidney	4 4	M&F M&F	0-3 / 63 0-3 / 63	20.3 ± 12.1 3.81 ± 1.77	11.5 - 37.9 1.72 - 6.0	McKie et al. (1980)
139	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1977	Liver Kidney	9 9	M&F M&F	4-6 / 91 4-6 / 91	21.18 ± 14.87 2.44 ± 1.12	0.26 - 48.6 0.88 - 3.69	McKie et al. (1980)
140	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1977	Liver Kidney	3 3	M&F M&F	7-9 / 129 7-9 / 129	49.1 ± 65.8 4.39 ± 2.06	0.23 - 123.9 1.71 - 6.73	McKie et al. (1980)
141	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1978	Liver Kidney	2 2	M M	0-3 / 91 0-3 / 91	50.3 ± 40.8 3.17 ± 0.90	9.55 - 9.11 2.27 - 4.06	McKie et al. (1980)
142	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1978	Liver Kidney	6 5	M&F M&F	4-6 / 103 4-6 / 103	39.17 ± 21.72 2.55 ± 1.30	12.3 - 74.7 1.41 - 4.42	McKie et al. (1980)
143	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1978	Liver Kidney	5 4	M&F M&F	7-9 / - 7-9 / -	61.80 ± 44.76 3.20 ± 0.96	37.0 - 125.9 2.33 - 4.31	McKie et al. (1980)
144	Grey Seal *(Halichoerus grypus)*	Sable Island, Eastern Canada	1973	Liver Kidney	6 6	M&F M&F	10.7 / - 10.7 / -	94.45 ± 50.36 1.20 ± 0.45	24.4 - 170.0 0.72 - 1.80	Sergeant and Armstrong (1973)
145	Grey Seal *(Halichoerus grypus)*	Sable Island, Eastern Canada	1973	Liver Muscle+	1 1	- -	1 / - 1 / -	14.3 1.80	- -	Sergeant and Armstrong (1973)
146	Grey Seal *(Halichoerus grypus)*	Sable Island Eastern Canada	1973	Liver Muscle+	1 1	M M	25 / - 25 / -	387 2.35	- -	Sergeant and Armstrong (1973)

Table 5. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean age / (yrs)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
147	Grey Seal *(Halichoerus grypus)*	Sable Island Eastern Canada	1973	Liver	3	M&F	pups	0.74 ± 0.39	0.46 - 1.18	Sergeant and Armstrong (1973)
				Muscle+	3	M&F	pups	0.35 ± 0.17	0.17 - 0.50	
148	Grey Seal *(Halichoerus grypus)*	Farne Islands N.E. England	-	Liver	24	M	-	43.0 -	-	Caines (1978)
				Kidney	27	M	-	4.12 -	-	
149	Grey Seal *(Halichoerus grypus)*	Farne Islands N.E. England	-	Liver	38	F	-	141.5 -	-	Caines (1978)
				Kidney	37	F	-	4.32 -	-	
150	Grey Seal *(Halichoerus grypus)*	East Anglia, England	-	Liver	2	-	adult & sub-adult	120 ± 78	65 - 175	Holden (1975)
				Muscle+	2	-	adult & sub-adult	4.0 ± 2.69	2.1 - 5.9	
				Kidney	2	-	adult & sub-adult	37.9 ± 42.6	7.8 - 68	
				Blubber	2	-	adult & sub-adult	0.75 ± 0.92	0.1 - 1.4	

Table 5. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean age (yrs) / length (m)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
151	Grey Seal *(Halichoerus grypus)*	East Anglia England	-	Liver	1	-	1 / -	6	-	Holden (1975)
				Muscle+	1	-	1 / -	1.7	-	
				Kidney	1	-	1 / -	4.3	-	
				Blubber	1	-	1 / -	0.2	-	
152	Grey Seal *(Halichoerus grypus)*	Fourchu Bay Nova Scotia, E. Canada	1972	Liver	1	M	pup / 1.32	4.1	-	Freeman and Horne (1973)
				Muscle+	1	M	pup / 1.32	0.77	-	
				Kidney	1	M	pup / 1.32	1.5	-	
				Blubber	1	M	pup / 1.32	0.062	-	
153	Grey Seal *(Halichoerus grypus)*	North Sea	1975	Liver	1	M	2 / -	19.5	-	Harms et al. (1978)
155	Grey Seal *(Halichoerus grypus)*	Fourchu Bay Nova Scotia, E. Canada	1972	Liver	1	F	pup / 1.22	2.8	-	Freeman and Horne (1973)
				Muscle+	1	F	pup / 1.22	0.58	-	
				Kidney	1	F	pup / 1.22	1.5	-	
				Blubber	1	F	pup / 1.22	0.036	-	
156	Grey Seal *(Halichoerus grypus)*	Fourchu Bay Nova Scotia, E. Canada	1972	Liver	2	M&F	- / 1.54	10.5 ± 0.71	10 - 11	Freeman and Horne (1973)
				Muscle+	2	M&F	- / 1.54	0.86 ± 0.01	0.85 - 0.86	
				Kidney	2	M&F	- / 1.54	2.9 ± 0.14	2.8 - 3.0	
				Blubber	2	M&F	- / 1.54	0.078 ± 0.032	0.055- 0.10	
157	Grey Seal *(Halichoerus grypus)*	Fourchu Bay Nova Scotia, E. Canada	1972	Liver	2	M&F	- / 2.04	28.0 ± 2.83	26 - 30	Freeman and Horne (1973)
				Muscle+	2	M&F	- / 2.04	1.6 ± 0.0	1.6 - 1.6	
				Kidney	2	M&F	- / 2.04	5.35 ± 0.49	5.0 - 5.7	
				Blubber	2	M&F	- / 2.04	0.098 ± 0.017	0.086- 0.11	
158	Grey Seal *(Halichoerus grypus)*	Great Britain	1977	Liver	2	M	- -	27[β] ± 17	15 - 39	van de Ven et al. (1979)
159	Grey Seal *(Halichoerus grypus)*	Great Britain	1977	Liver	6	F	7.2 / -	53.7[β] ± 42.8	17 - 127	van de Ven et al. (1979)
160	Grey Seal *(Halichoerus grypus)*	Great Britain	1977	Liver	2	F	- -	78.0[β] ± 9.9	71 - 85	van de Ven et al. (1979)
161	Grey Seal *(Halichoerus grypus)*	Great Britain	1977	Liver	5	-	pups / -	1.07 ± 0.78	0.55 - 2.30	van de Ven et al. (1979)

Table 5.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean length/weight (m) / (kg)	Hg µg/g mean ± S.D.	Hg µg/g Range		Source
165	Harbour Seal *(Phoca vitulina)*	Boothbay Harbour Maine, USA	1971	Liver	2	M	0.90 / 27.9	4.70 ± 4.53	1.50 -	7.90	Gaskin et al. (1973)
				Muscle+	2	M	0.90 / 27.9	0.70 ± 0.48	0.36 -	1.04	
				Kidney	2	M	0.90 / 27.9	0.03 ± 0.01	0.027-	0.037	
166	Harbour Seal *(Phoca vitulina)*	Boothbay Harbour Maine, USA	1971	Liver	2	F	0.88 / -	1.21 ± 0.98	0.52 -	1.91	Gaskin et al. (1973)
				Muscle+	2	F	0.88 / -	0.49 ± 0.39	0.21 -	0.76	
				Blubber	2	F	0.88 / -	0.033 ± 0.007	0.028-	0.038	
167	Harbour Seal *(Phoca vitulina)*	Boothbay Harbour Maine, USA	1971	Liver	2	M&F	1.24 / 64.2	3.40 ± 0.59	2.98 -	3.82	Gaskin et al. (1973)
				Muscle+	2	M&F	1.24 / 64.2	1.04 ± 0.70	0.55 -	1.54	
				Blubber	2	M&F	1.24 / 64.2	0.076 ± 0.016	0.064-	0.087	
168	Harbour Seal *(Phoca vitulina)*	New Brunswick, E. Canada	1971	Liver	1	M	∿0.3 / ∿20	1.72 -	-		Gaskin et al. (1973)
				Muscle+	1	M	∿0.03 / ∿20	0.35 -	-		
				Blubber	1	M	∿0.03 / ∿20	0.061 -	-		
169	Harbour Seal *(Phoca vitulina)*	New Brunswick, E. Canada	1971	Liver	1	F	∿1.25 / ∿55	50.9 -	-		Gaskin et al. (1973)
				Muscle	1	F	∿1.25 / ∿55	0.16 -	-		
				Blubber	1	F	∿1.25 / ∿55	0.036 -	-		
191	Harbour Seal *(Phoca vitulina)*	New Brunswick E. Canada	1971	Muscle+	2	M	∿87.5/ ∿25	0.46 ± 0.12	0.38 -	0.55	Gaskin et al. (1973)
				Blubber	2	M	∿87.5/ ∿25	0.08 ± 0.03	0.06 -	0.11	
							Age (yrs) / Length (m)				
173	Harbour Seal *(Phoca vitulina)*	Wadden Sea, Netherlands	1974 1976	Liver	1	M	0.3 / -	0.65^{β} -	-		van de Ven et al. (1979)
				Muscle+	1	M	0.3 / -	0.09^{β} -	-		
				Kidney	1	M	0.3 / -	0.68^{β} -	-		
174	Harbour Seal *(Phoca vitulina)*	Wadden Sea, Netherlands	1974 1976	Liver	1	F	0.5 / -	5.8^{β} -	-		van de Ven et al. (1979)
				Muscle+	1	F	0.5 / -	0.55^{β} -	-		
				Kidney	1	F	0.5 / -	3.2^{β} -	-		
				Blubber	1	F	0.5 / -	0.03^{β} -	-		
175	Harbour Seal *(Phoca vitulina)*	Wadden Sea, Netherlands	1974 1976	Liver	1	M	1 / -	36^{β} -	-		van de Ven et al. (1979)
				Muscle+	1	M	1 / -	1.6^{β} -	-		
				Kidney	1	M	1 / -	2.3^{β} -	-		
				Blubber	1	M	1 / -	0.11^{β} -	-		

Table 5. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean age (yrs) / length (m)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
176	Harbour Seal *(Phoca vitulina)*	Wadden Sea, Netherlands	1974 1976	Liver Kidney Blubber	2 1 1	F F F	1 / - 1 / - 1 / -	55.5[β] ± 6.36 4.9[β] - 0.08[β] -	51 - 60 - -	van de Ven et al. (1979)
177	Harbour Seal *(Phoca vitulina)*	Netherlands	1974 1976	Liver Kidney Blubber	1 1 1	M M M	24 / - 24 / - 24 / -	55[β] - 6.3[β] - 0.07[β] -	- - -	van de Ven et al. (1979)
178	Harbour Seal *(Phoca vitulina)*	Netherlands	1974 1976	Liver Kidney Blubber	1 1 1	F F F	adult / - adult / - adult / -	250[β] - 14[β] - 0.25[β] -	- - -	van de Ven et al. (1979)
179	Harbour Seal *(Phoca vitulina)*	San Miguel Isle, California, USA	1971	Liver	4	M&F	- / 1.62	269 ± 290	81 - 700	Anas (1974b)
180	Harbour Seal *(Phoca vitulina)*	Columbia River Oregon, USA	1971	Liver	3	M&F	- / 1.19	24.5 ± 37.7	0.3 - 68.0	Anas (1974b)
184	Harbour Seal *(Phoca vitulina)*	Pribilof Island, Alaska, USA	1971	Liver	3	M&F	- -	4.23 ± 4.25	0.6 - 8.9	Anas (1974b)
185	Harbour Seal *(Phoca vitulina)*	West Scotland	1969 1970	Liver Kidney	6 6	- -	- - - -	- - - -	0.05 - 1.13 0.04 - 3.5	Roberts et al. (1976)
186	Harbour Seal *(Phoca vitulina)*	East Anglia (Scroby Sands and the Wash)	1969 1970	Liver Kidney	7 9	- -	- - - -	- - - -	1.5 - 106[α] 0.2 - 4.7	Roberts et al. (1976)
187	Harbour Seal *(Phoca vitulina)*	Sable Island, Eastern Canada	1971	Liver[+] Muscle[+] Blubber	4 4 4	M&F M&F M&F	1 / - 1 / - 1 / -	2.91 ± 0.57 0.71 ± 0.04 0.04 ± 0.04	2.14 - 3.49 0.67 - 0.75 0.02 - 0.09	Sergeant and Armstrong (1973)
188	Harbour Seal *(Phoca vitulina)*	Sable Island, Eastern Canada	1971	Liver[+] Muscle[+] Blubber	4 4 4	M&F M&F M&F	5.2 / - 5.2 / - 5.2 / -	13.45 ± 6.97 0.44 ± 0.10 0.33 ± 0.01	6.91 - 21.7 0.31 - 0.55 0.02 - 0.03	Sergeant and Armstrong (1973)
189	Harbour Seal *(Phoca vitulina)*	East Anglia, England	-	Liver Muscle Kidney Blubber	1 1 1 1	- - - -	2 / - 2 / - 2 / - 2 / -	60 - 2.6 - 5.3 - 0.06 -	- - - -	Holden (1975)

Table 5. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean age (yrs) / weight (kg)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
209	Hooded Seal *(Cystophora cristata)*	Magdalen Island, Gulf of St.Lawrence E. Canada	1971	Liver Muscle+ Blubber	3 3 1	M M M	10 / - 10 / - 8 / -	37.2 ± 9.2 1.28 ± 0.66 0.08 ± -	27.2 - 45.2 0.62 - 1.93 -	Sergeant and Armstrong (1973)
210	Hooded Seal *(Cystophora cristata)*	Upernavik, W. Greenland	1974	Liver Muscle+	4 4	- -	- - - -	6.5 ± 4.5† 0.20 ± 0.04†	1.9 - 11.2 0.16 - 0.24	Johansen et al. (1980)
211	Hooded Seal *(Cystophora cristata)*	Upernavik, W. Greenland	1976	Liver Muscle+	10 10	- -	- - - -	16.7 ± 13.5† 0.33 ± 0.08†	2.8 - 44.4 0.21 - 0.47	Johansen et al. (1980)
207	Harp Seal *(Pagophilus groenlandicus)*	E. Canada Newfoundland	1980	Liver	6	M&F	0.5 / -	0.50 ± 0.27	0.24 - 0.89	Botta et al. (1983)
213	Harp Seal *(Pagophilus groenlandicus)*	Eastern Canada (various locations)	-	Liver	10 10	- -	pups / - pups / -	0.46 ± 0.05 0.22 ± 0.0	0.18 - 0.83 -	Freeman and Horne (1973)
214	Harp Seal *(Pagophilus groenlandicus)*	Umanak, W. Greenland	1972	Liver Muscle+	7 12	- -	- - - -	1.2 ± 1.3† 0.20 ± 0.05†	0.21 - 3.6 0.11 - 0.26	Johansen et al. (1980)
215	Harp Seal *(Pagophilus groenlandicus)*	Upernavik, W. Greenland	1973	Liver Muscle+	11 11	- -	- - - -	2.3 ± 1.71† 0.24 ± 0.12†	0.37 - 5.8 0.11 - 0.48	Johansen et al. (1980)
216	Harp Seal *(Pagophilus groenlandicus)*	Upernavik, W. Greenland	1976	Liver Muscle+	4 4	- -	- - - -	0.86 ± 0.37 0.20 ± 0.05†	0.54 - 1.3 0.16 - 0.26	Johansen et al. (1980)
217	Harp Seal *(Pagophilus groenlandicus)*	Gulf of St. Lawrence, E. Canada	1973	Liver	2	F	pups$^{\gamma}$/ -	0.33 ± 0.15	0.22 - 0.43	Jones et al. (1976)
218	Harp Seal *(Pagophilus groenlandicus)*	Gulf of St. Lawrence E. Canada	1973	Liver Muscle+	2 2	F F	12.3 / - 12.3 / -	7.10 ± 0.99 0.27 ± 0.06	6.4 - 7.8 0.23 - 0.31	Jones et al. (1976)
219	Harp Seal *(Pagophilus groenlandicus)*	Gulf of St. Lawrence E. Canada	1973	Liver Muscle+ Blubber	2 3 1	M&F M&F F	pups / - pups / - pup / -	0.16 ± 0.07 0.09 ± 0.02 0.09 -	0.12 - 0.21 0.07 - 0.12 -	Jones et al. (1976)
220	Harp Seal *(Pagophilus groenlandicus)*	Magdalen Islands Gulf of St.Lawrence E. Canada	1970	Liver Muscle+ Kidney	1 1 1	F F F	11 / 172 11 / 172 11 / 172	25.8 - 0.78 - 5.98 -	- - -	Freeman et al. (1975)

Table 5. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean age (yrs) /weight (kg)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
221	Harp Seal *(Pagaphilus groenlandicus)*	Escoumins,Quebec E. Canada	1971	Liver	2	M&F	1 / -	1.29 ± 0.64	0.84 - 1.74	Sergeant and Armstrong (1973)
				Muscle+	2	M&F	1 / -	0.24 ± 0.11	0.16 - 0.32	
				Blubber	2	M&F	1 / -	0.025 ± 0.007	0.02 - 0.03	
222	Harp Seal *(Pagophilus groenlandicus)*	Escoumins,Quebec E. Canada	1971	Liver	14	M&F	4.2/ -	3.28 ± 1.55	1.46 - 7.74	Sergeant and Armstrong (1973)
223	Harp Seal *(Pagophilus groenlandicus)*	Escoumins,Quebec E. Canada	1971	Liver	4	M	13.8/ -	6.35 ± 2.86	3.72 - 10.0	Sergeant and Armstrong (1973)
				Muscle+	4	M	13.8/ -	0.38 ± 0.09	0.29 - 0.50	
				Blubber	4	M	13.8/ -	0.033 ± 0.015	0.02 - 0.05	
224	Harp Seal *(Pagophilus groenlandicus)*	Eastern Canada (various locations)	1973	Liver	10	F	- -	4.60 ± 0.89	1.90 - 9.40	Freeman and Horne (1973)
				Muscle+	10	F	- -	0.46 ± 0.04	0.28 - 0.70	
				Blubber	5	F	- -	0.14 ± 0.0	-	
225	Harp Seal *(Pagophilus groenlandicus)*	Gulf of St. Lawrence, E. Canada	1973	Liver	10	M	pups / -	0.27 ± 0.12	0.116- 0.478	Jones et al. (1976)
				Kidney	8	M	pups / -	1.89 ± 0.16	0.04 - 0.48	
226	Harp Seal *(Pagophilus groenlandicus)*	Gulf of St. Lawrence, E. Canada	1973	Liver	6	F	pups / -	0.23 ± 0.13	0.094- 0.45	Jones et al. (1976)
				Muscle+	6	F	pups / -	0.14 ± 0.10	1.07 - 0.34	
227	Harp Seal *(Pagophilus groenlandicus)*	E. Canada Newfoundland	1980	Liver	6	M&F	1 / -	1.67 ± 0.81	0.72 - 2.71	Botta et al. (1983)
229	Harp Seal *(Pagophilus groenlandicus)*	E. Canada	1980	Liver	6	M&F	2 / -	2.42 ± 1.48	0.86 - 2.78	Botta et al. (1983)
230	Harp Seal *(Pagophilus groenlandicus)*	E. Canada	1980	Liver	6	M&F	3 / -	3.96 ± 1.32	1.88 - 5.87	Botta et al. (1983)

Table 5. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean age (yrs)	/weight (kg)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
231	Harp Seal *(Pagophilus groenlandicus)*	E. Canada	1980	Liver	6	M&F	4 & older/	-	3.08 ± 1.53	0.76 - 4.71	Botta et al. (1983)
236	Bearded Seal *(Erignathus barbatus)*	Victoria Island, W. Arctic Canada	1973	Liver Muscle+	6 3	- -	8.5 / 8.5 /	- -	143 ± 170 0.53 ± 0.35	27 - 313 -	Smith and Armstrong (1978)
237	Bearded Seal *(Erignathus barbatus)*	Belcher Island, E. Arctic Canada	1974	Liver Muscle+	56 55	- -	4.9 / 4.9 /	- -	26.18 ± 26.13 0.09 ± 0.04	0.05 - 52.31 -	Smith and Armstrong (1978)
238	Fur Seal *(Callorhinus ursinus)*	Pribilof Islands, Alaska, USA	1970	Liver Muscle+	10 5	M&F M&F	0.3 / 0.3 /	- -	- 0.1	- -	0.01 - 0.3 -	Anas (1974b)
239	Fur Seal *(Callorhinus ursinus)*	Pribilof Islands, Alaska, USA	1970	Liver Muscle+	29 29	M M	2-3 / 2-3 /	- -	- -	- -	3.0 - 19.0 0.1 - 0.4	Anas (1974b)
240	Fur Seal *(Callorhinus ursinus)*	Washington Coast, W. USA	1970	Liver	29	F	5-19/	-	-	-	19.0 - 172.0	Anas (1974b)
241	Fur Seal *(Callorhinus ursinus)*	Washington Coast, W. USA	1971	Liver	1	M	fetus/	-	0.4	-	-	Anas (1974b)
242	Fur Seal *(Callorhinus ursinus)*	Washington Coast, W. USA	1971	Liver Kidney	1 1	M M	1 / 1 /	- -	3.7 0.7	- -	- -	Anas (1974b)
243	Fur Seal *(Callorhinus ursinus)*	Washington Coast, W. USA	1971	Liver Kidney	8 8	F F	1-20/ 1-20/	- -	- -	- -	7.1 - 132.0 0.6 - 1.6	Anas (1974b)
246	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver Muscle+	15 15	- -	- -	- -	4.45 ± 3.51 0.14 ± 0.11	0.69 - 12.2 0.03 - 0.48	Wagemann et al. (1983)

Table 5. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean age (yrs) / weight (kg)	Hg µg/g mean ± S.D.	Hg µg/g Range	Source
247	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver	1	F[A]	adult / -	3.98	-	Wagemann (Unpublished)
				Muscle[+]	1	F[A]	adult / -	0.16	-	
248	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver	1	-	fetus / -	0.17	-	Wagemann (Unpublished)
				Muscle[+]	1	-	fetus / -	1.11	-	
249	Weddell Seal *(Leptonychotes weddelli)*	Antarctic	1978	Liver	1	-	- -	0.71	-	Wagemann (Unpublished)
				Muscle[+]	1	-	- -	0.20	-	
328	Atlantic Walrus *(Odobenus rosmarus)*	North Greenland (Thule)	1975-1977	Liver	46	M&F	10.9 / -	1.78 ± 1.54	0.12 - 7.3	Born et al. (1981)
				Muscle	58	M&F	10.9 / -	0.08 ± 0.05	0.03 - 0.13	

* - Different tissues belong to the same animal or groups of animals which have the same Index No.

[+] - Dorsal meat

† - S.D. estimated from the range

∿ - Approximately

■ - Concentrations are age correlated; significant at 1.0%

α - Concentrations are age correlated; significant at 0.1%

β - Arithmetic mean of three determinations per sample

γ - Kept in captivity for one year

A - Gravid

Table 6. Reference concentrations of Zn (wet weight basis) in different tissues of Pinnipeds.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Age (yrs) / Length (m)	Zn µg/g mean ± S.D.	Zn µg/g Range	Source
102	Ringed Seal *(Phoca hispida)*	North Sea	1975	Liver	1	F	- / 0.84	40.0 -	-	Harms et al. (1978)
104	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1975	Liver	6	-	- -	41.0 ± 5.1	33.9 - 48.6	Fallis (unpublished)
				Muscle+	6	-	- -	26.2 ± 5.8	18.8 - 29.9	
				Blubber	6	-	- -	1.27 ± 0.39	0.79 - 1.94	
126	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1976	Liver	1	-	- -	43.2 -	-	Fallis (unpublished)
				Muscle+	1	-	- -	19.6 -	-	
				Kidney	1	-	- -	39.6 -	-	
				Blubber	1	-	- -	5.4 -	-	
127	Ringed Seal *(Phoca hispida)*	Northern Baffin Island E. Arctic Canada	1977	Liver	5	-	- -	44.0 ± 3.4	36.6 - 52.1	Fallis (unpublished)
				Muscle+	7	-	- -	20.1 ± 1.4	14.8 - 23.7	
				Kidney	1	-	- -	41.1 -	-	
128	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1974	Liver	17	-	- -	34.3 ± 13.1	9.4 - 52.1	Fallis (unpublished)
				Muscle+	18	-	- -	21.7 ± 5.9	12.8 - 34.5	
129	Ringed Seal *(Phoca hispida)*	Umanak, W. Greenland	1979	Liver	29	-	- -	46.0 ± 9.0†	30.7 - 67.3	Johansen et al. (1980)
				Muscle+	29	-	- -	22.2 ± 6.22†	14.2 - 39.5	
				Kidney	29	-	- -	46.2 ± 12.3†	27.9 - 78.0	
				Blubber	29	-	- -	0.84 ± 0.12†	0.66 - 1.16	
130	Ringed Seal *(Phoca hispida)*	Upernavik, W. Greenland	1974 + 1976	Liver	12	-	- -	37.0 ± 8.6†	18 - 46	Johansen et al. (1980)
				Muscle+	7	-	- -	55.0 ± 17.4†	37 - 84	
				Blubber	7	-	- -	1.4 ± 0.81†	0.1 - 2.3	
153	Grey Seal *(Halichoerus grypus)*	North Sea	1975	Liver	1	M	2 / -	61.0 -	-	Harms et al. (1978)
163	Grey Seal *(Halichoerus grypus)*	East Scotland	-	Liver	9	-	- -	81 ± 8.8	68 - 94	Holden (1975)

Table 6. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Mean Sex	Age / (yrs)	Length (m)	Zn µg/g mean ± S.D.	Range	Source
193	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	27	-	0.0-0.5	/ -	39.4 ± 7.3†	27.0 - 56.0	Drescher et al. (1977)
194	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	10	-	0.58-1.0	/ -	39.6 ± 7.5†	27.5 - 50.5	Drescher et al. (1977)
				Kidney	9	-	0.58-1.0	/ -	22.2 ± 2.59†	18.8 - 26.5	
195	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	11	-	1.1-1.5	/ -	42.2 ± 4.7†	34.0 - 49.0	Drescher et al. (1977)
196	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	4	-	1.6-2.0	/ -	37.3 ± 10.2†	29.0 - 50.0	Drescher et al. (1977)
				Kidney	4	-	1.6-2.0	/ -	26.5 ± 4.37†	23.3 - 32.5	
198	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	4	-	6-8	/ -	36.0 ± 5.8†	29.0 - 41.0	Drescher et al. (1977)
				Kidney	3	-	6-8	/ -	18.8 ± 2.19†	16.3 - 20.0	
200	Harbour Seal *(Phoca vitulina)*	Wadden Sea Netherlands	-	Liver	1	-	fetus	/ -	89 -	-	Duinker et al. (1979)
201	Harbour Seal *(Phoca vitulina)*	Okhotsk Sea	1975	Muscle+	1	F	8	/ 1.5	22.2 -	-	Hamanaka et al. (1977)
				Blubber	1	F	8	/ 1.5	1.5 -	-	
202	Harbour Seal *(Phoca vitulina)*	Okhotsk Sea	1975	Muscle+	1	M	pup	/ 0.98	19.4 -	-	Hamanaka et al. (1977)
203	Harbour Seal *(Phoca vitulina)*	East Scotland	-	Liver	4	-	-	-	59 ± 19.9†	43 - 84	Holden (1975)
204	Harbour Seal *(Phoca vitulina)*	Scroby East Anglia	-	Liver	2	-	-	-	48 ± 8.9†	43 - 53	Holden (1975)
205	Harbour Seal *(Phoca vitulina)*	Wash, East Anglia	-	Liver	3	-	-	-	57 ± 3.6†	55 - 61	Holden (1975)
208	Harbour Seal *(Phoca vitulina)*	East Coast of England	-	Liver	5	-	-	-	54 ± 17.6†	43 - 84	Holden (1975)
				Muscle+	5	-	-	-	34 ± 0.86†	33 - 35	
212	Harbour Seal *(Phoca vitulina)*	Wadden Sea Netherlands	-	Liver	8	-	-	-	- -	16 - 64	Duinker et al. (1979)
				Kidney	2	-	-	-	- -	15 - 25	
				Blubber	3	-	1-24	-	- -	3 - 14	

Table 6. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Age (yrs) / Length (m)	Zn µg/g mean ± S.D.	Zn µg/g Range	Source
246	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver	15	-	- / -	53.9 ± 13.8	32.2 - 82.8	Wagemann (Unpublished)
				Muscle+	15	-	- / -	23.4 ± 10.5	14.8 - 49.3	
247	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver	1	F^A	adult/ -	60.9	-	Wagemann (Unpublished)
				Muscle+	1	F^A	adult/ -	26.8	-	
248	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver	1	-	fetus/ -	86.1	-	Wagemann (Unpublished)
				Muscle+	1	-	fetus/ -	32.8	-	
249	Weddell Seal *(Leptonychotes weddelli)*	Antarctic	1978	Liver	1	-	- / -	109.2	-	Wagemann (Unpublished)
				Muscle+	1	-	- / -	84.3	-	
206 A	Steller Sea Lion *(Eumetopias jubata)*	Japan (Hokkaido)	1977	Liver	1	F	0.7 / -	62	-	Hamanaka et al. (1982)
				Muscle	1	F	- / -	18	-	
				Kidney	1	F	- / -	20	-	
206 B	Steller Sea Lion *(Eumetopias jubata)*	Japan (Hokkaido)	1976-1977	Liver	5	M&F	1.7 / -	43	- 37 - 51	Hamanaka et al. (1982)
				Muscle	5	M&F	- / -	21	- 19 - 26	
				Kidney	8	M&F	- / -	24	- 20 - 28	
206 C	Steller Sea Lion *(Eumetopias jubata)*	Japan (Hokkaido)	1976-1977	Liver	9	M&F	2.7-4.8/ -	50	- 30 - 69	Hamanaka et al. (1982)
				Muscle	7	M&F	- / -	19	- 16 - 26	
				Kidney	10	M&F	- / -	28	- 23 - 40	
206 D	Steller Sea Lion *(Eumetopias jubata)*	Japan (Hokkaido)	1976-1977	Liver	2	M&F	7.7-8.8/ -	38	- 28 - 48	Hamanaka et al. (1982)
				Muscle	2	M&F	- / -	20	- 20 - 22	
				Kidney	2	M&F	- / -	32	- 30 - 33	

* - Different tissues belong to the same animal or groups of animals which have the same Index No.

\+ - Dorsal meat

† - S.D. estimated from the range

A - Gravid

Table 7. Reference concentrations of Cu (wet weight basis) in different tissues of Pinnipeds.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Age (yrs)	Cu µg/g mean ± S.D.	Cu µg/g Range	Source
102	Ringed Seal *(Phoca hispida)*	North Sea	1975	Liver	1	F	-	2.1 -	-	Harms et al. (1978)
104	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1975	Liver	6	-	-	8.94 ± 4.64	3.04 - 14.6	Fallis (unpublished)
107	Ringed Seal *(Phoca hispida)*	Daneborg, E. Greenland	1974	Liver	7	-	-	8.1 ± 4.94†	1.3 - 14.6	Johansen et al. (1980)
126	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1976	Liver	1	-	-	3.88 -	-	Fallis (unpublished)
				Muscle+	1	-	-	0.99 -	-	
				Kidney	1	-	-	4.18 -	-	
				Blubber	1	-	-	0.37 -	-	
128	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1974	Liver	17	-	-	5.51 ± 3.93	0.73 - 14.0	Fallis (unpublished)
				Muscle+	18	-	-	1.09 ± 0.26	0.58 - 1.58	
129	Ringed Seal *(Phoca hispida)*	Umanak, W. Greenland	1979	Liver	29	-	-	11.6 ± 4.41†	4.48 - 22.3	Johansen et al. (1980)
				Muscle+	29	-	-	1.27 ± 0.13†	1.03 - 1.55	
				Kidney	29	-	-	10.6 ± 4.15†	4.95 - 21.8	
				Blubber	29	-	-	0.12 ± 0.02†	0.08 - 0.18	
130	Ringed Seal *(Phoca hispida)*	Upernavik, W. Greenland	1974 +1976	Liver	12	-	-	7.6 ± 4.3†	2.8 - 16.9	Johansen et al. (1980)
				Muscle+	7	-	-	3.2 ± 1.0†	2.0 - 4.7	
				Blubber	7	-	-	0.2 -	0.2	
153	Grey Seal *(Halichoerus grypus)*	North Sea	1975	Liver	1	M	2	20.9 -	-	Harms et al. (1978)
163	Grey Seal *(Halichoerus grypus)*	East Scotland	-	Liver	9	-	-	28 ± 13.1†	9 - 48	Holden (1975)

Table 7. Continued.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean age (yrs)	Cu µg/g mean ± S.D.	Cu µg/g Range	Source
193	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	27	-	0 - 0.5	6.1 ± 2.7†	2.8 - 13.5	Drescher et al. (1977)
194	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver Kidney	11 9	- -	0.58 - 1.0 0.58 - 1.0	7.0 ± 2.3† 3.3 ± 0.34†	3.3 - 10.5 3.0 - 4.0	Drescher et al. (1977)
195	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	11	-	1.1 - 1.50	5.7 ± 2.6†	2.6 - 10.8	Drescher et al. (1977)
196	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver Kidney	4 4	- -	1.6 - 2.0 1.6 - 2.0	10.6 ± 5.4† 3.2 ± 0.63†	6.0 - 17.0 2.5 - 3.8	Drescher et al. (1977)
198	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver Kidney	4 3	- -	6 - 8 6 - 8	10.7 ± 3.1† 2.5 ± 0.30†	8.5 - 14.8 2.3 - 2.8	Drescher et al. (1977)
200	Harbour Seal *(Phoca vitulina)*	Wadden Sea Netherlands	-	Liver	1	-	fetus	49 -	-	Duinker et al. (1979)
203	Harbour Seal *(Phoca vitulina)*	East Scotland	-	Liver	4	-	-	15 ± 5.35†	10 - 21	Holden (1975)
204	Harbour Seal *(Phoca vitulina)*	Scroby, E. England	-	Liver	2	-	-	9 -	-	Holden (1975)
205	Harbour Seal *(Phoca vitulina)*	Wash, E. England	-	Liver	3	-	-	15 ± 7.09†	11 - 23	Holden (1975)
212	Harbour Seal *(Phoca vitulina)*	Wadden Sea Netherlands	-	Liver Kidney Blubber	8 2 3	- - -	- - -	- - -	2.0 - 20.0 4.8 - 5.1 0.9 - 3.0	Duinker et al. (1979)

Table 7. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Age (yrs)	Cu µg/g mean ± S.D.	Cu µg/g Range	Source
246	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver	15	-	-	44.64 ± 19.97	16.5 - 68.2	Wagemann (Unpublished)
				Muscle+	15	-	-	0.65 ± 0.26	0.35 - 1.15	
247	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver	1	F^A	adult	30.7	-	Wagemann (Unpublished)
				Muscle+	1	F^A	adult	0.43	-	
248	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver	1	-	fetus	53.1	-	Wagemann (Unpublished)
				Muscle+	1	-	fetus	1.88	-	
249	Weddell Seal *(Leptonychotes weddelli)*	Antarctic	1978	Liver	1	-	-	18.6	-	Wagemann (Unpublished)
				Muscle+	1	-	-	0.53	-	

* - Different tissues belong to the same animal or groups of animals which have the same Index No.

\+ - Dorsal meat

† - S.D. estimated from the range

A - Gravid

Table 8. Reference concentrations of Pb (wet weight basis) in different tissues of Pinnipeds.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Age (yrs)	Pb µg/g mean ± S.D.	Pb µg/g Range	Source
102	Ringed Seal *(Phoca hispida)*	North Sea	1975	Liver	1	F	-	0.24 -	-	Harms et al. (1978)
104	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1975	Liver	6	-	-	<0.04 -	<0.04 - -	Fallis (unpublished)
				Muscle+	6	-	-	<0.04 -	<0.04 - -	
107	Ringed Seal *(Phoca hispida)*	Daneborg, E. Greenland	1974	Liver	7	-	-	<0.03 -	<0.03 - 0.04	Fallis (unpublished)
111	Ringed Seal *(Phoca hispida)*	North Sea, Coast of W. Germany	1975	Liver	1	F	-	0.24 -	-	Drescher (1977)
126	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1976	Liver	1	-	-	<0.03 -	-	Fallis (unpublished)
				Muscle+	1	-	-	<0.03 -	-	
				Kidney	1	-	-	<0.02 -	-	
127	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1977	Liver	5	-	-	<0.05 -	-	Fallis (unpublished)
				Muscle+	7	-	-	- -	<0.05 - -	
				Kidney	1	-	-	<0.04 -	-	
128	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1974	Liver	15	-	-	- -	0.06 - 1.27	Fallis (unpublished)
				Muscle+	16	-	-	- -	<0.06 -99.2	
129	Ringed Seal *(Phoca hispida)*	Umanak, W. Greenland	1979	Liver	29	-	-	0.01^{β} -	<0.01 - 0.03	Johansen et al. (1980)
				Muscle+	29	-	-	$0.04^{\phi} \pm 0.02^{\dagger}$	0.02 - 0.10	
				Kidney	29	-	-	0.05^{ϕ} -	<0.004- 0.48	
				Blubber	29	-	-	0.12^{α} -	<0.05 - 2.38	
130	Ringed Seal *(Phoca hispida)*	Upernavik, W. Greenland	1974	Liver	12	-	-	<0.03 -	<0.03 - 0.06	Johansen et al. (1980)
			1976	Muscle+	7	-	-	0.16 -	<0.05 - 0.35	
153	Grey Seal *(Holichoerus grypus)*	North Sea	1975	Liver	1	M	2	0.31 -	-	Harms et al. (1978)

Table 8. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Age (yrs)	Pb µg/g mean ± S.D.	Pb µg/g Range	Source
163	Grey Seal *(Halichoerus grypus)*	East Scotland	-	Liver	9	-	-	7 -	< 3 - 17	Holden (1975)
164	Grey Seal *(Halichoerus grypus)*	Scroby, England	-	Liver	1	-	-	8 -	-	Holden (1975)
192	Harbour Seal *(Phoca vitulina)*	West Scotland and East Anglia, E. England	1969-1970	Liver Kidney	2 17	- -	- -	1.4 - 1.17 ± 0.5	- -	Roberts et al. (1976)
193	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	27	-	0 - 0.5	0.23 ± 0.12†	0.10 - 0.57	Drescher et al. (1977)
194	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver Kidney	11 9	- -	0.58 - 1.0 0.58 - 1.0	0.23 ± 0.14† 0.32 ± 0.10†	0.11 - 0.55 0.18 - 0.48	Drescher et al. (1977)
195	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	11	-	1.1 - 1.5	0.17 ± 0.06†	0.10 - 0.28	Drescher et al. (1977)
196	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver Kidney	4 4	- -	1.6 - 2.0 1.6 - 2.0	0.23 ± 0.08† 0.38 ± 0.20†	0.14 - 0.30 0.14 - 0.55	Drescher et al. (1977)
197	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	1	-	3 - 5	0.25 -	-	Drescher et al. (1977)
198	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	4	-	6 - 8	0.45 ± 0.07†	0.39 - 0.53	Drescher et al. (1977)
199	Harbour Seal *(Phoca vitulina)*	West Scotland and East Anglia	1969-1970	Liver Muscle+	15 12	- -	- -	2.31 ± 1.27 1.2 ± 0.3	- -	Roberts et al. (1976)
200	Harbour Seal *(Phoca vitulina)*	Wadden Sea Netherlands	-	Liver	1	-	fetus	<0.05 -	-	Duinker et al. (1979)

Table 8. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean age (yrs)	Pb µg/g mean ± S.D.	Pb µg/g Range	Source
203	Harbour Seal *(Phoca vitulina)*	East Scotland	-	Liver	4	-	-	5.0 ± 1.9†	3.0 - 7.0	Holden (1975)
204	Harbour Seal *(Phoca vitulina)*	Scroby, East Anglia	-	Liver	2	-	-	10 -	-	Holden (1975)
205	Harbour Seal *(Phoca vitulina)*	Wash, East Anglia	-	Liver	3	-	-	10 ± 2.4†	8 - 12	Holden (1975)
206	Harbour Seal *(Phoca vitulina)*	West Scotland and East Anglia	1969-1970	Liver	2	F	(mother)	2.4 -	-	Roberts et al. (1976)
				Kidney	2	F	(mother)	1.19 -	-	
207	Harbour Seal *(Phoca vitulina)*	West Scotland and East Anglia	1969-1970	Kidney	2	-	fetus	1.31 -	-	Roberts et al. (1976)
212	Harbour Seal *(Phoca vitulina)*	Wadden Sea Netherlands	-	Liver	8	-	-	- -	<0.05 - 2.3	Duinker et al. (1979)
				Kidney	2	-	-	- -	0.16 - 0.23	
				Blubber	3	-	-	- -	<0.05 - 1.0	
241	Fur Seal *(Callorhinus ursinus)*	Washington Coast, USA	1971	Liver	1	M	fetus	0.8 -	-	Anas (1974b)
				Kidney	1	M	fetus	0.3 -	-	
242	Fur Seal *(Callorhinus ursinus)*	Washington Coast, USA	1971	Liver	1	M	1	0.2 -	-	Anas (1974b)
				Kidney	1	M	1	0.3 -	-	
243	Fur Seal *(Callorhinus ursinus)*	Washington Coast, USA	1971	Liver	8	F	10	0.59 ± 0.12	0.4 - 0.8	Anas (1974b)
				Kidney	8	F	10	0.90 ± 0.14	0.8 - 1.0	

* - Different tissues belong to the same animal or groups of animals which have the same Index No.

\+ - Dorsal meat

† - S.D. estimated from the range

α - 26 out of 29 values were below the detection limit (0.05 ppm)

β - 15 values were below the detection limit (0.02 ppm)

ϕ - 12 values were below the detection limit (0.02 ppm)

Table 9. Reference concentrations of Cd (wet weight basis) in different tissues of Pinnipeds.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Age (yrs) / Weight (kg)	Cd µg/g mean ± S.D.	Cd µg/g Range	Source
102	Ringed Seal *(Phoca hispida)*	North Sea	1975	Liver	1	F	- / -	0.31 -	-	Harms et al. (1978)
104	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1975	Liver	6	-	- / -	4.2 ± 3.3	0.65 - 8.07	Fallis (unpublished)
				Muscle+	6	-	- / -	0.029 ± 0.019	0.011 - 0.058	
				Blubber	6	-	- / -	0.017 ± 0.013	<0.01 - 0.038	
107	Ringed Seal *(Phoca hispida)*	Daneborg, E. Greenland	1974	Liver	7	-	- / -	6.6 ± 6.1†	1.8 - 18.2	Johansen et al. (1980)
126	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	-	Liver	1	-	- / -	15.6 -	-	Fallis (unpublished)
				Muscle+	1	-	- / -	0.31 -	-	
				Kidney	1	-	- / -	65.9 -	-	
				Blubber	1	-	- / -	0.43 -	-	
127	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1977	Liver	5	-	- / -	5.5 ± 0.8	2.8 - 10.0	Fallis (unpublished)
				Muscle+	7	-	- / -	0.05 ± 0.01	0.03 - 0.07	
				Kidney	1	-	- / -	27.9 -	-	
128	Ringed Seal *(Phoca hispida)*	Northern Baffin Island, E. Arctic Canada	1974	Liver	15	-	- / -	5.8 ± 4.0	<0.07 - 12.3	Fallis (unpublished)
				Muscle+	3	-	- / -	0.16 ± 0.08	<0.03 - 0.23	
129	Ringed Seal *(Phoca hispida)*	Umanak, W. Greenland	1979	Liver	29	-	- / -	7.32 ± 3.0†	2.71 - 14.9	Johansen et al. (1980)
				Muscle+	29	-	- / -	0.07 ± 0.10†	0.02 - 0.42	
				Kidney	29	-	- / -	37.4 ± 33.7†	9.01 - 146.2	
				Blubber	29	-	- / -	<0.02 -	<0.02 - 0.03	
130	Ringed Seal *(Phoca hispida)*	Upernavik, W. Greenland	1974-1976	Liver	12	-	- / -	17.0 ± 9.0†	2.3 - 31.6	Johansen et al. (1980)
				Muscle+	7	-	- / -	0.15 ± 0.06†	0.09 - 0.24	
				Blubber	7	-	- / -	<0.02 -	<0.02 - 0.04	
132	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1975	Liver	9	M&F	0-3 / 59	0.61 ± 0.75	0.09 - 2.21	McKie et al. (1980)
				Kidney	10	M&F	0-3 / 59	1.38 ± 1.36	0.10 - 4.21	

Table 9. Continued.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Age / Weight (yrs) (kg)	Cd µg/g mean ± S.D.	Cd µg/g Range	Source
133	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1975	Liver	8	M&F	4-6 / 92	2.39 ± 2.70	0.23 - 8.49	McKie et al. (1980)
				Kidney	8	M&F	4-6 / 92	5.81 ± 4.68	1.15 -15.1	
134	Grey Seal *(Halichoeruo grypus)*	East Coast of Scotland	1975	Liver	3	M	7-9 /163	0.49 ± 0.10	0.32 - 0.61	McKie et al. (1980)
				Kidney	3	M	7-9 /163	1.76 ± 0.37	1.47 - 2.18	
135	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1976	Liver	9	M	0-3 / 67	0.49 ± 0.50	0.07 - 1.53	McKie et al. (1980)
				Kidney	11	M&F	0-3 / 67	1.28 ± 1.30	0.17 - 3.82	
136	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1976	Liver	7	M&F	4-6 / 98	0.84 ± 0.96	0.17 - 2.95	McKie et al. (1980)
				Kidney	7	M&F	4-6 / 98	2.73 ± 2.40	1.36 - 8.08	
137	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1976	Liver	4	M	7-9 /143	0.54 ± 0.50	0.17 - 1.26	McKie et al. (1980)
				Kidney	5	M	7-9 /175	1.38 ± 0.68	0.83 - 2.50	
138	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1977	Liver	3	M&F	0-3 / 63	0.76 ± 0.81	0.05 - 1.64	McKie et al. (1980)
				Kidney	4	M&F	0-3 / 63	1.80 ± 1.89	0.28 - 4.77	
139	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1977	Liver	9	M&F	4-6 / 91	0.37 ± 0.31	0.05 - 0.80	McKie et al. (1980)
				Kidney	9	M&F	4-6 / 91	1.21 ± 0.77	0.19 - 2.12	
140	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1977	Liver	3	M&F	7-9 /129	0.23 ± 0.09	0.15 - 0.32	McKie et al. (1980)
				Kidney	3	M&F	7-9 /129	0.56 ± 0.19	0.40 - 0.77	
141	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1978	Liver	2	M	0-3 / 91	0.48 ± 0.24	0.31 - 0.65	McKie et al. (1980)
				Kidney	2	M	0-3 / 91	1.29 ± 0.15	1.81 - 1.39	
142	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1978	Liver	6	M&F	4-6 /103	0.51 ± 0.28	0.24 - 0.85	McKie et al. (1980)
				Kidney	5	M&F	4-6 /103	1.43 ± 0.59	0.50 - 2.0	
143	Grey Seal *(Halichoerus grypus)*	East Coast of Scotland	1978	Liver	4	M&F	7-9 / -	0.97 ± 0.33	0.53 - 1.23	McKie et al. (1980)
				Kidney	5	M&F	7-9 / -	2.84 ± 0.88	1.95 - 4.24	
153	Grey Seal *(Halichoerus grypus)*	North Sea	1975	Liver	1	M	2 / -	0.021	-	Harms et al. (1978)

Table 9. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Age (yrs) / Weight (kg)	Cd µg/g mean ± S.D.	Cd µg/g Range	Source
163	Grey Seal *(Halichoerus grypus)*	East Scotland	-	Liver	9	-	- / -	1.6 ± 0.4†	1.1 - 2.3	Holden (1975)
164	Grey Seal *(Halichoerus grypus)*	Scroby, England	-	Liver	1	-	- / -	1.2 -	-	Holden (1975)
185	Harbour Seal *(Phoca vitulina)*	West Scotland	1969-1970	Liver	6	-	- / -	- -	0.2 - 1.1	Roberts et al. (1976)
				Kidney	8	-	- / -	- -	0.1 - 1.9	
186	Harbour Seal *(Phoca vitulina)*	East Anglia, E. England	1969-1970	Liver	7	-	- / -	- -	0.2 - 0.8	Roberts et al. (1976)
				Kidney	9	-	- / -	- -	0.1 - 0.6	
192	Harbour Seal *(Phoca vitulina)*	West Scotland and East Anglia, E. England	1969-1970	Muscle+	12	-	- / -	0.13 ± 0.06	-	Roberts et al. (1976)
193	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	27	-	0.0 -0.5/ -	0.018 ± 0.01†	0.01 - 0.042	Drescher et al. (1977)
194	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	11	-	0.58-1.0/ -	0.024 ± 0.004†	0.018 - 0.03	Drescher et al. (1977)
				Kidney	9	-	0.58-1.0/ -	0.10 ± 0.03†	0.06 - 0.15	
195	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	11	-	1.1 -1.5/ -	0.028 ± 0.017†	0.01 - 0.063	Drescher et al. (1977)
196	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	4	-	1.6 -2.0/ -	0.032 ± 0.006†	0.025 - 0.038	Drescher et al. (1977)
				Kidney	4	-	1.6 -2.0/ -	0.22 ± 0.05†	0.19 - 0.29	
198	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	4	-	6-8 / -	0.135 ± 0.015†	0.05 - 0.02	Drescher et al. (1977)
				Kidney	3	-	6-8 / -	0.31 ± 0.07†	0.26 - 0.38	
200	Harbour Seal *(Phoca vitulina)*	Wadden Sea, Netherlands	-	Liver	1	-	fetus / -	<0.24 -	-	Duinker et al. (1979)
201	Harbour Seal *(Phoca vitulina)*	Okhotsk Sea	1975	Liver	1	F	5 / 1.57	0.48 ± 0.17	-	Hamanaka et al. (1977)
				Muscle+	1	F	8 / 1.47	0.10 ± 0.01	-	
				Blubber	1	F	8 / 1.47	0.19 -	-	

Table 9. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Age / length (yrs) / (m)	Cd µg/g mean ± S.D.	Cd µg/g Range	Source
202	Harbour Seal *(Phoca vitulina)*	Okhotsk Sea	1975	Muscle+	1	M	pup / 0.98	0.18 -	-	Hamanaka et al. (1977)
203	Harbour Seal *(Phoca vitulina)*	East Scotland	-	Liver	4	-	- -	1.3 ± 0.29 †	1.1 - 1.7	Holden (1975)
204	Harbour Seal *(Phoca vitulina)*	Scroby, E. England	-	Liver	2	-	- -	1.0 -	-	Holden (1975)
205	Harbour Seal *(Phoca vitulina)*	Wash, E. England	-	Liver	3	-	- -	1.2 ± 0.3 †	0.9 - 1.4	Holden (1975)
212	Harbour Seal *(Phoca vitulina)*	Wadden Sea, Netherlands	-	Liver	8	-	- -	- -	0.03 - 0.21	Duinker et al. (1979)
				Kidney	2	-	- -	- -	0.15 - 0.17	
				Blubber	3	-	- -	- -	<0.01 - 0.02	
241	Fur Seal *(Callorhinus ursinus)*	Washington Coast, W. USA	1971	Liver	1	M	fetus / -	0.5 -	-	Anas (1974b)
				Kidney	1	M	fetus / -	0.1 -	-	
242	Fur Seal *(Callorhinus ursinus)*	Washington Coast, W. USA	1971	Liver	1	M	1 / -	0.6 -	-	Anas (1974b)
				Kidney	1	M	1 / -	1.7 -	-	
243	Fur Seal *(Callorhinus ursinus)*	Washington Coast, W. USA	1971	Liver	8	F	10 / -	2.66 ± 2.12	0.9 - 4.6	Anas (1974b)
				Kidney	8	F	10 / -	6.33 ± 4.89	0.2 - 15.6	
244	Ribbon Seal *(Histriophoca fasciata)*	Okhotsk Sea	1975	Liver	1	M	3-5 / -	3.05 ± 0.25	-	Hamanaka et al. (1977)
				Muscle+	9	M	2-9 / 1.4-1.6	0.19 ± 0.06	0.11 - 0.31	
				Blubber	1	M	- -	0.14 -	-	
245	Ribbon Seal *(Histriophoca fasciata)*	Okhotsk Sea	1975	Liver	1	F	3 / 1.4	2.07 ± 0.83	-	Hamanaka et al. (1977)
				Muscle+	7	F	1-16 / 1.2-1.6	0.15 ± 0.04	0.09 - 0.20	

Table 9. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Mean Sex	age (yrs) /	length (m)	Cd µg/g mean ± S.D.	Range	Source
246	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver	15	-	- /	-	5.11 ± 7.37	0.8 - 29	Wagemann (Unpublished)
				Muscle+	15	-	-	-	<0.01	-	
247	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver	1	F[A]	adult /	-	6.7	-	Wagemann (Unpublished)
				Muscle+	1	F[A]	adult /	-	<0.01	-	
248	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver	1	-	fetus /	-	<0.1	-	Wagemann (Unpublished)
				Muscle+	1	-	fetus /	-	<0.01	-	
249	Weddell Seal *(Leptonychotes wedaelli)*	Antarctic	1978	Liver	1	-	-	-	1.6	-	Wagemann (Unpublished)
				Muscle+	1	-	-	-	<0.01	-	
206 A	Steller Sea Lion *(Eumetopias jubata)*	Japan (Hokkaido)	1977	Liver	1	F	0.7 /	-	0.24	-	Hamanaka et al. (1982)
				Muscle	1	F	-	-	0.05	-	
				Kidney	1	F	-	-	1.97	-	
206 B	Steller Sea Lion *(Eumetopias jubata)*	Japan (Hokkaido)	1976-1977	Liver	7	M&F	1.7	-	0.58	-	0.15 - 0.82	Hamanaka et al. (1982)
				Muscle	4	M&F		-	0.07	-	0.05 - 0.12	
				Kidney	8	M&F		-	2.36	-	0.77 - 3.1	
206 C	Steller Sea Lion *(Eumetopias jubata)*	Japan (Hokkaido)	1976-1977	Liver	10	M&F	2.7-4.8/	-	0.86	-	0.28 - 1.3	Hamanaka et al. (1982)
				Muscle	8	M&F		-	0.04	-	0.02 - 0.10	
				Kidney	10	M&F		-	4.82	-	1.9 - 7.2	
206 D	Steller Sea Lion *(Eumetopias jubata)*	Japan (Hokkaido)	1976-1977	Liver	1	M	8.8 /	-	1.28	-	-	Hamanaka et al. (1982)
				Muscle	2	M&F	7.7-8.8/	-	0.08	-	0.05 - 0.11	
				Kidney	2	M&F	7.7-8.8/	-	8.96	-	7.9 - 10.0	

* - Different tissues belong to the same animal or groups of animals which have the same Index No.

\+ - Dorsal meat

† - S.D. estimated from the range

■ - Concentrations are age correlated; significant at 1.0%.

A - Gravid

Table 10. Reference concentrations of Se (wet weight basis) in different tissues of Pinnipeds.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Age (yrs)	Se µg/g mean ± S.D.	Se µg/g Range	Source
109	Ringed Seal *(Phoca hispida)*	Bothnian Bay, W. Finland	1974	Liver	12	-	-	35 ± 31.9[†]	6.1 - 110	Kari and Kauranen (1978)
110	Ringed Seal *(Phoca hispida)*	Saimaa, S.E. Finland	1974-1975	Liver	3	-	-	81 ± 142.4[†]	29 - 270	Kari and Kauranen (1978)
117	Ringed Seal *(Phoca hispida)*	Somerset Island, E. Arctic Canada	1975	Liver	12	-	-	16.35 ± 7.83	-	Smith and Armstrong (1978)
118	Ringed Seal *(Phoca hispida)*	Barrow Strait, E. Arctic Canada	1976	Liver	10	-	10.2	9.44 ± 6.66	-	Smith and Armstrong (1978)
119	Ringed Seal *(Phoca hispida)*	N.E.Baffin Island E. Arctic Canada	1976	Liver	8	-	5.2	4.13 ± 2.67	-	Smith and Armstrong (1978)
121	Ringed Seal *(Phoca hispida)*	Victoria Island, W. Arctic Canada	1972-	Liver	42	-	12.8	15.24 ± 7.75	-	Smith and Armstrong (1978)
124	Ringed Seal *(Phoca hispida)*	Holman W.Victoria Island W. Arctic Canada	1977	Liver	112	-	8.1	14.96 ± 6.42	-	Smith and Armstrong (1978)
158	Grey Seal *(Halichoerus grypus)*	Great Britain	1977	Liver	2	M	-	13.30[β] ± 6.65	8.6 - 18	van de Ven et al. (1979)
159	Grey Seal *(Halichoerus grypus)*	Great Britain	1977	Liver	6	F	7.2	36.0[β] ± 27.9	18 - 88	van de Ven et al. (1979)
160	Grey Seal *(Halichoerus grypus)*	Great Britain	1977	Liver	2	-	-	68.5[β] ± 20.5	54 - 83	van de Ven et al. (1979)
161	Grey Seal *(Halichoerus grypus)*	Great Britain	1977	Liver	5	-	pups	1.80[β] ± 0.29	1.4 - 2.1	van de Ven et al. (1979)
162	Grey Seal *(Halichoerus grypus)*	Wadden Sea Netherlands	1974-1975	Liver Muscle[+]	1 1	M Y M Y	1 1	6.2[β] - 2.5[β] -	- -	van de Ven et al. (1979)

Table 10. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Age (yrs)	Se µg/g mean ± S.D.	Range	Source
173	Harbour Seal	Wadden Sea	1974-	Liver	1	M	0.3	2.0[β]	-	van de Ven et al.
	(Phoca vitulina)	Netherlands	1976	Muscle[+]	1	M	0.3	1.0[β]	-	(1979)
174	Harbour Seal	Wadden Sea	1974-	Liver	1	F	0.5	4.0[β]	-	van de Ven et al.
	(Phoca vitulina)	Netherlands	1976	Muscle[+]	1	F	0.5	1.9[β]	-	(1979)
175	Harbour Seal	Wadden Sea	1974-	Liver	1	M	1	1.3	-	van de Ven et al.
	(Phoca vitulina)	Netherlands	1976	Muscle[+]	1	M	1	1.3	-	(1979)
				Kidney	1	M	1	1.9	-	
176	Harbour Seal	Wadden Sea	1974-	Liver	2	F	1	23.0[β] ± 8.5	17 - 29	van de Ven et al.
	(Phoca vitulina)	Netherlands	1976	Kidney	1	F	1	2.1[β]	-	(1979)
177	Harbour Seal	Netherlands	1974-	Liver	1	M	24	22[β]	-	van de Ven et al.
	(Phoca vitulina)		1976							(1979)
178	Harbour Seal	Netherlands	1974-	Liver	1	F	adult	130[β]	-	van de Ven et al.
	(Phoca vitulina)		1976	Muscle[+]	1	F	adult	1.2[β]	-	(1979)
				Kidney	1	F	adult	7.1[β]	-	
324 A	Harbour Seal	Schleswig-Holstein	1975-	Liver	6-8	-	juveniles &	2.6	- 0 - 0.8	Reijnders
	(Phoca vitulina)	(Denmark)	1976	Kidney	6-8	-	sub-adults	0.6	- 0 - 1.3	(1980)
324 B	Harbour Seal	Wadden Sea	1975-	Liver	5-6	-	juveniles &	2.8	- 0.7 - 6.5	Reijnders
	(Phoca vitulina)	Netherlands	1976	Kidney	5	-	sub-adults	1.2	- 0.6 - 1.6	(1980)
324 C	Harbour Seal	Schleswig-Holstein	1975-	Liver	5	-	adult	112	- 9.2 - 409	Reijnders
	(Phoca vitulina)	(Denmark)	1976	Kidney	4	-	adult	3.5	- 1.9 - 7.3	(1980)
324 D	Harbour Seal	Wadden Sea	1975-	Liver	8	-	adult	109	- 3.9 - 350	Reijnders
	(Phoca vitulina)	Netherlands	1976	Kidney	4	-	adult	7.1	- 2.3 - 10.0	(1980)

Table 10. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Age (yrs)	Se µg/g mean ± S.D.	Se µg/g Range	Source
236	Bearded Seal *(Erignathus barbatus)*	Holman W.Victoria Island W. Arctic Canada	-	Liver	6	-	8.5	34.42 ± 33.23	-	Smith and Armstrong (1978)
237	Bearded Seal *(Erignathus barbatus)*	Belcher Island, E. Arctic Canada	1974	Liver	10	-	4.9	20.83 ± 13.47	-	Smith and Armstrong (1978)
246	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver Muscle+	15 15	- -	- -	3.32 ± 0.81 0.57 ± 0.09	2.57 - 4.92 0.44 - 0.71	Wagemann (Unpublished)
247	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver Muscle+	1 1	F^A F^A	adult adult	2.83 0.60	- -	Wagemann (Unpublished)
248	Leopard Seal *(Hydrurga leptonyx)*	Antarctic	1978	Liver Muscle+	1 1	- -	fetus fetus	0.72 0.43	- -	Wagemann (Unpublished)
249	Weddell Seal *(Leptonychotes weddelli)*	Antarctic	1978	Liver Muscle+	1 1	- -	- -	1.01 0.30	- -	Wagemann (Unpublished)

* - Different tissues belong to the same animal or groups of animals which have the same Index No.

+ - Dorsal meat

† - S.D. estimated from the range

β - Arithmetic mean of three determinations per sample

γ - Kept in captivity for one year

A - Gravid

Table 11. Reference concentrations of ΣDDT (wet weight basis) in different tissues of Cetaceans.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	age (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
51	Pilot Whale *(Globicephala melaena)*	Southwest England	~1975	Blubber	2	-	-	-	42.7 -	-	Holden (1975)
52	Pilot Whale *(Globicephala melaena)*	R.I. & Maine, E. USA	1971-1975	Blubber	2	M&F	-	/adults	149.2 -	30.3 - 268	Taruski et al. (1975)
53	Pilot Whale *(Globicephala melaena)*	French Coast (Atlantic and Mediterranean)	~1979	Blubber	7	-	-	-	94.2 ± 139.6	-	Alzieu and Duguy (1979)
90	Pilot Whale *(Globicephala melaena)*	Japan	1968-1976	Blubber	6	M&F	3.01 /	-	4.7 ± 3.3	0.9 - 8.8	O'Shea et al. (1980)
54	Beluga Whale *(Delphinapterus leucus)*	Shallow Bay, Mackenzie River Delta	1972	Liver Muscle+ Blubber	7 7 7	- - -	- - -	/adults /adults /adults	0.78 ± 0.23 0.91 ± 0.26 3.90 ± 0.89	- - -	Addison and Brodie (1973)
55	Beluga Whale *(Delphinapterus leucus)*	Kugmallet Bay, Mackenzie River Delta	1972	Blubber	7	-	-	/adults	2.56 ± 1.46	-	Addison and Brodie (1973)
13 A	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, Arctic Canada	1979	Blubber	9	F	3.79 /	-	1.88 ± 2.01	-	Wagemann et al. (1983)
13 B	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, Arctic Canada	1979	Blubber	11	M	3.92 /	-	4.84 ± 2.13	-	Wagemann et al. (1983)
14	Minke Whale *(Balaenoptera acutorostrata)*	Umanak, W. Greenland	1972	Blubber	6	-	-	-	1.4 ± 0.94†	0.21 - 2.6	Johansen et al. (1980)
56	Minke, Fin, and White Whales *(B. acutorostrata, B. physalus)*	St. Lawrence River, E. Canada	1979	Blubber	3	-	-	-	10.6 ± 14.91	-	Sergeant (1980)

Table 11. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ age (m) (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
57	Fin Whale *(Balaenoptera physalus)*	S.E. Greenland	1975	Blubber	3	-	- -	2.83 -	-	Holden (1975)
58	Fin Whale *(Balaenoptera physalus)*	N. Atlantic	1967-1970	Blubber (oil)	5	-	- -	26.4 ± 4.5	22.3 - 32.3	Addison et al. (1972)
58 A	Fin Whale *(Balaenoptera physalus)*	France, Brittany and Mediterranean Coast	1976	Blubber	2	M&F	14.3 / -	14.8 -	-	Alzieu and Duguy (1979)
59	Fin Whale *(Balaenoptera physalus)*	Nova Scotia, Canada, NW Atlantic	1970-1971	Blubber	9	M	- /adult	1.38 ± 0.43	0.67 - 2.09	Saschenbrecker (1973)
60	Fin Whale *(Balaenoptera physalus)*	Nova Scotia, Canada, NW Atlantic	1970-1971	Blubber	3	M	- /adult	2.05 ± 0.45	1.78 - 2.58	Saschenbrecker (1973)
61	Humpback Whale *(Megaptera novaeangliae)*	Nova Scotia, Canada; New Jersey, USA, NW Atlantic	1971-1975	Blubber	2	M&F	- /adult	15.4 -	7.6 - 23.1	Taruski et al. (1975)
63	Humpback Whale *(Megaptera novaeangliae)*	Antigua, St. Kitts West Indies	1971-1975	Blubber	2	M	- /juvenile	1.75 -	1.4 - 2.1	Taruski et al. (1975)
62	Dense-beaked Whale *(Mesoplodon densirostris)*	New Jersey and North Carolina USA, NW Atlantic	1971-1975	Blubber	2	M	- /juvenile and adult	51.7 -	38.2 - 65.1	Taruski et al. (1977)
64	Sperm Whale *(Physeter catodon)*	Anegada Passage, West Indies	1971-1975	Blubber	2	M&F	- /adults	8.4 -	1.1 - 15.5	Taruski et al. (1975)
65	Sperm Whale *(Physeter catodon)*	Antarctic	1962-1966	Blubber (oil)	3	-	- -	21.2 -	0.07 - 34.98	Addison et al. (1972)
66	Sperm Whale *(Physeter catodon)*	California	1968	Liver Blubber	6 6	- M&F	- 11.71/ -	0.34 - 5.8 ± 2.5	- 1.82 - 9.43	Wolman and Wilson (1970)

Table 11. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	age (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
67	Gray Whale *(Balaenoptera musculus)*	Near San Francisco California SW USA	1968-1969	Liver Blubber	23 23	M&F M&F	11.91 / 11.91 /	- -	0.01 - 0.071± 0.174	- -	Wolman and Wilson (1970)
94	Pygmy Killer Whale *(Feresa attenuata)*	Florida	1975	Blubber	2	M	1.97 /	-	25.0 -	23.1 - 26.9	Forrester et al. (1980)
23	Harbour Porpoise *(Phocoena phocoena)*	Baltic Sea	1976	Liver Blubber	2 2	- -	- -	- -	1.09 - 37.6 -	0.37 - 1.8 29.3 - 45.9	Huschenbeth (1977)
68	Harbour Porpoise *(Phocoena phocoena)*	E. Scotland	1965-1967	Blubber	3	-	-	/adults	42.8 ± 10.3†	27.9 - 45.3	Holden and Marsden (1967)
69	Harbour Porpoise *(Phocoena phocoena)*	E. Scotland	1968	Blubber	2	-	-	/adults	12.4 -	-	Holden (1975)
70	Harbour Porpoise *(Phocoena phocoena)*	E. Scotland	1970	Blubber	3	-	-	-	37.4 -	-	Holden (1975)
71	Harbour Porpoise *(Phocoena phocoena)*	E. Scotland	1971	Blubber	4	-	-	-	18.4 -	-	Holden (1975)
72	Harbour Porpoise *(Phocoena phocoena)*	New Brunswick & Nova Scotia Bay of Fundy, E. Canada	1969-1970	Liver Blubber	3 12	M M	- -	/adults /adults	2.69 ± 0.80 306.7 ± 113.3†	1.97 - 3.32 150.8 - 520.0	Gaskin et al. (1971)
73	Harbour Porpoise *(Phocoena phocoena)*	New Brunswick & Nova Scotia E. Canada	1969-1970	Liver Blubber	8 15	F F	- -	/adults /adults	1.36 ± 1.03† 214.27 ± 96.9†	0.61 - 3.57 111.6 - 447.9	Gaskin et al. (1971)
74	Harbour Porpoise *(Phocoena phocoena)*	New Brunswick & Nova Scotia	1969-1970	Liver Blubber	2 6	F F	- -	/adults /adults	0.48 ± 0.04 69.0 ± 32.4†	0.46 - 0.50 40.0 - 122.0	Gaskin et al. (1971)
75	Harbour Porpoise *(Phocoena phocoena)*	W. Greenland	1972	Blubber	2	-	-	-	0.29 ± 0.18	-	Clausen et al. (1974)
76	Harbour Porpoise *(Phocoena phocoena)*	North Sea	1972	Blubber	7	-	-	-	41.2 ± 33.6†	11.1 - 102	Koeman et al. (1972)

Table 11. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	age (yrs)	ΣDDT µg/g mean ± S.D.	Range	Source
93 A	Harbour Porpoise *(Phocoena phocoena)*	Bay of Fundy	1975-1977	Liver	-②	M	-	-	0.79 -	0.21 - 2.03	Gaskin (1982)
				Kidney	-	M	-	-	0.22 -	0.12 - 0.47	
				Muscle	-	M	-	-	0.52 -	0.11 - 1.47	
				Blubber	-	M	-	-	103.42 -	22.83 - 227.00	
93 B	Harbour Porpoise *(Phocoena phocoena)*	Bay of Fundy	1975-1977	Liver	-②	F	-	-	0.21 -	0.10 - 0.30	Gaskin (1982)
				Kidney	-	F	-	-	0.13 -	0.12 - 0.15	
				Muscle	-	F	-	-	0.38 -	0.08 - 1.53	
				Blubber	-	F	-	-	39.35 -	21.48 - 55.69	
95	Harbour Porpoise *(Phocoena phocoena)*	Danish Coast	1972-1973	Liver	4	M&F	-	/ 1-3	0.55 -	0.04 - 1.1	Anderson & Rebsdorff (1976)
				Blubber	4	M&F	-	/ 1-3	18 -	3.9 - 27	
77	Common Dolphin *(Delphinus delphis)* Dusky Dolphin *(Lagenorhynchus obscurus)*	North Sea (3) & New Zealand (1)	~1972	Blubber	4	-	-	-	85 ± 84	4.27 - 177	Koeman et al. (1972)
78	Common Dolphin *(Delphinus delphis)*	French Coast (Atlantic & Mediterranean)	~1979	Liver	17	-	-	-	10.9 -	-	Alzieu and Duguy (1979)
				Muscle+	25	-	-	-	5.6 -	-	
				Kidney	18	-	-	-	6.4 -	-	
				Blubber	12	-	-	-	73.5 ± 64.2	-	
87	Common Dolphin *(Delphinus delphis)*	California	1968-1976	Muscle	13	M&F	2.06	/ -	13.0 ± 9.1	4.6 - 39.9	O'Shea et al. (1980)
				Blubber	13	M&F	2.06	/ -	926.8 ± 416.4	405 -1767	
79	Blue-White Dolphin[T] *(Stenella caeruleoalba)*	French Coast (Atlantic & Mediterranean)	~1979	Liver	24	-	-	-	109.8 -	-	Alzieu and Duguy (1979)
				Muscle+	10	-	-	-	13.3 -	-	
				Kidney	26	-	-	-	28.1 -	-	
				Blubber	8	-	-	-	344.2 ± 302.9	-	
80	Risso's Dolphin *(Globicephala griseus)*	French Coast (Atlantic & Mediterranean)	1979	Liver	4	-	-	-	21.4 -	-	Alzieu and Duguy (1979)
				Muscle+	3	-	-	-	4.2 -	-	
				Kidney	4	-	-	-	24.2 -	-	
				Blubber	3	-	-	-	70.0 ± 33.6	-	

Table 11. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m) age (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
81	Striped Dolphin [T] *(Stenella caeruleoalba)*	Maryland and Rhode Island, E. USA	1971-1975	Blubber	2	M&F	- /adults	150.9 -	70.7 - 231.0	Taruski et al. (1975)
86	Striped Dolphin [T] *(Stenella caeruleoalba)*	E. Tropical Pacific	1968-1976	Muscle	13	M&F	1.77/ -	0.4 ± 0.5	<0.01 - 1.65	O'Shea et al. (1980)
				Blubber	14	M&F	1.77/ -	41.9 ± 58.0	0.62 - 166.4	
89	Striped Dolphin [T] *(Stenella caeruleoalba)*	Japan	1968-1976	Muscle	5	M&F	2.22/ -	0.6 ± 0.7	<0.01 - 1.8	O'Shea et al. (1980)
				Blubber	5	M&F	2.22/ -	10.0 ± 5.4	<2.0 - 17.1	
82	Common Dolphin & Atlantic White-Sided Dolphin *(Delphinus delphis and Lagenorhynchus acutus)*	Rhode Island, E. USA and Nova Scotia, E. Canada	1971-1975	Blubber	2	M&F	- /adults	55.8 -	40.7 - 70.9	Taruski et al. (1975)
83	Gray Dolphin *(Globicephala macrorhyncha)*	St. Lucia, Lesser Antilles	1972	Liver	5	M&F	4.3 / -	0.04 ± 0.04	0.01 - 0.10	Gaskin et al. (1974)
				Muscle [+]	5	M&F	4.3 / -	0.19 ± 0.24	0.01 - 0.59	
				Kidney	4	M&F	4.3 / -	0.21 ± 0.15	0.04 - 0.39	
				Blubber	5	M&F	4.3 / -	1.62 ± 0.42	1.25 - 2.28	
84	Long-snouted Dolphin *(Stenella longirostris)*	St. Lucia, Lesser Antilles	1972	Liver	2	M&F	1.8 / -	0.10 -	0.06 - 0.134	Gaskin et al. (1974)
				Muscle [+]	2	M&F	1.8 / -	0.05 -	0.04 - 0.064	
				Kidney	2	M&F	1.8 / -	0.10 -	0.065- 0.145	
				Blubber	2	M&F	1.8 / -	4.41 -	1.44 - 7.38	
85	Bottlenose Dolphin *(Tursiops truncatus)*	California	1968-1976	Muscle	2	F	2.33/ -	2215 -	1746 -2684	O'Shea et al. (1980)
				Blubber	2	F	2.33/ -	35.8 -	18.7 - 52.8	

Table 11. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	age (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
88	Rough-toothed Dolphin *(Steno bredanensis)*	Hawaii	1968-1976	Muscle	7	M&F	2.17 /	-	0.1 ± 0.1	<0.01 - 0.3	O'Shea et al. (1980)
				Blubber	7	M&F	2.17 /	-	8.9 ± 9.9	<0.01 - 27.1	
91	Finless Porpoise *(Neophocaena phocoenoides)*	Japan	1968-1976	Muscle	5	M&F	1.53 /	-	0.3 ± 0.2	<0.01 - 0.7	O'Shea et al. (1980)
				Blubber	6	M&F	1.47 /	-	66.0 ± 46.8	8.6 - 107	

* - Different tissues belong to the same animal or groups of animals which contain the same Index No.

\+ - Dorsal meat

† - S.D. estimated from the range

② - No. of animals not given. See Gaskin et al. (1983). Index No. 92A and B.

~ - Approximate sampling date or several years previously.

T - Blue-White and Striped Dolphins are used interchangeably, depending on the name used in the original literature.

Table 12. Reference concentrations of PCB's (wet weight basis) in different tissues of Cetaceans.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ age (m)	PCB µg/g mean ± S.D.	PCB µg/g Range	Source
51	Pilot Whale *(Globicephala melaena)*	Southwest England	~1975	Blubber	2	-	- -	98 -	-	Holden (1975)
52	Pilot Whale *(Globicephala melaena)*	R.I. & Maine E. USA	1971-1975	Blubber	2	M&F	- /adults	78 -	42 - 114	Taruski et al. (1975)
53	Pilot Whale *(Globicephala melaena)*	France, Atlantic & Mediterranean	~1979	Blubber	7	-	- -	189.0 ± 298.0	-	Alzieu and Duguy (1979)
90	Pilot Whale *(Globicephala melaena)*	Japan	1968-1976	Muscle	6	M&F	3.01/ -	8.03 ± 12.0	0.4 - 32	O'Shea et al. (1980)
54	Beluga Whale *(Delphinapterus leucas)*	Shallow Bay Mackenzie River Delta, W. Arctic Canada	1972	Liver Muscle+ Blubber	7 7 7	- - -	- /adults - /adults - /adults	<0.5 - <0.5 - <0.5 -	- - -	Addison et al. (1973)
55	Beluga Whale *(Delphinapterus leucas)*	Kugmalit Bay Mackenzie River Delta, W. Arctic Canada	1972	Blubber	7	-	- /adults	<0.5 -	-	Addison et al. (1973)
13 A	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, E. Arctic Canada	1979	Blubber	9	F	3.8 / -	6.73 ± 2.22	-	Wagemann et al. (1983)
13 B	Narwhal *(Monodon monoceros)*	Pond Inlet Baffin Island, E. Arctic Canada	1979	Blubber	11	M	3.9 / -	12.85 ± 6.88	-	Wagemann et al. (1983)

Table 12. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ age (m)	PCB µg/g mean ± S.D.	PCB µg/g Range		Source
14	Minke Whale *(Balaenoptera acutorostrata)*	Umanak, W. Greenland	1972	Blubber	6	-	- -	0.61 ± 0.379	0.14 -	1.1	Johansen et al. (1980)
56	Minke, Fin, and White Whales *(B. acutorostrata, B. physalus)*	St. Lawrence River, E. Canada	1979	Blubber	3	-	- -	71.6 ± 91.72	-		Sergeant (1980)
57	Fin Whale *(Balaenoptera physalus)*	S.E. Greenland	1975	Blubber	6	-	- -	3.6 -	-		Holden (1975)
58	Fin Whale *(Balaenoptera physalus)*	N. Atlantic	1967-1970	Blubber (oil)	5	-	- -	4.1 ± 3.3	<0.01 -	7.0	Addison et al. (1972)
58 A	Fin Whale *(Balaenoptera physalus)*	France, Brittany & Mediterranean Coasts	1976	Blubber	2	M&F	14.3 / -	4.96 -	-		Alzieu and Duguy (1979)
59	Fin Whale *(Balaenoptera physalus)*	Nova Scotia E. Canada, & N.W. Atlantic	1970-1971	Blubber	9	F	- /adult	0.04 ± 0.04	0.01 -	0.05	Saschenbrecker (1973)
60	Fin Whale *(Balaenoptera physalus)*	Nova Scotia E. Canada, & N.W. Atlantic	1970-	Blubber	3	M	- /adult	0.09 ± 0.08	0.04 -	0.19	Saschenbrecker (1973)
61	Humpback Whale *(Megaptera novaeangliae)*	Nova Scotia, Canada & New Jersey, USA N.W. Atlantic	1971-1975	Blubber	2	M&F	- /adult	5.7 -	5.4 -	6.0	Taruski et al. (1975)
63	Humpback Whale *(Megaptera novaeangliae)*	Antigua, St. Kitts West Indies	1971-1975	Blubber	2	M	- /juvenile & adult	1.4 -	1.3 -	1.5	Taruski et al. (1975)

Table 12. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age	PCB µg/g mean ± S.D.	PCB µg/g Range	Source
62	Dense-beaked Whale *(Mesoplodon densirostris)*	New Jersey & North Carolina, N.W. Atlantic	1971-1975	Blubber	2	M	-	/juvenile & adult	21.5 -	14 - 29	Taruski et al. (1975)
64	Sperm Whale *(Physeter catodon)*	Anegata Passage, West Indies	1971-1975	Blubber	2	M&F	-	/adult	2.4 -	0.7 - 4.0	Taruski et al. (1975)
65	Sperm Whale *(Physeter catodon)*	Antarctic	1962-1966	Blubber (oil)	3	-	-	-	0.67 -	<0.01 - 1.0	Addison et al. (1972)
94	Pygmy Killer Whale *(Feresa attenuata)*	Florida	1975	Blubber	2	M	1.97 /	-	57.8 -	36.6 - 79.0	Forrester et al. (1980)
23	Harbour Porpoise *(Phocoena phocoena)*	Baltic Sea	1976	Liver	2	-	-	-	6.2 -	2.4 - 10.0	Huschenbeth (1977)
				Blubber	2	-	-	-	114.3 -	88.6 - 140	
69	Harbour Porpoise *(Phocoena phocoena)*	E. Scotland	1968	Blubber	2	-	-	-	31 -	-	Holden (1975)
70	Harbour Porpoise *(Phocoena phocoena)*	E. Scotland	1970	Blubber	3	-	-	-	68 -	-	Holden (1975)
71	Harbour Porpoise *(Phocoena phocoena)*	E. Scotland	1971	Blubber	4	-	-	-	39 -	-	Holden (1975)
75	Harbour Porpoise *(Phocoena phocoena)*	W. Greenland	1972	Blubber	2	-	-	-	6.65 ± 6.72	-	Clausen et al. (1974)
76	Harbour Porpoise *(Phocoena phocoena)*	North Sea	1974	Blubber	7	-	-	-	88 ± 42 †	35 - 148	Koeman et al. (1972)

Table 12. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age	PCB µg/g mean ± S.D.	PCB µg/g Range	Source
92 A	Harbour Porpoise *(Phocoena phocoena)*	Bay of Fundy	1971-1977	Liver	45	M	1.39/	3.96	1.20 ± 0.73	-	Gaskin et al. (1983)
				Kidney	33	M	1.36/	4.08	0.63 ± 0.44	-	
				Muscle	61	M	1.35/	3.96	1.02 ± 0.69	-	
				Blubber	62	M	1.35/	3.96	78.7 ± 58.6	-	
92 B	Harbour Porpoise *(Phocoena phocoena)*	Bay of Fundy	1971-1977	Liver	21	F	1.33/	2.73	0.66 ± 0.41	-	Gaskin et al. (1983)
				Kidney	18	F	1.29/	2.35	0.39 ± 0.30	-	
				Muscle	39	F	1.33/	2.73	0.73 ± 0.67	-	
				Blubber	40	F	1.33/	2.73	46.6 ± 27.0	-	
95	Harbour Porpoise *(Phocoena phocoena)*	Danish Coast	1972-1973	Liver	4	M&F	- /	1-3	5.4 -	0.7 - 11	Andersen & Rebsdorff (1976)
				Blubber	4	M&F	- /	1-3	78 -	28 - 125	
91	Finless Porpoise *(Neophocoena phocoenoides)*	Japan	1968-1976	Muscle	5	M&F	1.53/	-	0.81 ± 0.33	0.43 - 1.1	O'Shea et al. (1980)
				Blubber	6	M&F	1.47/	-	65 ± 28	18 - 96	
77	Common Dolphin *(Delphinus delphis)* and Dusky Dolphin *(Lagenorhynchus obscurus)*	North Sea (3) and New Zealand (1)	~1972	Blubber	4	-	-	-	<0.75 ± <0.48	-	Koeman et al. (1972)
78	Common Dolphin *(Delphinus delphis)*	French Coast (Atlantic & Mediterranean)	1979	Liver	17	-	-	-	28.2 ± 66.7	-	Alzieu and Duguy (1979)
				Muscle+	25	-	-	-	10.6 ± 15.5	-	
				Kidney	18	-	-	-	13.5 ± 15.9	-	
				Blubber	12	-	-	-	122.9 ± 91.1	-	
87	Common Dolphin *(Delphinus delphis)*	California	1968-1976	Muscle	13	M&F	2.06/	-	1.24 ± 0.94	<0.01 - 3.3	O'Shea et al. (1980)
				Blubber	13	M&F	2.06/	-	130.0 ± 59.2	80 - 300	

Table 12. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age	PCB µg/g mean ± S.D.	PCB µg/g Range	Source
79	Blue-White Dolphin [T] *(Stenella caeruleoalba)*	French Coast (Atlantic & Mediterranean)	1979	Liver	24	-	-	-	101.8 ± 136.9	-	Alzieu and Duguy (1979)
				Muscle [+]	10	-	-	-	12.3 ± 19.1	-	
				Kidney	26	-	-	-	36.2 ± 36.9	-	
				Blubber	8	-	-	-	266.9 ± 250.7	-	
80	Risso's Dolphin *(Globicephala griseus)*	French Coast (Atlantic & Mediterranean)	1979	Liver	4	-	-	-	49.0 ± 57.0	-	Alzieu and Duguy (1979)
				Muscle [+]	3	-	-	-	3.9 ± 2.2	-	
				Kidney	4	-	-	-	35.8 ± 53.0	-	
				Blubber	3	-	-	-	68.1 ± 23.1	-	
81	Striped Dolphin [T] *(Stenella caeruleoalba)*	Maryland & R.I., E. USA	~1971-1975	Blubber	2	M&F	-	/adults	54	39 - 69	Taruski et al. (1975)
86	Striped Dolphin [T] *(Stenella caeruleoalba)*	E. Tropical Pacific	1968-1976	Muscle	13	M&F	1.77 / -		<0.01	-	O'Shea et al. (1980)
				Blubber	14	M&F	1.77 / -		4.0 ± 4.0	<0.01 - 5.2	
89	Striped Dolphin [T] *(Stenella caeruleoalba)*	Japan	1968-1976	Muscle	5	M&F	2.22 / -		0.62 ± 0.67	<0.01 - 0.85	O'Shea et al. (1980)
				Blubber	5	M&F	2.22 / -		3.36 ± 1.75	1.2 - 5.0	
82	Common Dolphin & Atlantic White-Sided Dolphin *(Delphinus delphis and Lagenorhynchus acutus)*	Rhode Island, E. USA; Nova Scotia, E. Canada	~1971-1975	Blubber	2	M&F	-	/adults	53	37 - 69	Taruski et al. (1975)
83	Gray Dolphin *(Globicephala macrophyncha)*	St. Lucia Lesser Antilles	1972	Liver	5	M&F	4.3 / -		0.31 ± 0.34	0.07 - 0.85	Gaskin et al. (1974)
				Muscle [+]	5	M&F	4.3 / -		0.20 ± 0.21	0.05 - 0.54	
				Kidney	4	M&F	4.3 / -		0.19 ± 0.11	0.06 - 0.33	
				Blubber	5	M&F	4.3 / -		1.13 ± 0.40	0.69 - 1.60	

Table 12. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age	PCB µg/g mean ± S.D.	PCB µg/g Range	Source
84	Long-snouted Dolphin *(Stenella longirostris)*	St. Lucia, Lesser Antilles	1972	Liver	2	M&F	1.8 / -		0.20 -	0.15 - 0.24	Gaskin et al. (1974)
				Muscle+	2	M&F	1.8 / -		0.07 -	0.03 - 0.10	
				Kidney	2	M&F	1.8 / -		0.22 -	0.17 - 0.26	
				Blubber	2	M&F	1.8 / -		3.50 -	2.00 - 5.00	
85	Bottlenose Dolphin *(Tursiops truncatus)*	California	1968-1976	Muscle	2	F	2.33 / -		435 -	420 - 450	O'Shea et al. (1980)
				Blubber	2	F	2.33 / -		10.3 -	5 - 15	
88	Rough-toothed Dolphin *(Steno bredanensis)*	Hawaii	1968-1976	Muscle	7	M&F	2.17 / -		0.19 ± 0.20	<0.01 - 0.45	O'Shea et al. (1980)
				Blubber	7	M&F	2.17 / -		13.17 ± 14.15	<0.01 - 38	

* - Different tissues belong to the same animal or groups of animals which have the same Index No.

\+ - Dorsal meat

† - Standard deviation calculated from the range

∿ - Approximate sampling date or several years previously.

T - Blue-White and Striped Dolphins are used interchangeably, depending on the name used in the original literature.

Table 13. Reference concentrations of ΣDDT (wet weight basis) in different tissues of Pinnipeds.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
106	Ringed Seal *(Phoca hispida)*	Upernavik, W. Greenland	1974-1976	Blubber	57	-	-	-	1.02 ± 0.97	-	Johansen et al. (1980)
107	Ringed Seal *(Phoca hispida)*	Daneborg, W. Greenland	1974	Blubber	7	-	-	-	3.1 ± 2.1[†]	-	Johansen et al. (1980)
250	Ringed Seal *(Phoca hispida)*	Gulf of Bothnia, W. Finland	1968	Blubber	2	-	-	-	63 -	58 - 68	Jensen et al. (1969)
251	Ringed Seal *(Phoca hispida)*	Bothnian Bay, W. Finland	1973	Blubber	40	F	-	/adults	110 ± 63	-	Helle et al. (1976a)
252	Ringed Seal *(Phoca hispida)*	Gulf of Bothnia, W. Finland	1973	Blubber	33	-	-	/adults	200 ± 161	-	Helle et al. (1976a)
253	Ringed Seal *(Phoca hispida)*	Simo,Bothnian Bay, W. Finland	1975	Blubber	37	F[B]	-	/adults	115 ± 76	-	Helle et al. (1976b)
254	Ringed Seal *(Phoca hispida)*	Simo,Bothnian Bay, W. Finland	1975	Blubber	24	F[A]	-	/adults	88 ± 47.5	-	Helle et al. (1976b)
255	Ringed Seal *(Phoca hispida)*	Simo,Bothnian Bay, W. Finland	1975	Blubber	24	M	-	/adults	130 ± 88	-	Helle et al. (1976b)
256	Ringed Seal *(Phoca hispida)*	Sacks Harbour Hudson Bay, N. Canada	1972	Liver[+]	3	M&F	-	-	0.022± 0.013	-	Bowes and Jonkel (1975)
				Muscle	3	M&F	-	-	0.016± 0.009	-	
				Blubber	5	M&F	-	-	1.538± 0.876		
257	Ringed Seal *(Phoca hispida)*	Lancaster Sound, Canadian Arctic	∿1972	Liver	3	F	-	-	0.078± 0.089	-	Bowes and Jonkel (1975)
				Blubber	2	M&F	-	-	0.367± 0.266	-	

Table 13. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
258	Ringed Seal *(Phoca hispida)*	W. Greenland	1972	Blubber	5	-	-	-	0.15 ± 0.10	-	Clausen et al. (1974)
260	Ringed Seal *(Phoca hispida)*	Arctic Canada	∿1970	Blubber	3	-	-	/adults	2.7 ± 1.5†	1.3 - 3.9	Holden (1972)
261	Ringed Seal *(Phoca hispida)*	Arctic Norway	∿1970	Muscle+	2	-	-	/adults	2.44 -	1.8 - 2.9	Holden (1972)
262	Ringed Seal *(Phoca hispida)*	Victoria Island, W. Arctic Canada	1972	Blubber	13	F	-	/ 10.9	0.61 ± 0.27	0.17 - 1.08	Addison and Smith (1974)
263	Ringed Seal *(Phoca hispida)*	Victoria Island, W. Arctic Canada	1970-1972	Blubber	15	M	-	/ 14.5	1.31 ± 0.31	0.39 - 1.45	Addison and Smith (1974)
264	Grey Seal *(Halichoerus grypus)*	Archipelago of Stockholm	1968	Blubber	3	-	-	-	36 -	35 - 36	Jensen et al. (1969)
265	Grey Seal *(Halichoerus grypus)*	Gulf of Finland	1968	Blubber	2	-	-	/pups	25 -	24 - 26	Jensen et al. (1969)
266	Grey Seal *(Halichoerus grypus)*	Wales, W. England	∿1970	Blubber	3	-	-	/adults	17.5 ± 3.9†	14.3 - 20.9	Holden (1972)
267	Grey Seal *(Halichoerus grypus)*	Cornwall, S. England	∿1970	Blubber	3	-	-	/pups	11.1 ± 5.7†	5.2 - 14.8	Holden (1972)
268	Grey Seal *(Halichoerus grypus)*	Orkney, N. Scotland	∿1970	Blubber	8	-	-	/adults	13.0 ± 7.7†	2.9 - 24.9	Holden (1972)

Table 13. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
269	Grey Seal *(Halichoerus grypus)*	Hebrides, W. Scotland	~1970	Blubber	3	-		adults	15.1 ± 7.8†	10.0 - 23.2	Holden (1972)
270	Grey Seal *(Halichoerus grypus)*	Summer Island, W. Scotland	~1970	Blubber	4	-		adults	9.8 ± 6.8†	4.1 - 18.1	Holden (1972)
271	Grey Seal *(Halichoerus grypus)*	Aberdeen-Montrose, E. Scotland	~1970	Blubber	16	-		adults	20.1 ± 7.9†	8.5 - 36.3	Holden (1972)
272	Grey Seal *(Halichoerus grypus)*	Farne Islands, N.E. England	~1970	Blubber	5	-		pups	13.1 ± 5.5†	6.4 - 19.1	Holden (1972)
273	Grey Seal *(Halichoerus grypus)*	Scroby E. England	~1970	Blubber	2	-		adults	39.7 -	26.1 - 52.1	Holden (1972)
274	Grey Seal *(Halichoerus grypus)*	Sable Island, Nova Scotia E. Canada	~1970	Blubber	5	-		adults	45.4 ± 30.3	14.9 - 85.3	Holden (1972)
275	Grey Seal *(Halichoerus grypus)*	Basque, Gulf of St. Lawrence, E. Canada	-	Blubber	2	-		adults	49.9 ± 24.4	36.1 - 63.6	Holden (1972)
276	Grey Seal *(Halichoerus grypus)*	Outer Hebrides, N. Scotland	1972	Blubber	6	-		adults	7.40 ± 4.07	-	Heppleston (1973)
277	Grey Seal *(Halichoerus grypus)*	Shetland, N. Scotland	1972	Blubber	8	-		adults	8.90 ± 5.08	-	Heppleston (1973)
278	Grey Seal *(Halichoerus grypus)*	Farne Islands, N.E. England	1972	Blubber	7	-		adults	10.71 ± 3.21	-	Heppleston (1973)

Table 13. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
279	Grey Seal *(Halichoerus grypus)*	E. Anglia, E. England	1972	Blubber	4	-	-	/adults	15.53 ± 8.31	-	Heppleston (1973)
280	Grey Seal *(Halichoerus grypus)*	Gulf of Bothnia W. Finland	1973	Blubber	15	-	-	/adults	210 ± 108.4†	-	Olsson et al. (1975)
281	Grey Seal *(Halichoerus grypus)*	Baltic Sea	1973	Blubber	18	-	-	/adults	420 ± 225	-	Olsson et al. (1975)
282	Grey Seal *(Halichoerus grypus)*	Sable Island, Nova Scotia, E. Canada	1974-1976	Blubber	11	-	-	/pups	15.45 ± 5.94	-	Addison and Brodie (1977)
283	Grey Seal *(Halichoerus grypus)*	Sable Island Nova Scotia, E. Canada	1974-1976	Blubber	11	F	-	/adults	27.1 ± 15.2	-	Addison and Brodie (1977)
284	Grey Seal *(Halichoerus grypus)*	E. Anglia, E. England	∿1975	Liver Muscle+ Kidney Blubber	3 3 3 3	- - - -	- - - -	- - - -	2.08 ± 0.51 0.42 ± 0.21 0.66 ± 0.13 18.5 ± 7.0	1.49 - 2.40 0.25 - 0.66 0.53 - 0.78 13.8 - 26.6	Holden (1978a)
285	Grey Seal *(Halichoerus grypus)*	Orkney, N. Scotland	∿1978	Blubber	7	-	-	-	8.3 -	-	Holden (1978a)
286	Grey Seal *(Halichoerus grypus)*	Shetland, W. Scotland	∿1978	Blubber	8	-	-	-	8.4 -	-	Holden (1978a)
286 A	Grey Seal *(Halichoerus grypus)*	Farne Islands, N.E. England	1975	Blubber Blubber	26 33	M F	- -	/ 3-27 / 1-36	8.97 - 4.26 -	3.48 - 16.88 2.04 - 11.84	Holden (1978b)
323	Grey Seal *(Halichoerus grypus)*	Farne Islands, N.E. England	1972	Blubber Blubber	8 9	M F	1.88 /12.9 1.82 /19.4		26.8 ± 6.3 10.1 ± 4.2	16.9 - 33.6 4.3 - 19.3	Donkin et al. (1981)

Table 13. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
165	Harbour Seal *(Phoca vitulina)*	Booth Bay Harbour Gulf of Maine, E. USA	1971	Liver Muscle+ Blubber	3 2 3	M M M	- - -	/ adults / adults / adults	1.42 ± 0.63† 0.17 ± 0.08† 84.9 ± 60.4†	0.87 - 1.93 0.12 - 0.22 37.0 - 139.2	Gaskin et al. (1973)
166	Harbour Seal *(Phoca vitulina)*	Booth Bay Harbour Gulf of Maine, E. USA	1971	Liver Muscle+ Blubber	3 3 3	F F F	- - -	/ adults / adults / adults	0.37 ± 0.33† 0.08 ± 0.04† 45.91 ± 23.80†	0.09 - 0.65 0.04 - 0.11 25.26 - 65.54	Gaskin et al. (1973)
168	Harbour Seal *(Phoca vitulina)*	Grand Manan and Deer Island New Brunswick, E. Canada	1971	Liver Muscle+ Blubber	4 4 3	M M M	- - -	/ adults / adults / adults	0.68 ± 0.82† 0.91 ± 1.09† 38.41 ± 13.6	0.35 - 2.26 0.22 - 2.77 29.13 - 52.10	Gaskin et al. (1973)
180	Harbour Seal *(Phoca vitulina)*	Columbia River Oregon, USA	1971	Blubber	3	-	-	/ 2-4	72.7 -	27.7 - 109.9	Anas (1974a)
183	Harbour Seal *(Phoca vitulina)*	Puget Sound Washington, W. USA	1971	Blubber	2	-	-	/ 1	1039.7 ε -	459.4 -1620	Anas (1974a)
212	Harbour Seal *(Phoca vitulina)*	Wadden Sea, Netherlands	~1974	Blubber	3	M	-	/ 1-24	10.4 ± 6.7 -		Duinker et al. (1979)
287	Harbour Seal *(Phoca vitulina)*	Wadden Sea, Netherlands	1965	Blubber	2	-	-	-	18.5 -	9.6 - 27.4	Koeman and van Genderen (1966)
288	Harbour Seal *(Phoca vitulina)*	Netherlands	~1972	Blubber	5	-	-	/ 14-25	9.5 ± 4.6	6.5 - 17.3	Koeman et al. (1972)
289	Harbour Seal *(Phoca vitulina)*	Netherlands	1972	Blubber	3	-	-	/juvenile <2	2.0 ± 2.8†	0.33 - 5.1	Koeman et al. (1972)

Table 13. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
290	Harbour Seal *(Phoca vitulina)*	Scroby, E. England	~1970	Blubber	3	-	-	/ adults	23.9 ± 11.1†	15.6 - 34.4	Holden (1972)
291	Harbour Seal *(Phoca vitulina)*	Shetland, N. Scotland	1970	Blubber	4	-	-	/ pups	2.6 ± 0.97	1.6 - 3.6	Holden (1972)
292	Harbour Seal *(Phoca vitulina)*	Summer, W. Scotland	1970	Blubber	17	-	-	/ adults	5.3 ± 1.7	2.5 - 8.6	Holden (1972)
293	Harbour Seal *(Phoca vitulina)*	Wash, E. England	1970	Blubber	12	-	-	/ pups	6.5 ± 2.2	2.5 - 9.73	Holden (1972)
294	Harbour Seal *(Phoca vitulina)*	Pribilof Island Alaska, USA	1971	Blubber	3	-	-	-	13.9 ε	-	6.8 - 27.8	Anas (1974)
295	Harbour Seal *(Phoca vitulina)*	Wadden Sea, Netherlands	~1979	Liver	5	M&F	-	/ 1-24	0.55 ± 0.49	-	Duinker et al. (1979)
				Kidney	2	F	-	/ 1	0.41 -	0.05 - 0.76	
				Blubber	4	F	-	/ 1-23	11.2 ± 10.3	-	
296	Harbour Seal *(Phoca vitulina)*	North German Coast	1974-1976	Liver	5	-	-	/ 0-8	0.14 ± 0.10	-	Drescher et al. (1977)
				Kidney	4	-	-	/ 0-8	0.15 ± 0.14	-	
				Blubber	56	-	-	/ 0-8	7.28 ± 2.07	-	
297	Harbour Seal *(Phoca vitulina)*	W. Scotland	~1978	Blubber	8	-	-	-	22.3	-	-	Holden (1978)
324 A	Harbour Seal *(Phoca vitulina)*	Schleswig-Holstein	1975-1976	Blubber	8	-	-	/juveniles	16.9	-	4.0 - 47.1	Reijnders (1980)
				Blubber	6	-	-	/ adults	8.5	-	3.7 - 15.2	
324 B	Harbour Seal *(Phoca vitulina)*	Wadden Sea, Netherlands	1975-1976	Blubber	6	-	-	/juveniles	29.8	-	3.3 - 127.0	Reijnders (1980)
				Blubber	8	-	-	/ adults	47.3	-	6.6 - 178	

Table 13. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
298	Harbour and Grey Seals (*Phoca vitulina* and *Halichoerus grypus*)	E. Anglia, E. England	1972	Liver	9	-	-	adults	1.42 ± 1.38	-	Heppleston (1973)
				Muscle[+]	9	-	-	adults	0.34 ± 0.19	-	
				Kidney	9	-	-	adults	0.38 ± 0.24	-	
				Blubber	9	-	-	adults	12.55 ± 6.23	-	
299	Harbour and Grey Seals (*Phoca vitulina* and *Halichoerus grypus*)	Baltic Sea	1968	Blubber	2	-	-	-	66 -	58 - 74	Jensen et al. (1969)
300	Harbour and Grey Seals (*Phoca vitulina* and *Halichoerus grypus*)	E. Scotland	1965 1966	Blubber	18	-	-	adults	15.1 -	2.8 - 37	Holden and Marsden (1967)
301	Harbour and Grey Seals (*Phoca vitulina* and *Halichoerus grypus*)	N. and W Scotland	1965 1966	Blubber	6	-	-	adults	7.6 -	3.1 - 15.5	Holden and Marsden (1967)
302	Harbour and Grey Seals (*Phoca vitulina* and *Halichoerus grypus*)	N. and W. Scotland	1965	Blubber	9	-	-	pups	5.12 -	2.23 - 8.29	Holden and Marsden (1967)
210	Hooded Seal (*Cystophora cristata*)	Upernavik and Disko Bay, W. Greenland	1974	Blubber	4	-	-	-	3.5 ± 1.5[†]	2.1 - 6.5	Johansen et al. (1980)
305	Hooded Seal (*Cystophora cristata*)	W. Greenland	1972	Blubber	5	-	-	-	0.29 ± 0.10[δ]	-	Clausen et al. (1974)

Table 13. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	ΣDDT µg/g mean ± S.D.	Range	Source
214	Harp Seal *(Pagophilus groenlandicus)*	Upernavik and Disko Bay, W. Greenland	1972	Blubber	8	-	-	-	4.9 ± 5.6†	0.82 - 17.2	Johansen et al. (1980)
215	Harp Seal *(Pagophilus groenlandicus)*	Upernavik and Disko Bay, W. Greenland	1974	Blubber	3	-	-	-	1.5 ± 0.6†	0.92 - 2.6	Johansen et al. (1980)
216	Harp Seal *(Pagophilus groenlandicus)*	Upernavik and Disko Bay, W. Greenland	1976	Blubber	3	-	-	-	2.8 ± 1.4	2.1 - 6.5	Johansen et al. (1980)
218	Harp Seal *(Pagophilus groenlandicus)*	Gulf of St. Lawrence, E. Canada	1973	Liver	4	F	-	/ adults	0.03 ± 0.01	-	Jones et al. (1976)
				Muscle+	4	F	-	(lactating)	0.01 ± 0.000	-	
				Blubber	4	F	-	/ "	4.40 ± 1.27	-	
225	Harp Seal *(Pagophilus groenlandicus)*	Gulf of St. Lawrence, E. Canada	1973	Liver	10	M	-	/ 8-14 days	0.129 ± 0.179	0.003- 0.61	Jones et al. (1976)
				Kidney	7	M	-	/ 8-11 days	0.546 ± 1.02	0.007- 3.04	
				Blubber	10	M	-	/ 8-14 days	1.34 ± 0.49	0.66 - 2.08	
226	Harp Seal *(Pagophilus groenlandicus)*	Gulf of St. Lawrence E. Canada	1973	Liver	6	F	-	/ 3-14 days	0.126 ± 0.175	0.02 - 0.48	Jones et al. (1976)
				Kidney	6	F	-	/ 3-14 days	0.49 ± 0.54	0.09 - 1.5	
				Blubber	5	F	-	/ 10-14 days	1.36 ± 0.87	0.69 - 2.30	
306	Harp Seal *(Pagophilus groenlandicus)*	East of Newfoundland	1970	Liver	9	-	-	/ pups & juveniles	0.48 -	-	Frank et al. (1973)
				Muscle+	9	-	-	/ <3 wks	0.43 -	-	
				Blubber	9	-	-	/ <3 wks	3.46 -	-	
307	Harp Seal *(Pagophilus groenlandicus)*	East of Newfoundland	1970	Liver	3	F	-	/ adults	0.18 -	-	Frank et al. (1973)
				Muscle+	3	F	-	/ adults	0.11 -	-	
				Blubber	5	F	-	/ adults	8.84 -	-	

Table 13. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
308	Harp Seal (*Pagophilus groenlandicus*)	Magdalen Island Gulf of St.Lawrence E. Canada	1971	Liver Muscle+ Blubber	10 10 10	- - -	- - -	/ <3 wks / - / <3 wks	0.29 0.22 4.51	- - -	- - -	Frank et al. (1973)
309	Harp Seal (*Pagophilus groenlandicus*)	Magdalen Island Gulf of St.Lawrence E. Canada	1971	Liver Muscle+ Blubber	11 11 11	F F F	- - -	/ adults / adults / adults	0.49 0.20 9.05	- - -	- - -	Frank et al. (1973)
310	Harp Seal (*Pagophilus groenlandicus*)	Escoumins,Quebec Gulf of St.Lawrence E. Canada	1971	Blubber	4	F	-	/ 3.25	6.4 ±	3.7†	3.6 - 12.1	Addison et al. (1973)
311	Harp Seal (*Pagophilus groenlandicus*)	Escoumins,Quebec Gulf of St.Lawrence E. Canada	1971	Blubber	14	M	-	/ 7.0	10.2 ±	5.7†	3.1 - 22.6	Addison et al. (1973)
312	Harp Seal (*Pagophilus groenlandicus*)	Gulf of St. Lawrence E. Canada	1973	Liver Blubber	10 20	- -	- -	/ <2 wks / <2 wks	0.08 ± 1.98 ±	0.03 0.67	0.05 - 0.14 1.08 - 2.98	Rosewell et al. (1979)
313	Harp Seal (*Pagophilus groenlandicus*)	Gulf of St. Lawrence E. Canada	1971	Liver Muscle+ Kidney Blubber	9 9 10 10	M M M M	- - - -	/ 6.5 / 7.5 / 7.7 / 7.7	0.38 ± 0.24 ± 0.24 ± 3.44 ±	0.23 0.05 0.05 1.35	0.15 - 0.82 0.20 - 0.31 0.09 - 0.68 1.64 - 5.42	Rosewell et al. (1979)
303	Harp & Grey Seals (*Pagophilus groenlandicus* and *Halichoerus grypus*)	Magdalen Island Gulf of St.Lawrence E. Canada	1967	Blubber	2	-	-	/juvenile and adult	1.68	-	0.83 - 2.59	Holden and Marsden (1967)
304	Harp & Grey Seals (*Pagophilus groenlandicus* and *Halichoerus grypus*)	Cabot Strait, Gulf of St.Lawrence E. Canada	1967	Blubber	6	-	-	/juvenile	12.2	-	3.55 - 35	Holden and Marsden (1967)

Table 13. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
314	Bearded Seal *(Erignathus barbatus)*	W. Greenland	1972	Blubber	5	-	-	-	0.47 ± 0.26 [δ]	-	Clausen et al. (1974)
315	Fur Seal *(Callorhinus ursinus)*	Pribilof Island Alaska, USA	1969	Liver [+]	5	-	-	/ pups	2.21 -	0.20 - 6.75	Anas and Wilson (1970b)
				Muscle [+]	5	-	-	/ pups	2.18 -	0.09 - 8.77	
				Blubber	5	-	-	/ pups	15.91 -	0.64 - 47.9	
316	Fur Seal *(Callorhinus ursinus)*	Pribilof Island Alaska, and Washington State Coast, W. USA	1968 1969	Liver	13	M	-	/ 2.8	0.80 -	0.08 - 5.95	Anas and Wilson (1970a)
317	Fur Seal *(Callorhinus ursinus)*	Pribilof Island Alaska, and Washington State Coast, W. USA	1968 1969	Liver	10	F [B]	-	/ 3.0	0.98 -	0.19 - 3.27	Anas and Wilson (1970a)
318	Fur Seal *(Callorhinus ursinus)*	Pribilof Island Alaska, and Washington State Coast, W. USA	1968	Liver	7	F [A]	-	/ 8.0	0.46 -	0.16 - 0.81	Anas and Wilson (1970a)
319	Fur Seal *(Callorhinus ursinus)*	Pribilof Island Alaska, and Washington State Coast, W. USA	1968	Liver	7	-	-	/ fetus	0.01 -	0.01 - 0.10	Anas and Wilson (1970a)
320	Fur Seal *(Callorhinus ursinus)*	St. Paul Island Alaska, USA	1972	Blubber	5	-	-	/ pups	39.9 ± 48.2	-	Kurtz and Kim (1976)
321	Fur Seal *(Callorhinus ursinus)*	St. Paul Island Alaska, USA	1972	Blubber	2	F	-	/ adults	5.2 ± 2.6	-	Kurtz and Kim (1976)

Table 13. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	ΣDDT µg/g mean ± S.D.	ΣDDT µg/g Range	Source
322	Species *(Bearded, Hooded, Ringed)*	W. Greenland	~1978	Blubber	20	-	-	-	0.70 ± 0.50	-	Clausen (1978)
325	Sea Lion *(Zalophus californianus)*	California	1970	Blubber	25	21M/ 4F	-	/adults	911 ± 582	41 -2678	Le Boeuf & Bonnell (1971)
326 A	Sea Lion *(Zalophus californianus)*	California	1970	Liver	3	F	-	/ 8	25.2 ± 4.1	22 - 30	Delong et al. (1973)
				Blubber	6	F	-	/ 8	824.4 ± 167.8	626 -1039	
326 B	Sea Lion *(Zalophus californianus)*	California	1970	Liver	4	F	-	/12	6.7 ± 5.1	2.4 - 13.6	Delong et al. (1973)
				Blubber	4	F	-	/12	103.2 ± 69.7	51 - 203	
327	Walrus *(Odobenus rosmarus rosmarus)*	Alaska	1970	Blubber	4	-	-	-	0.08 -	-	Galster & Burns (1972)
328	Walrus *(Odobenus rosmarus rosmarus)*	Thule, Greenland	1975-1977	Blubber	8	M	-	/0-19	0.09 ± 0.13	0.03 - 0.40	Born et al. (1981)
				Blubber	20	F	-	/0-19	0.05 ± 0.05	0.01 - 0.26	

* - Different tissues belong to the same animal or groups of animals which have the same Index No.

\+ - Dorsal meat

† - Standard deviation calculated from the range.

~ - Approximate sampling date or several years previously.

ε - Total DDT + PCB

δ - as DDE

A - Gravid

B - Non-gravid

Table 14. Reference concentration of PCB's (wet weight basis) in different tissues of Pinnipeds.

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	PCB µg/g mean ± S.D.	PCB µg/g Range	Source
106	Ringed Seal *(Phoca hispida)*	Upernavik, W. Greenland	1974-1976	Blubber	57	-	-	-	0.96 ± 0.71	-	Johansen et al. (1980)
107	Ringed Seal *(Phoca hispida)*	Daneborg, E. Greenland	1974	Blubber	7	-	-	-	3.2 ± 1.3†	-	Johansen et al. (1980)
250	Ringed Seal *(Phoca hispida)*	Gulf of Bothnia, W. Finland	1968	Blubber	2	-	-	-	6.8 -	5.0 - 8.5	Jensen et al. (1969)
251	Ringed Seal *(Phoca hispida)*	Bothnian Bay, W. Finland	1973	Blubber	40	F	-	/ adults	69 ± 25.3	-	Helle et al. (1976a)
252	Ringed Seal *(Phoca hispida)*	Gulf of Bothnia, W. Finland	1973	Blubber	33	-	-	/ adults	110 ± 86	-	Helle et al. (1976a)
253	Ringed Seal *(Phoca hispida)*	Simo, Bothnian Bay, W. Finland	1975	Blubber	37	F[B]	-	/ adults	100 ± 57	-	Helle et al. (1976b)
254	Ringed Seal *(Phoca hispida)*	Simo, Bothnian Bay, W. Finland	1975	Blubber	24	F[A]	-	/ adults	73 ± 32	-	Helle et al. (1976b)
255	Ringed Seal *(Phoca hispida)*	Simo, Bothnian Bay, W. Finland	1975	Blubber	24	M	-	/ adults	100 ± 64	-	Helle et al. (1976b)
256	Ringed Seal *(Phoca hispida)*	Sachs Harbour Hudson Bay, N. Canada	1972	Liver Muscle+ Blubber	3 3 5	M&F M&F M&F	- - -	- - -	0.041 ± 0.062 0.011 ± 0.006 0.92 ± 0.77	- - -	Bowes and Jonkel (1975)
257	Ringed Seal *(Phoca hispida)*	Lancaster Sound Arctic Canada	~1972	Liver Blubber	3 2	F M&F	- -	- -	0.042 ± 0.041 0.50 ± 0.49	- -	Bowes and Jonkel (1975)

Table 14. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	PCB µg/g mean ± S.D.	PCB µg/g Range	Source
258	Ringed Seal *(Phoca hispida)*	Greenland, West Coast	1972	Blubber	5	-	-	-	0.90 ± 0.27	-	Clausen et al. (1974)
260	Ringed Seal *(Phoca hispida)*	Arctic Canada	∿1970	Blubber	3	-	-	-	3 ± 1.2 ①	2 - 4	Holden (1972)
261	Ringed Seal *(Phoca hispida)*	Arctic Norway	∿1970	Blubber	2	-	-	-	1.5 -	1 - 2	Holden (1972)
262	Ringed Seal *(Phoca hispida)*	Victoria Island, W. Arctic Canada	1970-1972	Blubber	13	F	10.9 /	-	2.0 ± 0.90	1 - 4	Addison and Smith (1974)
263	Ringed Seal *(Phoca hispida)*	Victoria Island,	1970	Blubber	15	M	14.5 /	-	4.1 ± 1.44	1 - 6	Addison and Smith (1974)
264	Grey Seal *(Halichoerus grypus)*	Archipelago of Stockholm	1968	Blubber	3	-	-	-	6.1 -	5.7 - 6.4	Jensen et al. (1969)
265	Grey Seal *(Halichoerus grypus)*	Gulf of Finland	1968	Blubber	2	-	-	/pups	3.9 -	3.4 - 4.4	Jensen et al. (1969)
266	Grey Seal *(Halichoerus grypus)*	Wales, W. England	∿1970	Blubber	3	-	-	/adults	212 ± 21†	200 - 235	Holden (1972)
267	Grey Seal *(Halichoerus grypus)*	Cornwall, S. England	∿1970	Blubber	3	-	-	/pups	160 ± 41†	118 - 187	Holden (1972)
268	Grey Seal *(Halichoerus grypus)*	Orkney, N. Scotland	∿1970	Blubber	8	-	-	/adults	18 ± 9.5†	3 - 30	Holden (1972)

Table 14. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	PCB µg/g mean ± S.D.	PCB µg/g Range	Source
269	Grey Seal *(Halichoerus grypus)*	Hebrides, W. Scotland	∿1970	Blubber	3	-	-	/ adults	30 ± 12†	19 - 40	Holden (1972)
270	Grey Seal *(Halichoerus grypus)*	Summer Island, W. Scotland	∿1970	Blubber	4	-	-	/ adults	16 ± 4†	11 - 19	Holden (1972)
271	Grey Seal *(Halichoerus grypus)*	Aberdeen-Montrose, E. Scotland	∿1970	Blubber	16	-	-	/ adults	38 ± 22†	12 - 88	Holden (1972)
272	Grey Seal *(Halichoerus grypus)*	Farne Islands, N.E. England	∿1970	Blubber	5	-	-	/ pups	40 ± 11†	25 - 50	Holden (1972)
273	Grey Seal *(Halichoerus grypus)*	Scroby, E. England	∿1970	Blubber	2	-	-	/ adults	123 -†	100 - 146	Holden (1972)
274	Grey Seal *(Halichoerus grypus)*	Sable Island Nova Scotia, E. Canada	∿1970	Blubber	5	-	-	/ adults	27 ± 23†	12 - 65	Holden (1972)
275	Grey Seal *(Halichoerus grypus)*	Basque Island, Gulf of St.Lawrence E. Canada	∿1970	Blubber	2	-	-	/ adults	32 ± 26	17 - 46	Holden (1972)
276	Grey Seal *(Halichoerus grypus)*	Outer Hebrides, N. Scotland	1972	Blubber	6	-	-	/ adults	14.4 ± 14.7	-	Heppleston (1973)
277	Grey Seal *(Halichoerus grypus)*	Shetland, W. Scotland	1972	Blubber	8	-	-	/ adults	11.1 ± 6.9	-	Heppleston (1973)
278	Grey Seal *(Halichoerus grypus)*	Farne Island, N.E. England	1972	Blubber	7	-	-	/ adults	31.0 ± 13.1	-	Heppleston (1973)

Table 14. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	PCB µg/g mean ± S.D.	PCB µg/g Range	Source
279	Grey Seal *(Halichoerus grypus)*	E. Anglia, E. England	1972	Blubber	4	-	-	/ adults	152.0 ± 164.2	-	Heppleston (1973)
280	Grey Seal *(Halichoerus grypus)*	Gulf of Bothnia, W. Finland	1973	Blubber	15	-	-	/ adults	100 ± 70	-	Olsson et al. (1975)
281	Grey Seal *(Halichoerus grypus)*	Baltic Sea	1973	Blubber	18	-	-	/ adults	140 ± 72	-	Olsson et al. (1975)
282	Grey Seal *(Halichoerus grypus)*	Sable Island Nova Scotia, E. Canada	1974-	Blubber	11	-	-	/ pups	2.3 ± 0.9	-	Addison and Brodie (1977)
283	Grey Seal *(Halichoerus grypus)*	Sable Island Nova Scotia, E. Canada	1974-	Blubber	11	F	-	/ adults	14.5 ± 6.1	-	Addison and Brodie (1977)
284	Grey Seal *(Halichoerus grypus)*	E. Anglia, E. England	∿1975	Liver+	3	-	-	-	14.0 ± 0.3	9.7 - 10.3	Holden (1975)
				Muscle+	3	-	-	-	3.0 ± 1.8	1.6 - 5.0	
				Kidney	3	-	-	-	4.7 ± 1.70	3.3 - 6.6	
				Blubber	3	-	-	-	195 ± 170	77 - 390	
285	Grey Seal *(Halichoerus grypus)*	Orkney, N. Scotland	∿1978	Blubber	7	-	-	-	26.6 -	-	Holden (1978a)
286	Grey Seal *(Halichoerus grypus)*	Shetland, N. Scotland	∿1978	Blubber	8	-	-	-	11.1 -	-	Holden (1978a)
286 A	Grey Seal *(Halichoerus grypus)*	Farne Islands N.E. England	1975	Blubber	26	M	-	/ 3-27	48.7 -	23.5 - 90.5	Holden (1978b)
				Blubber	33	F	-	/ 1-36	35.4 -	17.0 - 103.0	
323	Grey Seal *(Halichoerus grypus)*	Farne Islands N.E. England	1972	Blubber	10	M	1.84	/12.6	44.7 ± 21.4	13.8 - 89.1	Donkin et al. (1981)
				Blubber	9	F	1.82	/19.4	19.1 ± 9.9	4.1 - 37.6	

Table 14. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m) Age (yrs)	PCB µg/g mean ± S.D.	PCB µg/g Range	Source
165	Harbour Seal *(Phoca vitulina)*	Boothbay Harbour Gulf of Maine, E. USA	1971	Liver Muscle+ Blubber	3 2 3	M M M	- / adults - / adults - / adults	3.16 ± 2.96† 0.39 ± 0.13† 131.8 ± 121.2	1.00 - 6.00 0.28 - 0.50 35.1 - 240.2	Gaskin et al. (1973)
166	Harbour Seal *(Phoca vitulina)*	Boothbay Harbour Gulf of Maine, E. USA	1971	Liver Muscle+ Blubber	3 3 3	F F F	- / adults - / adults - / adults	0.39 ± 0.34† 0.18 ± 0.06† 43.57 ± 42.5 †	0.10 - 0.68 0.1 - 0.25 27.93 - 99.78	Gaskin et al. (1973)
168	Harbour Seal *(Phoca vitulina)*	Grand Manan & Deer Island, New Brunswick, E. Canada	1971	Liver Muscle+ Blubber	4 4 3	M M M	- / adults - / adults - / adults	2.03 ± 2.48† 1.58 ± 2.06† 52.33 ± 11.80†	0.30 - 4.50 0.30 - 5.10 43.0 - 63.0	Gaskin et al. (1973)
212	Harbour Seal *(Phoca vitulina)*	Wadden Sea, Netherlands	~1979	Liver Blubber	5 3	M&F M	- / 1-24 - / 1-24	16.98 ± 15.29 151.7 ± 96.7	- -	Duinker et al. (1979)
288	Harbour Seal *(Phoca vitulina)*	Netherlands	1972	Blubber	5	-	- /14-25	1470 ± 922†	385 -2530	Koeman et al. (1972)
289	Harbour Seal *(Phoca vitulina)*	Netherlands	1972	Blubber	3	-	-/juveniles	240 ± 326†	47 - 600	Koeman et al. (1972)
290	Harbour Seal *(Phoca vitulina)*	Scroby, E. England	~1970	Blubber	3	-	- / adults	131 ± 54†	93 - 185	Holden (1972)
291	Harbour Seal *(Phoca vitulina)*	Shetland, N. Scotland	~1970	Blubber	4	-	- / pups	4 ± 1.9	2 - 6	Holden (1972)
292	Harbour Seal *(Phoca vitulina)*	Summer Island, W. Scotland	~1970	Blubber	17	-	- / adults	12 ± 4.2	5 - 20	Holden (1972)

Table 14. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	PCB µg/g mean ± S.D.	PCB µg/g Range	Source
293	Harbour Seal *(Phoca vitulina)*	Wash, E. England	~1979	Blubber	12	-	-	/pups	15 ± 5.2	7 - 24	Holden (1972)
295	Harbour Seal *(Phoca vitulina)*	Wadden Sea, Netherlands	~1979	Kidney	2	F	-	-	16.3 -	1.6 - 31.0	Duinker et al. (1979)
				Blubber	4	F	-	/ 1-23	217.8 ± 255	-	
296	Harbour Seal *(Phoca vitulina)*	German North Sea Coast	1974-1976	Liver	5	-	-	/ 0-8	0.96 ± 0.92	-	Drescher et al. (1977)
				Kidney	4	-	-	/ 0-8	0.55 ± 0.46	-	
				Blubber	56	-	-	/ 0-8	131.5 ± 42.5	-	
297	Harbour Seal *(Phoca vitulina)*	W. Scotland	1978	Blubber	8	-	-	-	65.8 -	-	Holden (1978a)
324 A	Harbour Seal *(Phoca vitulina)*	Schleswig-Holstein Denmark	1975-1976	Blubber	8	-	-	/juveniles	113.8 -	23 - 340	Reijnders (1980)
				Blubber	6	-	-	adults	76.4 -	41 - 123	
324 B	Harbour Seal *(Phoca vitulina)*	Wadden Sea, Netherlands	1975-1976	Blubber	6	-	-	/juveniles	134.0 -	5 - 680	Reijnders (1980)
				Blubber	8	-	-	adults	701 -	87 -1447	
298	Harbour and Grey Seals *(Phoca vitulina* and *Halichoerus grypus)*	E. Anglia, E. England	1972	Liver	9	-	-	/ adults	6.12 ± 6.66	-	Heppleston (1973)
				Muscle+	9		-	/ adults	2.02 ± 1.61	-	
				Kidney	9	-	-	/ adults	2.11 ± 2.16	-	
				Blubber	9	-	-	/ adults	90.40 ± 110.23	-	
299	Harbour and Grey Seals *(Phoca vitulina* and *Halichoerus grypus)*	Baltic Sea	1968	Blubber	2	-	-	-	15 -	8.5 - 21	Jensen et al. (1969)
210	Hooded Seal *(Cystophora cristata)*	Upernavik and Disko Bay, W. Greenland	1974	Blubber	4	-	-	-	3.9 ± 2.0†	2.2 - 8.2	Johansen et al. (1980)
305	Hooded Seal *(Cystophora cristata)*	W. Greenland	1972	Blubber	5	-	-	-	2.74 ± 1.83	-	Clausen et al. (1974)

Table 14. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	PCB µg/g mean ± S.D.	PCB µg/g Range		Source
214	Harp Seal *(Pagophilus groenlandicus)*	Upernavik and Disko Bay, W. Greenland	1972	Blubber	8	-	-	-	19 ± 1.1	0.74 -	4.0	Johansen et al. (1980)
215	Harp Seal *(Pagophilus groenlandicus)*	Upernavik and Disko Bay, W. Greenland	1974	Blubber	3	-	-	-	1.7 ± 0.5	1.2 -	2.8	Johansen et al. (1980)
216	Harp Seal *(Pagophilus groenlandicus)*	Upernavik and Disko Bay, W. Greenland	1976	Blubber	3	-	-	-	1.6 ± 0.7	0.74 -	2.7	Johansen et al. (1980)
218	Harp Seal *(Pagophilus groenlandicus)*	Gulf of St. Lawrence, E. Canada	1973	Liver	4	F	-	adult (lactating)	0.07 ± 0.01	-		Jones et al. (1976)
				Muscle+	4	F	-	adult (lactating)	0.45 ± 0.01	-		
				Blubber	4	F	-	adult (lactating)	6.05 ± 2.05	-		
225	Harp Seal *(Pagophilus groenlandicus)*	Gulf of St. Lawrence, E. Canada	1971	Liver	10	M	-	8-14+ days	0.33 ± 0.60	0.07 -	0.45	Jones et al. (1976)
				Kidney	7	M	-	8-11+ days	0.49 ± 0.53	0.15 -	1.3	
				Blubber	10	M	-	8-14+ days	1.26 ± 0.42	0.6 -	1.7	
226	Harp Seal *(Pagophilus groenlandicus)*	Gulf of St. Lawrence E. Canada	1973	Liver	6	F	-	3-14 days	0.18 ± 0.21	0.05 -	0.60	Jones et al. (1976)
				Kidney	6	F	-	3-14 days	0.36 ± 0.37	0.04 -	1.00	
				Blubber	5	F	-	10-14 days	0.71 ± 0.64	0.3 -	1.8	
306	Harp Seal *(Pagophilus groenlandicus)*	East of Newfoundland	1970	Liver	9	-	-	pups & juveniles	0.17	-	-	Frank et al. (1973)
				Muscle+	9	-	-	<3 wks	0.21	-	-	
				Blubber	9	-	-	<3 wks	1.8	-	-	

Table 14. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	PCB µg/g mean ± S.D.	PCB µg/g Range	Source
307	Harp Seal (*Pagophilus groenlandicus*)	East of Newfoundland	1970	Liver	3	F	-	adults	0.08	-	Frank et al. (1973)
				Muscle+	3	F	-	adults	0.05	-	
				Blubber	5	F	-	adults	4.50	-	
308	Harp Seal (*Pagophilus groenlandicus*)	Magdalen Island Gulf of St.Lawrence E. Canada	1971	Liver	10	-	-	<3 wks	0.17	-	Frank et al. (1973)
				Muscle+	10	-	-	<3 wks	0.14	-	
				Blubber	10	-	-	<3 wks	2.60	-	
309	Harp Seal (*Pagophilus groenlandicus*)	Magdalen Island Gulf of St.Lawrence E. Canada	1971	Liver	11	F	-	adults	0.30	-	Frank et al. (1973)
				Muscle+	11	F	-	adults	0.14	-	
				Blubber	11	F	-	adults	5.3	-	
310	Harp Seal (*Pagophilus groenlandicus*)	Escoumins,Quebec Gulf of St.Lawrence E. Canada	1971	Blubber	4	F	-	3.25	6.8 ± 5.2	33 - 15	Addison et al. (1973)
311	Harp Seal (*Pagophilus groenlandicus*)	Escoumins,Quebec Gulf of St.Lawrence E. Canada	1971	Blubber	14	M	-	7.0	8.6 ± 5.9†	2 - 22	Addison et al. (1973)
312	Harp Seal (*Pagophilus groenlandicus*)	Gulf of St. Lawrence E. Canada	1973	Liver	10	-	-	<2 wks	0.09 ± 0.04	0.04 - 0.15	Rosewell et al. (1979)
				Blubber	20	-	-	<2 wks	2.26 ± 1.06	1.15 - 2.91	
313	Harp Seal (*Pagophilus groenlandicus*)	Gulf of St. Lawrence E. Canada	1971	Liver	9	M	-	6.5	0.59 ± 0.39	0.11 - 1.45	Rosewell et al. (1979)
				Muscle+	9	M	-	7.5	0.34 ± 0.22	0.06 - 0.77	
				Kidney	10	M	-	7.7	0.34 ± 0.24	0.04 - 0.86	
				Blubber	10	M	-	7.7	3.51 ± 3.52	1.53 - 13.30	
329	Harp Seal (*Pagophilus groenlandicus*)	Gulf of St. Lawrence E. Canada		Blubber	4	-	-	-	10.63 ± 10.86	-	Sergeant (1980)

Table 14. Continued

Index No.*	Species	Location	Year Taken	Tissue	No. of Animals	Sex	Mean Length/ (m)	Age (yrs)	PCB µg/g mean ± S.D.	PCB µg/g Range	Source
314	Bearded Seal *(Erignathus barbatus)*	W. Greenland	1972	Blubber	5	-	-	-	1.8 ± 0.99	-	Clausen et al. (1974)
320	Fur Seal *(Callorhinus ursinus)*	St.Paul Island Alaska, USA	1972	Blubber	5	-	-	pups	21.9 ± 33.5	-	Kurtz and Kim (1976)
321	Fur Seal *(Callorhinus ursinus)*	St.Paul Island Alaska, USA	1972	Blubber	2	F	-	adults	5.8 ± 1.5	-	Kurtz and Kim (1976)
330	Fur Seal *(Callorhinus ursinus)*	Washington State Coast, W. USA	1972	Blubber	12	M	-	adults	28.64$^{\epsilon}$ -	5.3 - 95.7	Anas and Worland (1975)
322	Seal Species (Bearded, Hooded, Ringed)	W. Greenland	~1978	Blubber	20	-	-	-	5.1 ± 5.2	-	Clausen (1978)
326 A	Sea Lion *(Zalophus californianus)*	California	1970	Liver Blubber	3 6	F F	- -	/ 8 / 8	5.7 ± 3.5 112.4 ± 24.4	3.4 - 9.7 85 - 145	DeLong et al. (1973)
326 B	Sea Lion *(Zalophus californianus)*	California	1970	Liver Blubber	4 4	F F	- -	/12 /12	1.3 ± 0.8 17.1 ± 6.1	0.5 - 2.2 12 - 25	DeLong et al. (1973)
327	Walrus *(Odobenus rosmarus rosmarus)*	Alaska	1970	Blubber	4	-	-	-	1.8 -	-	Galster and Burns (1972)
328	Walrus *(Odobenus rosmarus rosmarus)*	Thule, Greenland	1975-1976	Blubber Blubber	8 20	M F	- -	/ 0-19 / 0-19	0.36 ± 0.31 0.18 ± 0.12	0.16 - 1.1 0.06 - 0.53	Born et al. (1981)

* - Different tissues belong to the same animal or groups of animals which have the same Index No.

+ - Dorsal meat

† - S.D. estimated from the range.

~ - Approximate sampling time or several years previously.

$^{\epsilon}$ - Total DDT + PCB

A - Gravid

B - Non-gravid

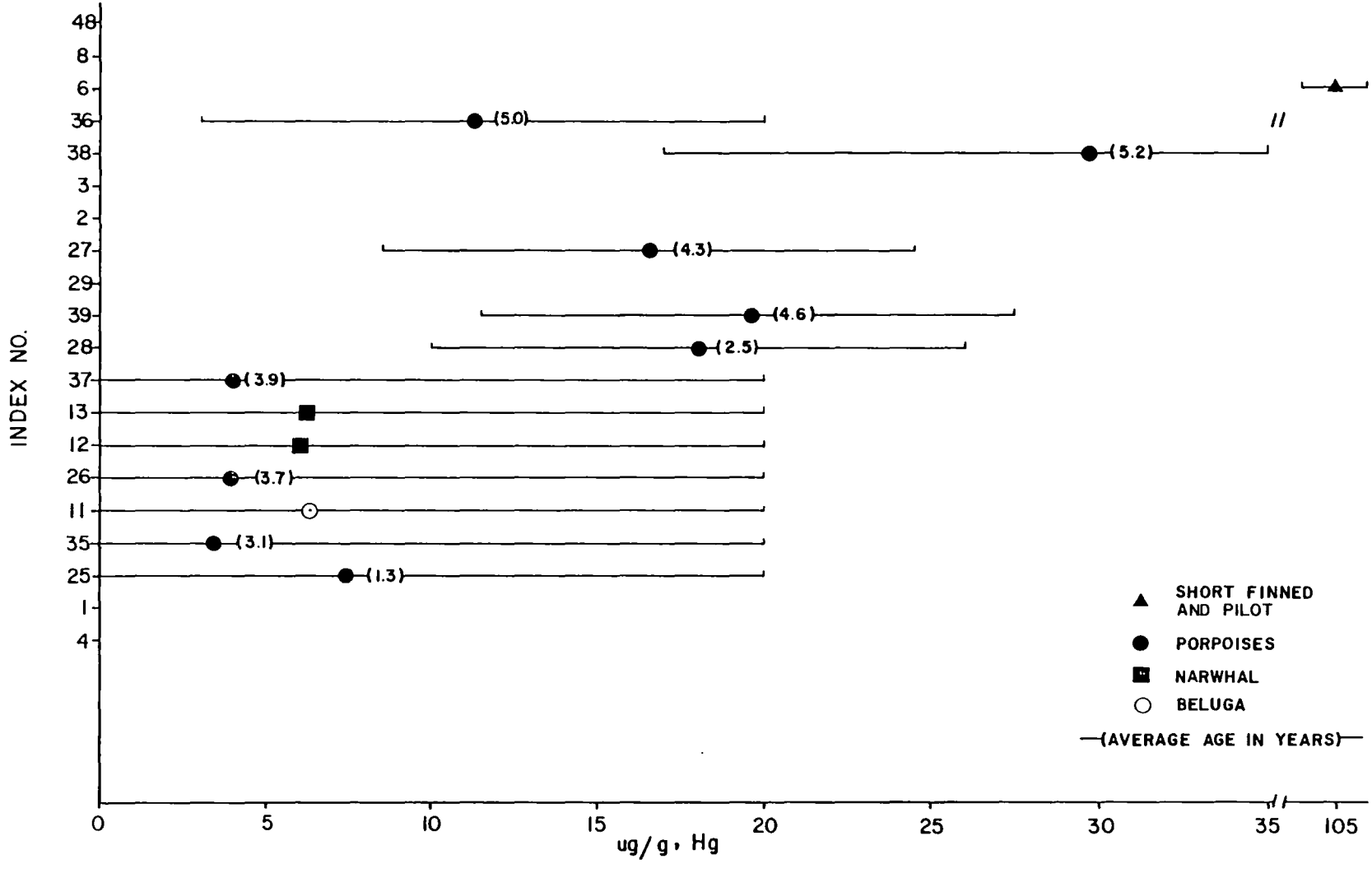

Figure 1. Mercury in liver of cetaceans.

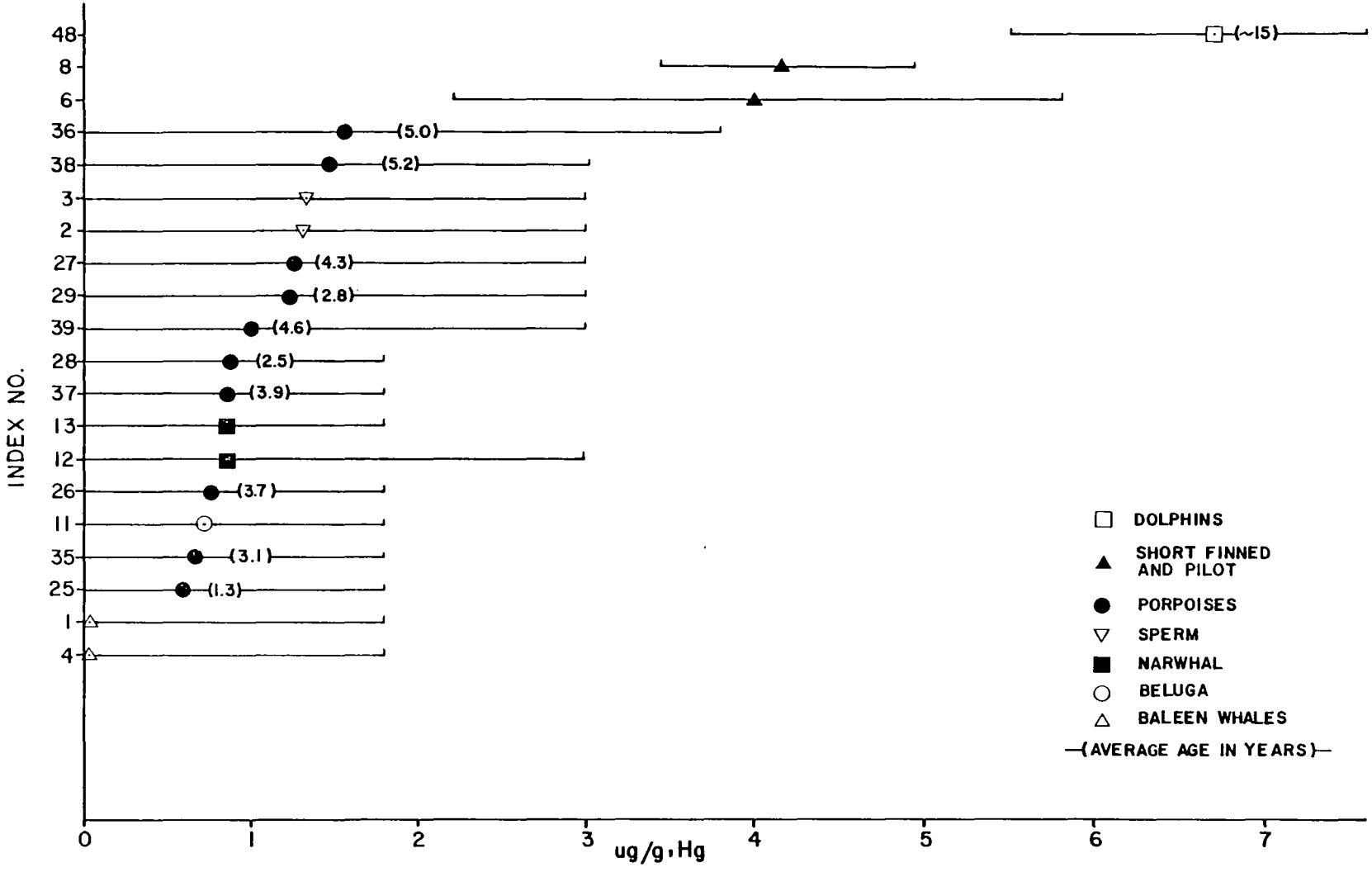

Figure 2. Mercury in muscle of cetaceans.

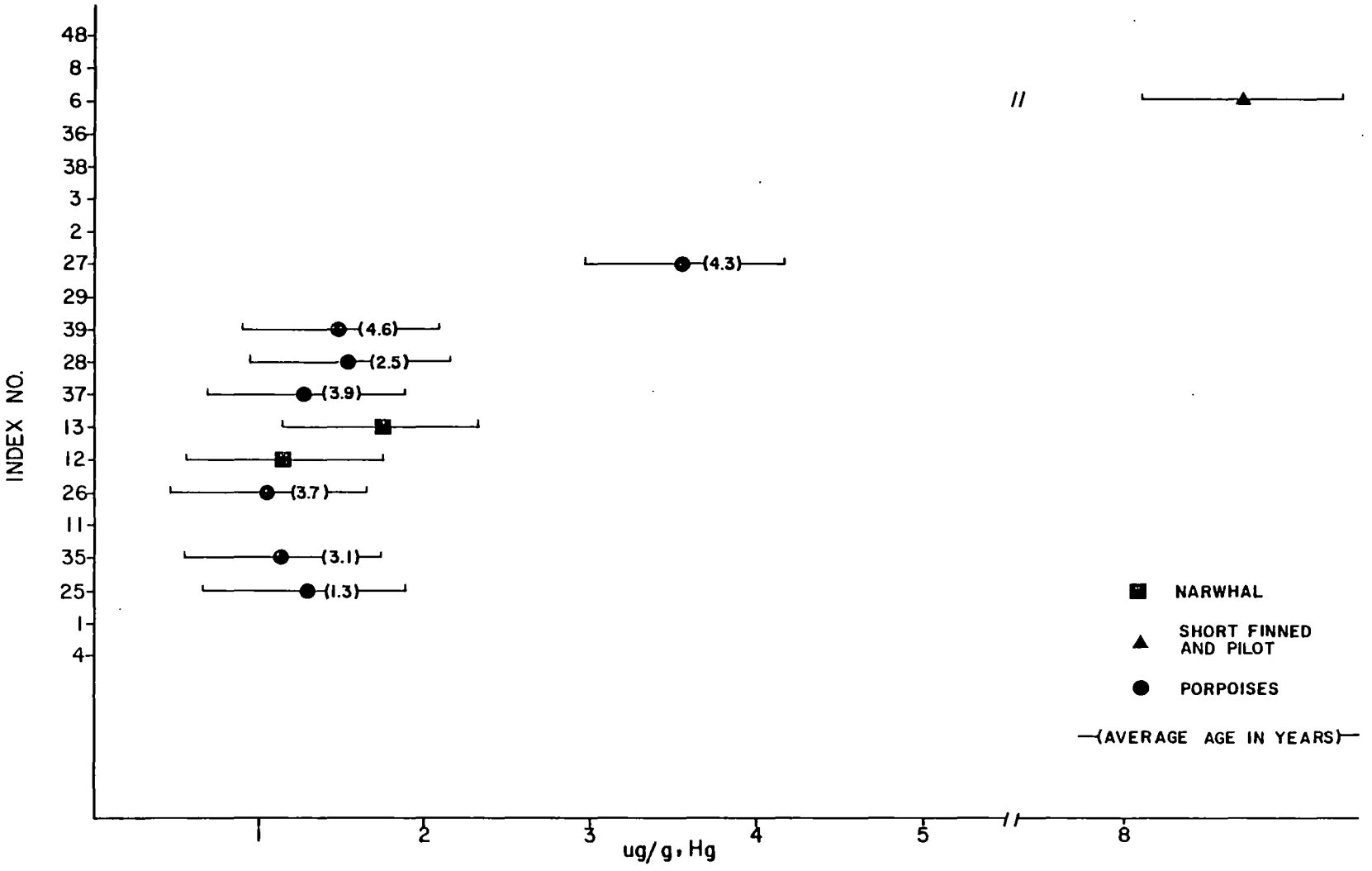

Figure 3. Mercury in kidney of cetaceans.

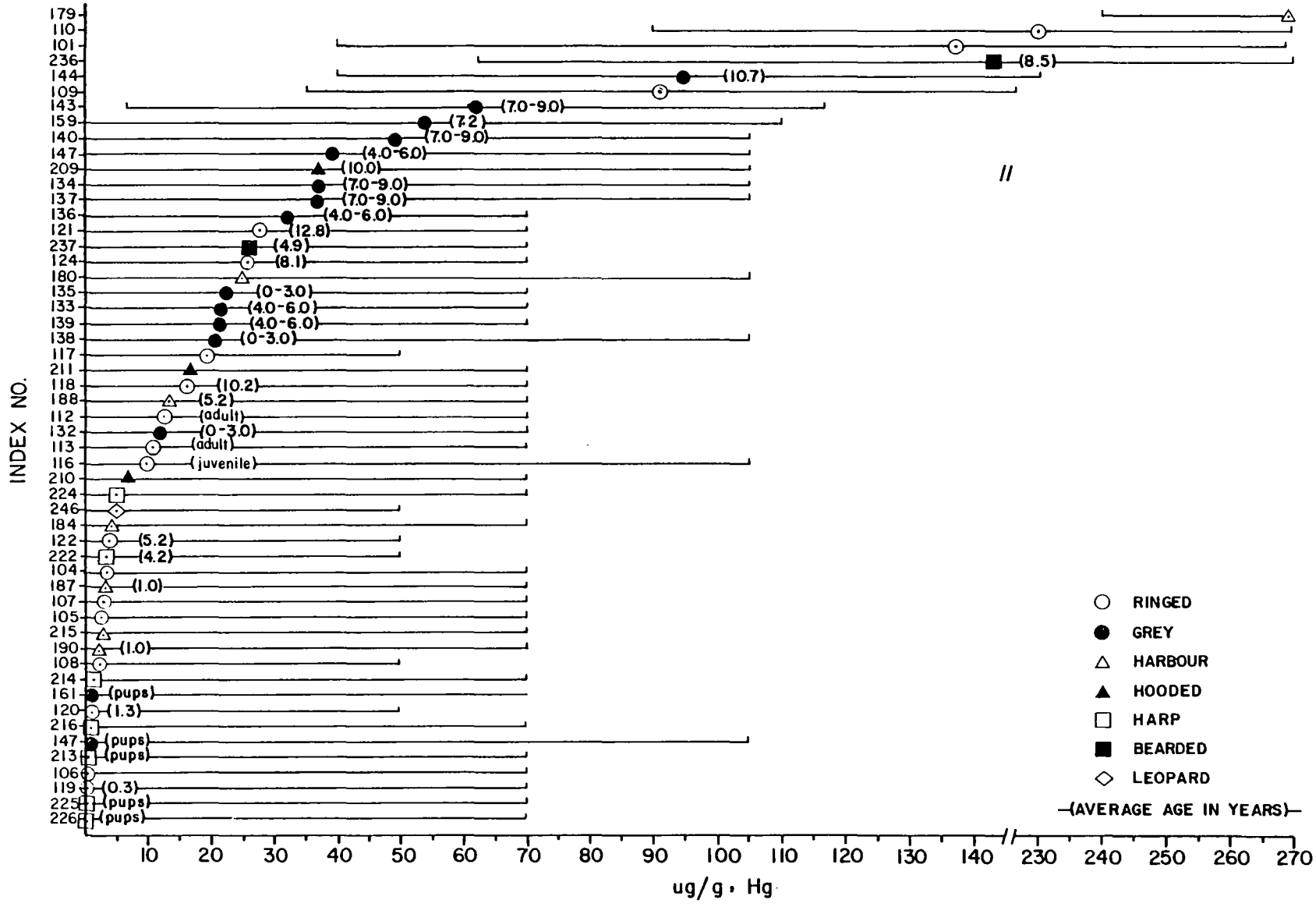

Figure 4. Mercury in liver of seals.

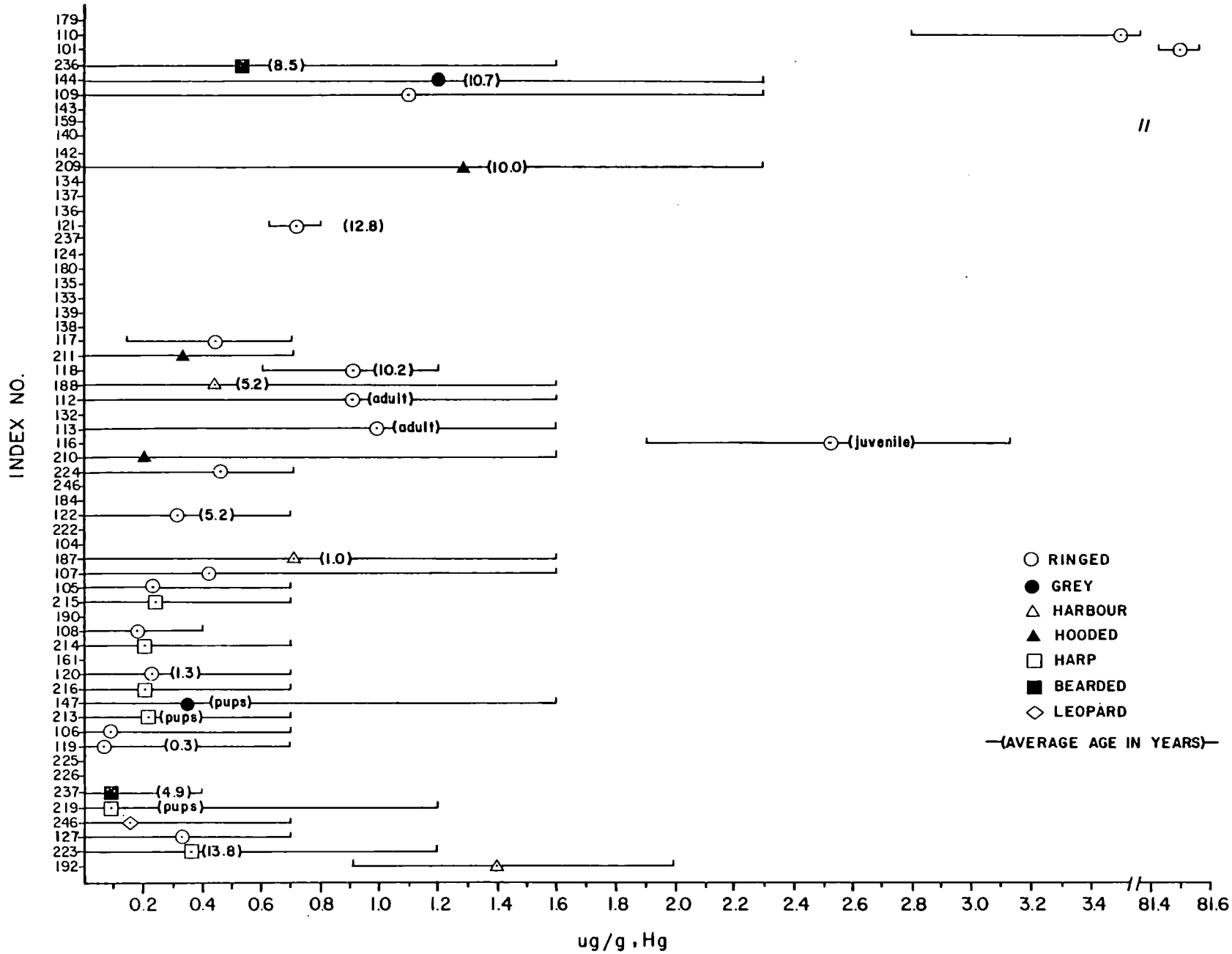

Figure 5. Mercury in muscle of seals.

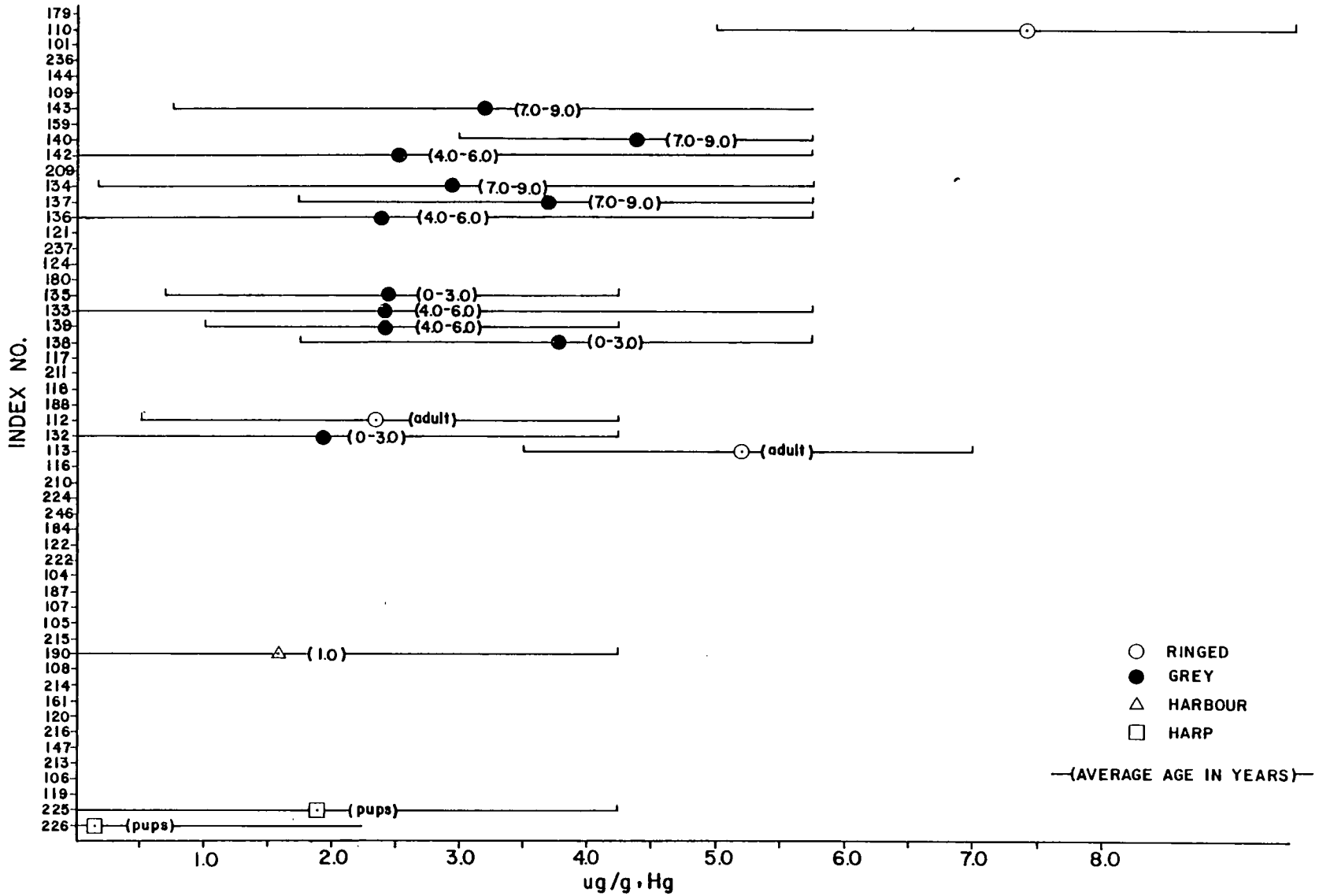

Figure 6. Mercury in kidney of seals.

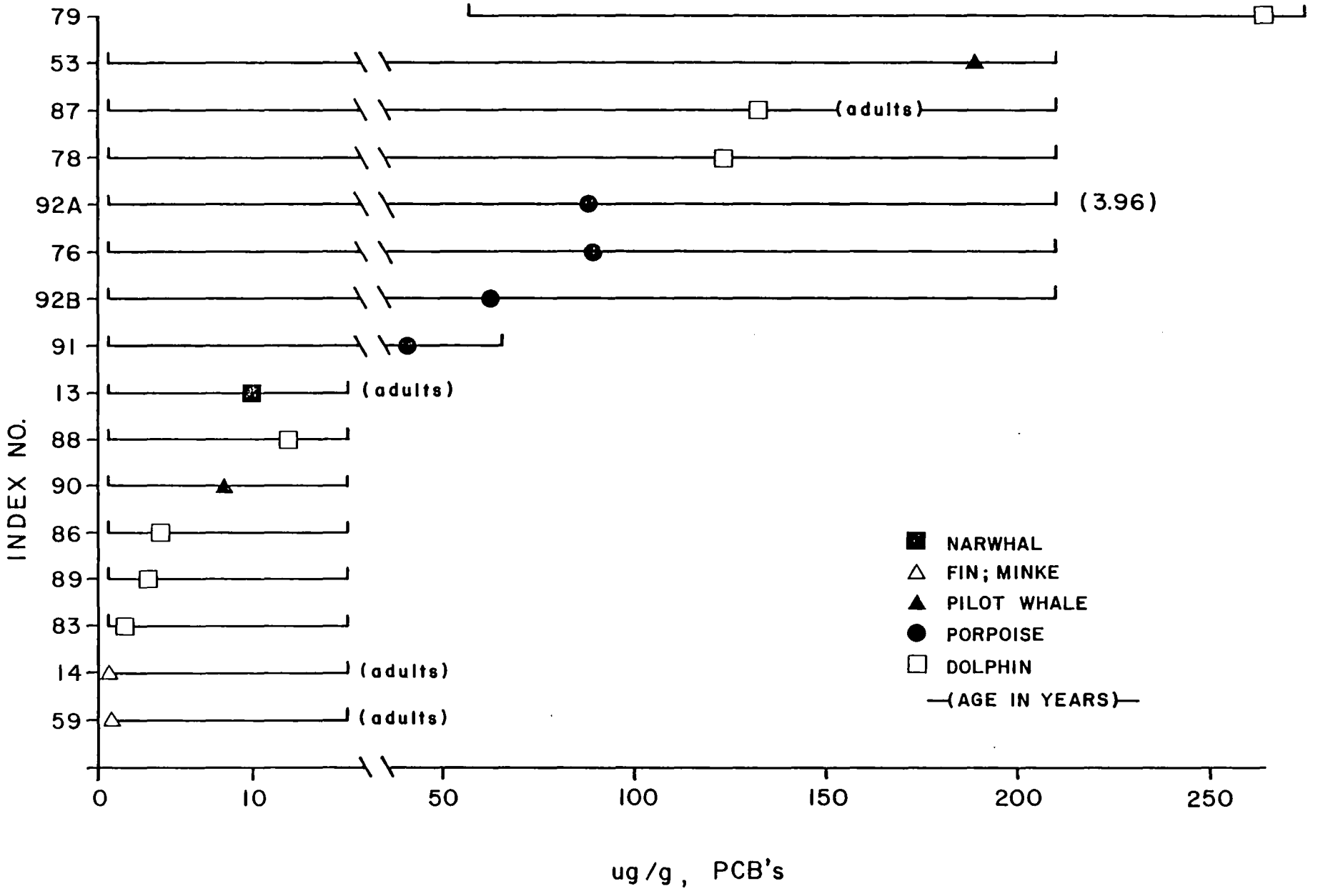

Figure 7. PCB's in cetaceans (blubber).

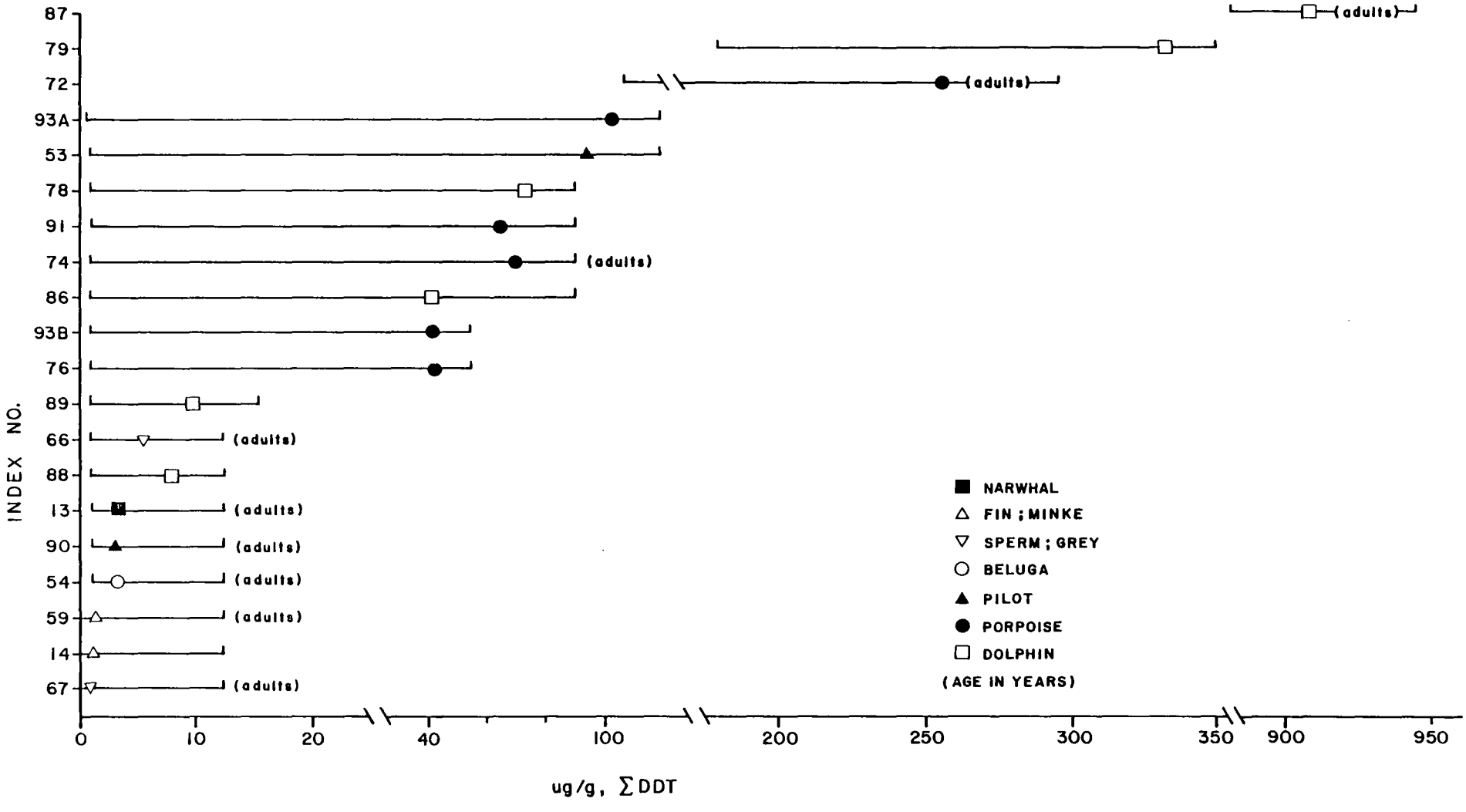

Figure 8. ΣDDT in cetaceans (blubber).

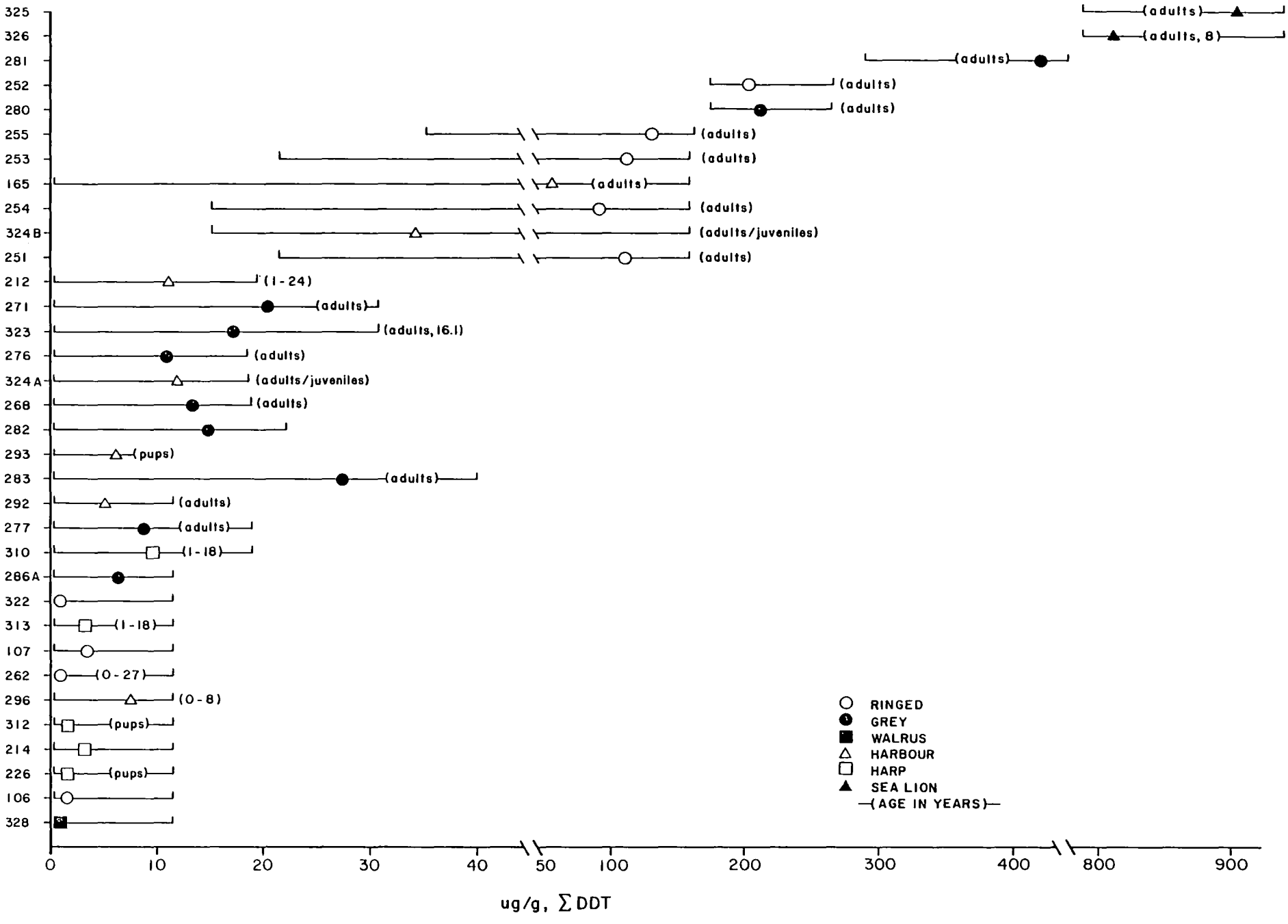

Figure 9. ΣDDT in pinnipeds (blubber).

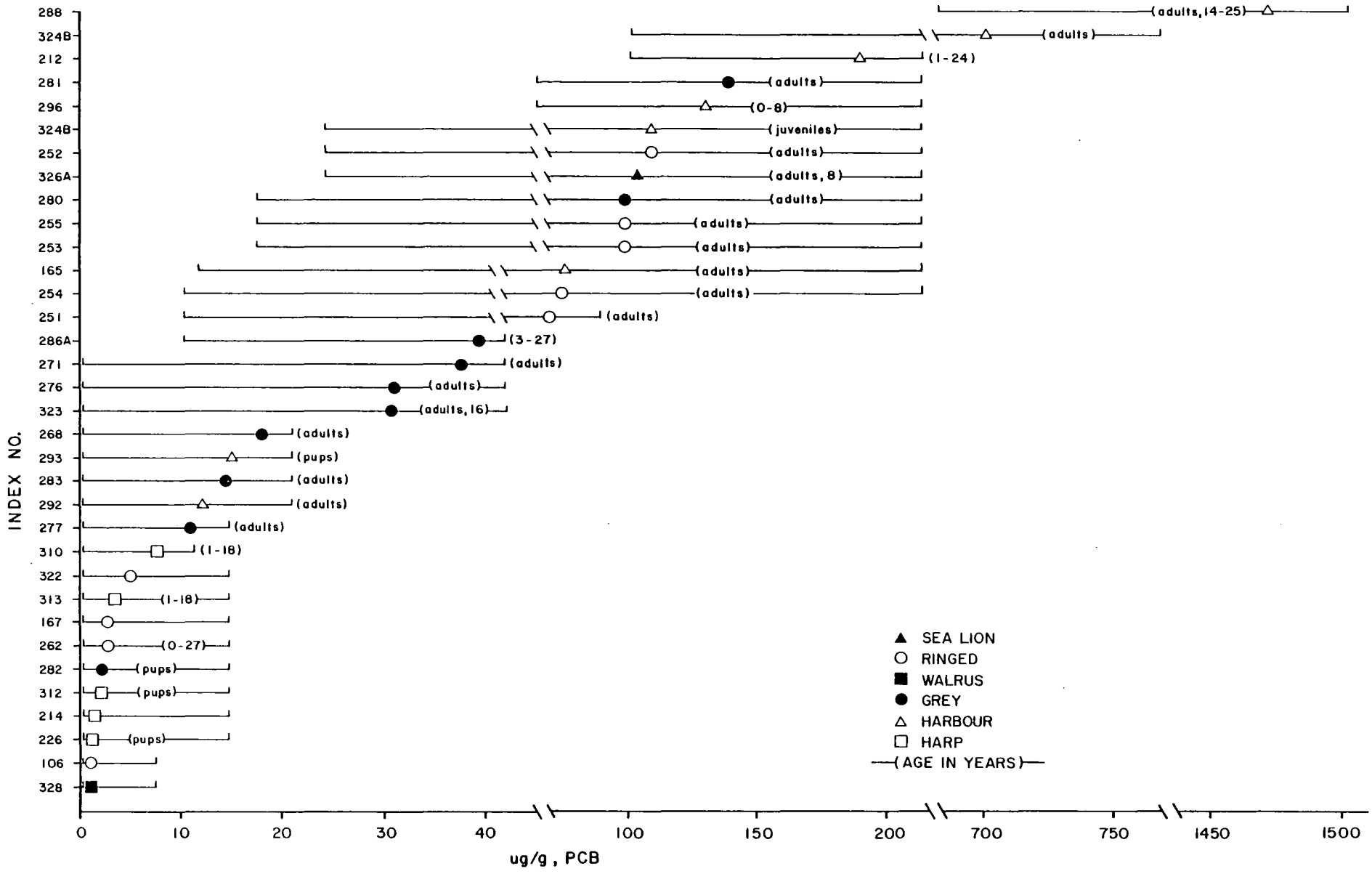

Figure 10. PCB in pinnipeds (blubber).

APPENDIX

Statistical Treatment

Scheffé's multiple comparison of means method is based on the formula:

$$(\overline{Y}_i - \overline{Y}_{i+x}) = \pm S[MSE(1/n_i + 1/n_{i+x})]^{1/2}$$

where "i" is the running index for the k groups (means) being compared, and x is an incremental integer from 1 - k-1.

$$S = [(k - 1)\, F_{k-1,n-k,\,1-\alpha}]^{1/2} \text{ , and}$$

$$MSE = \frac{\sum_{i=1}^{k}\sum_{j=1}^{ni} Y_{ij}^2 - \sum_{i=1}^{k} n_i(\overline{Y}_i)^2}{(n - k)}$$

where "j" is the running index within a group, and "Y_{ij}" is an individual observation. When the interval (1st eq.) does not contain zero, the null hypothesis H_0: $u_i = u_{i+x}$ is rejected.

Individual observations "Y_{ij}" were not available. However, MSE can be expressed in terms of the k estimates of individual variances S_1^2, S_2^2, ... S_k^2 namely,

$$MSE = \frac{[(n_1-1)S_1^2 + (n_2-1)S_2^2 + \ldots + (n_k-1)S_k^2]}{(n_1 + n_2 + n_3 + \ldots\ldots + n_k - k)}$$

which was the formula used to obtain MSE from the given standard deviations. If the standard deviations were not given but the range (w) and number of samples (n) were, the standard deviation was estimated from f(w), where "f" is a multiplication factor appropriate for the given number of samples, and obtainable from statistical handbooks, e.g. Beyer (1966) p. 271.

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