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Composition of the Edible Portion of Raw (Fresh or Frozen) Crustaceans, Finfish, and Mollusks. III. Microelements

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ABSTRACT—This report summarizes data from 224 publications referring to the microelements found in the flesh of commonly eaten seafoods. These microelements are: Copper, iron, zinc, iodine, manganese, mercury, organic mercury, lead, arsenic, fluorine, silver, cadmium, cobalt, selenium, chromium, vanadium, tin, aluminum, nickel, barium, and molybdenum.

INTRODUCTION

In Part I of this series, Sidwell et al. (1974) described the data bank being established at the Southeast Fisheries Center of the National Marine Fisheries Service, NOAA, and outlined the system that would be employed for management and retrieval of the data.

The objectives of the data bank are: 1) To develop a comprehensive, systematic data retrieval system containing information on the chemical and nutritional composition of seafoods; 2) to publish information on the nutrients in fishery products (by surveying the literature); and 3) to point out aspects of the chemical composition of fish needing further investigation. Part I also summarized the data on the content of protein, fat, moisture, ash, carbohydrates, energy (calories), and cholesterol in commonly eaten seafoods.

In Part II, Sidwell et al. (1977) reviewed the data on the concentrations of sodium, potassium, calcium, phosphorus, chlorine, and magnesium found in edible portions of seafoods.

Part III summarizes the available data on the concentrations of various microelements (trace elements) in seafood. There is a need for such information in the medical community, e.g., in the evaluation of nutritional aspects and in the calculation of special diets. There is also a need for such data in the fishing industry, because high contents of certain microelements in fishery products may cause public health concern or invoke legal restraint of the products' sale. The nutrition-conscious consumer also wants to be aware of the positive nutritional aspects of the fish he or she buys, as well as the possible contamination.

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RESULTS AND DISCUSSION

In this report, Part III, we assembled data from 224 references on microelements found in 167 different species of the most commonly eaten fish and shellfish. These microelements are: Copper, iron, zinc, iodine, manganese, mercury, organic mercury, lead, arsenic, fluorine, silver, cadmium, cobalt, selenium, chromium, vanadium, tin, aluminum, nickel, barium, and molybdenum.

The averages and ranges for each microelement were calculated from the data reported by various investigators. These data may have been in the form of an average based on multiple determinations, or they may have been reported as individual values for which an average could be calculated. Regardless, only the averages were used to calculate the overall averages in Tables 1, 2, and 3. With the overall average and range is the number of averages used in the calculation of the two statistics.

Sometimes the average appears as 0.0 ppm (Tables 1, 2, and 3). This means the investigator either reported no detectable amount or the amount was less than 0.05 ppm; therefore, to fulfill the criteria set up for the format of the tables the figure was rounded off to 0.0.

Only a limited number of analyses are available for many species of fish and shellfish listed in Tables 1, 2, and 3. Also, a number of species of commonly caught fish have not been analyzed for microelement content. Whenever the information for a specific fish or element is limited, the listed value should be regarded only as an estimate of what can be expected. More data are necessary to obtain a value which possesses a notable degree of reliability.

Excellent and reliable data on the microelement content in the flesh of commercially important species harvested from the coastal waters of the United States, Hawaii, and Alaska, can

be noted in Hall et al[1]. The data reported were generated over a period of 5 years at the Southeast Fisheries Center's College Park Laboratory of the National Marine Fisheries Service. None of those data are included in this report. However, the publication by Hall et al. does not fully fill the gaps that are evident in this summary.

The literature we researched contains minimal information on: 1) The physiological need for microelements in fish muscle; 2) the physiological interrelationships between the elements; and 3) how much of an element can be expected to be naturally present in the fish muscle.

In Tables 1, 2, and 3 the range of values for each element in the flesh of the same species of animal is sometimes quite large. A portion of this variation is undoubtedly associated with seasonal and biological differences, i.e., the animal's size, age, sex, degree of sexual maturity, and elements present in its diet. Some of the variation may be related to the technique used in preparing the sample before it is analyzed or the method of analysis used by the investigator. High figures in some cases may reflect environmental contamination.

In Table 1, mercury and organic mercury are the only elements that are of public health concern. The Food and Drug Administration (FDA) has set a guideline for maximum acceptable mercury content of foods at 0.5 ppm. With the exceptions of burbot, cuttlefish, goby, perch, shark, stargazer, swordfish, and weever, the mercury contents reported here fall within the limits of the guideline.

The other elements listed in Table 1—copper, iron, zinc, iodine, and manganese—are of known nutritional importance. A 100-g portion (approximately 3½ ounces) of raw flesh will often make a significant contribution to the daily requirement for the elements.

In Table 2 the following elements may be of public health concern: Lead, arsenic, fluorine, cadmium, and selenium. Historically, they are known to be toxic to humans and terrestrial animals if the dietary intake is excessive. Yet, small amounts of fluorine and selenium are nutritionally important. Fluorine plays an important role in preventing dental caries in children and in maintaining the rigidity of the bones of the elderly. Selenium is the metallic component of an enzyme, xanthine oxidase, which plays a role in protein metabolism. No such nutritional need has been observed for lead, arsenic, or cadmium. Certain mollusks—mactra clams, oysters, and whelks—contain more lead than other species of sea animals. Arsenic is also present in varying amounts in the flesh of many finfish and shellfish. The elemental state of arsenic is known to be more toxic to humans than the organic forms. The possible function of arsenic in marine life is not known. Cobalt, also listed in Table 2, is important as an integral part of the vitamin B_{12} molecule. Since vitamin B_{12} is not concentrated in animal flesh, a low content of cobalt is expected.

The data for the metals listed in Table 3 are based on too few species for any conclusions to be drawn. Nutritionally, there are indications that chromium, vanadium, and tin are important food constituents for the maintenance of good health. More extensive research needs to be conducted in reference to these metals and their requirement by humans. Aluminum is found universally in all plants and animals.

The data for each species of finfish, crustaceans, and mollusks were obtained from the bibliography listed in Table 4.

The literature review summarized in this report will provide the medical community with an estimate of the content of various microelements found in seafood for the calculation of special diets involving minerals needed or to be avoided by the patients. It will help make the fisherman and processor aware of possible contamination in certain species of fish, which may present marketing difficulties. The information reported on the nutritional value of many of the elements seen to be present in seafood will be useful to those concerned with consumer education.

[1]Hall, R.A., E.G. Zook, and G.M. Meaburn. 1978. National Marine Fisheries Service survey of trace elements in the fishery resource. U.S. Dep. Commer., NOAA Tech. Rep. NMFS SSRF-721, 313 p.

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(Literature citations continue on page 17.)

Table 1.—Composition of the edible portion of raw (fresh or frozen) crustaceans, finfish, and mollusks. III Microelements: Copper, iron, zinc, iodine, manganese, mercury, and organic mercury.

	Copper	Iron	Zinc	Iodine	Manganese	Mercury	Organic mercury
				ppm			
Abalones Haliotidae	24.1	23.5 7.9-30.0 5	9.7 0.8-21.10 3	1.1	0.5		
Anchovies Engraulidae	2.9 0.8-5.0 2	19.8 8.1-49.0 9	15.0		0.4 0.0-0.7 2	0.1 0.0-0.3 6	0.1
Argentines Argentinidae							0.0
Barracudas Sphyraenidae		6.8 1.1-12.7 6	2.1	0.3			
Basses, sea Serranidae	1.2 0.0-4.0 8	12.3 1.9-41.0 18	18.0 1.4-50.0 3	0.2 0.1-0.4 4	0.4 0.0-1.1 4		
Basses, temperate Percichthyidae		13.1 4.2-22.0 2	2.7	0.4 0.4-0.5 2	0.3	0.3 0.1-1.0 7	0.9
Batfishes Ogeocephalidae		11.0					
Beardfishes Polymixiidae	2.5						
Billfishes Istiophoridae		4.7 1.4-8.0 2	0.8		2.4 0.1-4.8 5		0.9
Bluefishes Pomatomidae	0.2 0.2-0.3 2	22.7 6.0-52.0 3		0.3 0.3-0.4 3	0.0 0.0-0.0 2		
Bombay ducks *Harpodon nehereus*		43.3 12.0-105.0 3					
Bowfins Amiidae				0.0		0.4	
Burbots Lota				0.8		5.1 0.1-21.9 7	
Butterfishes Stromateidae		67.4 9.0-122.3 6		0.1			
Butterflyfishes Chaetodontidae		8.8 4.6-11.0 3	7.8		0.0		
Caesios Caesionidae		6.0 5.1-6.9 3					
Catfishes, airbreathing Clariidae	1.5	10.0 4.8-19.0 4			0.0		
Catfishes, airbreathing Heteropneustidae	4.8 1.5-8.0 3	26.0 22.6-31.0 2					
Catfishes, freshwater Ictaluridae	1.1 0.6-1.7 4	14.7 3.6-26.9 10	0.0 11	1.0	0.6	0.2 0.0-0.5 11	0.4 0.2-0.5 3
Catfishes, sea Ariidae	0.6	33.3 4.8-63.7 10	0.1 0.1-0.2 2	0.1 0.0-0.2 2	0.0		
Cavefishes Amblyopsidae		5.2					
Characins Characidae		14.7					
Chubs, sea Kyphosidae	0.0	10.0			0.0		

Table 1.—continued.

	Copper	Iron	Zinc	Iodine	Manganese	Mercury	Organic mercury
				ppm			
Cichlids Cichlidae		18.0 4.0-32.0 2					
Clams, arkshell Arcidae		57.1					
Clams, donax Donacidae	0.7						
Clams, freshwater Mixed species			30.0		10.0		
Clams, mactra Mactridae	0.9 0.7-1.1 2				0.2	0.1 0.0-0.2 3	
Clams, razor Solenidae		42.2 5.0-110.0 8	77.0	1.4		0.1	
Clams, softshell Myacidae	2.5			45.5 1.1-90.0 2			
Clams, tellin Tellinidae		86.0					
Clams, Venus Veneridae	4.3 0.0-19.2 10	59.6 16.0-130.0 12	27.5 5.1-77.0 11	0.8 0.2-1.4 5		0.1 0.0-0.3 18	
Cockles Cardiidae		43.3 28.0-78.0 4			1.8 1.6-2.0 2	0.0 0.0-0.1 2	
Cods, Atlantic *Gadus morhua*	0.3				0.1 0.0-0.2 7		0.0 0.0-0.0 3
Cods *Gadus* sp.	3.3 0.2-5.5 7	8.9 3.4-42.9 9	31.3 9.0-52.5 3	1.0 0.2-5.0 10	0.2 0.0-0.5 7	0.2 0.0-0.8 9	1.0
Codfishes Gadidae	2.6 1.1-19.4 24	8.1 3.4-42.9 31	17.0 2.8-52.5 12	1.5 0.1-6.0 26	0.2 0.0-0.6 16	0.2 0.0-0.8 49	0.0 0.0-0.0 10
Crabs Mixed species	9.2 0.1-50.7 28	21.9 2.5-61.0 22	41.3 14.0-93.6 18	1.2 0.1-4.6 11		0.2 0.1-0.5 6	0.1 0.0-0.1 2
Crayfishes Mixed species	20.4 0.1-167.0 18	47.3 4.4-373.0 11	27.0 1.5-66.0 13	1.0 0.3-1.4 4	1.5 0.1-4.2 7	0.2 0.0-0.5 11	0.1
Cusk eels and brotulas Ophidiidae	1.2 1.0-1.4 2	7.2 5.0-9.4 2	6.0				
Cutlassfishes and hairtails Trichiuridae	1.7 1.0-2.3 2	35.0 6.0-138.7 5	5.0	0.1			
Cuttlefishes Mixed species	4.2	30.0 11.0-49.0 2			1.1	2.7 0.9-5.1 3	
Dolphins Coryphaenidae		17.0		0.2		0.2 0.1-0.3 2	0.3
Dories Zeidae	0.0	10.0			0.0	0.2 0.1-0.3 2	
Drepanes Drepanidae		5.0 4.0-7.0 3					
Drums Sciaenidae	0.9 0.1-2.1 7	17.4 0.8-79.2 27	3.6 0.7-7.6 6	0.2 0.0-0.6 9		0.2 0.1-0.4 7	

Table 1.—continued.

	Copper	Iron	Zinc	Iodine	Manganese	Mercury	Organic mercury
				ppm			
Eels, conger Congridae	2.0 0 0-6.0 5	12.8 5.0-40.0 7	8.8 8 7-9.0 2		0.1 0.0-0.3 2	0.4 0.1-0.7 5	
Eels, freshwater Anguillidae	0.9 0.2-1 7 3	18.6 5.0-54.4 6	18 1 6.2-30.0 2	0 8	0.3 0.3-0.3 2	0 7 0.1-3.1 13	0.4 0 2-0.6 5
Eels, moray Muraenidae		4.8					
Eels, pike conger Muraenesocidae	0.3	13 6 0 8-42.4 5	0.6				
Eels, snake Ophichthidae	1.5 0.4-3.8 4	96.6 2.9-350.0 11	5.5 5.4-5.7 2		0.0	0.2 0.2-0 3 2	
Eels, snipe Nemichthyidae						0.0	
Eels, spiny Notacanthidae	0.0	258.4 4.3-512 5 2					
Eels, swamp Flutidae		22.0					
Eelpouts Zoarcidae	2.4	9.4				0.0 0 0-0 0 2	
Featherbacks Notopteridae		83.8 4.2-225.0 6				1.7	
Flatheads Percophididae		7.5 1.2-13.0 4	1.3	0.2	0.2 0 0-0.4 2		
Flounders Bothidae	0.6 0.1-1.2 2	5.1 3.3-6.9 4	3.1	0.2	0.2 0 2-0.3 2	1.8	
Flounders Pleuronectidae	1.7 0.1-7.0 16	7.9 0.4-22.0 26	4.6 0.8-14.2 9	0.4 0.1-1 0 19	0.4 0.0-1.8 9	0.2 0.0-0.8 27	0.0 0.0-0.1 5
Flyingfishes and halfbeaks Exocoetidae	0.0	10.3 5.1-14.5 5			0.1 0.0-0.1 3	0.3	
Gars Lepisoteidae	1.0	7.0	5.0	0.0		0.2 0.2-0.3 4	
Gillrakers Chirocentridae		34.0					
Goatfishes Mullidae		8.8 5.1-11.0 4			0.0	0.1 0.1-0.1 3	0.1
Gobies Gobiidae	2.2 0.3-4.0 2	19.4 1.0-82.4 11	6.0	0.1	0.0	1.5 0.2-2.8 2	
Goosefishes Lophiidae		12.5 10.0-15.0 2				0.7 0.2-1.3 2	0.1
Greenlings Hexagrammidae	4.1	4.9 0.2-9.6 2	0.3	0.2 0.1-0.2 2	0.3	0.3 0 1-0.4 4	
Grenadiers Macrouridae	4.0	9.0	6.0				
Grunts Pomadasyidae	0 8 0.0-1.6	11.7 1.0-22.5 8	29.7 8.4-51.0 2				

Table 1.—continued.

	Copper	Iron	Zinc	Iodine	Manganese	Mercury	Organic mercury
				ppm			
Guitarfishes Rhinobatidae	0.6	2.6	2.0 1.0-3.0 2		0.3		
Gurnards, flying Dactylopteridae	0.1	14.2 10.0-18.0 4	0.9		0.0	0.5	
Haddocks *Melanogrammus aeglefinnus*	1.5 0.1-2.4 10	8.5 3.5-14.0 12	7.8 2.7-17.4 3	3.1 0.3-6.0 8	0.2 0.2-0.2 2	0.1 0.0-0.2 9	0.0 0.0-0.0 2
Hakes *Merluccius* sp.	0.1 0.1-0.1 2	7.9 5.0-11.6 3	19.0 8.0-30.0 2		0.2 0.1-0.3 2	0.3 0.1-0.5 10	0.0
Herrings Clupeidae	1.7 0.1-2.3 4	10.9 0.0-31.2 13	1.7	0.2 0.0-0.5 5	0.1 0.0-0.2 3	0.2 0.1-0.3 4	0.1
Jacks and pompanos Carangidae	0.4 0.0-1.1 6	17.3 0.1-82.1 37	3.7 0.0-9.0 7	0.3 0.1-0.6 6	0.3 0.0-0.5 6	0.2 0.1-0.8 5	0.1
Lampreys Petromyzontidae		9.0				0.4 0.1-1.1 3	
Lanternfishes Myctophidae						0.0 0.0-0.1 2	
Lings Molva		6.7 5.0-8.0 3		2.1 1.2-3.0 3		0.1	
Lizardfishes Synodontidae		3.5 0.2-6.0 3	0.4				
Longarays Ambassidae		5.4					
Lumpfishes and snailfishes Cyclopteridae		14.0				0.0	
Mackerels *Scomber* sp.	0.9 0.3-2.0 4	29.3 0.7-84.9 7	1.0	0.4 0.1-1.0 8	0.0	0.1 0.0-0.3 5	
Mackerels *Scomberomorus* sp.	0.5	16.1 0.6-40.2 8	1.9 0.6-3.2 2	0.2 0.1-0.4 3	0.0	0.6 0.1-1.1 2	
Mackerels and Tunas Scombridae	1.4 0.0-3.4 14	23.5 0.7-84.9 55	1.2 0.2-3.2 5	0.4 0.1-1.0 21	0.2 0.0-0.5 8	0.4 0.0-1.4 64	0.5 0.4-0.5 3
Milkfishes Chanidae		7.1 3.2-11.0 2				0.0	
Minnows and carps Cyprinidae	2.2 0.5-6.1 13	16.0 5.0-56.0 17	35.0 10.0-60.0 2	0.9 0.0-3.1 10	0.6 0.0-2.3 7	0.3 0.1-0.9 13	0.5 0.1-1.1 6
Mojarras Gerreidae		4.2 4.0-4.4 2					
Mooneyes Hiodontidae						0.2 0.1-0.3 4	
Mullets Mugilidae	1.0 0.0-2.1 9	27.1 1.0-250.0 25	3.3 0.8-5.3 4	1.9 0.1-4.9 6	0.0 0.0-0.0 2	0.1 0.0-0.2 6	0.1
Mussels Mytilidae	2.2 0.2-3.6 6	76.7 10.0-127.0 5	33.7 20.0-44.8 4	1.4 0.8-1.9 2	2.3 0.0-4.6 4	1.5	

Table 1.—continued.

	Copper	Iron	Zinc	Iodine	Manganese	Mercury	Organic mercury
				ppm			
Needlefishes Belonidae	4.2	11.3 9.8-14.0 3		1.9			
Nemipterids Nemipteridae		3.3 1.4-5.5 3	1.0				
Octopuses Mixed species		14.7 0.9-2.5 3	16.2	0.2	0.1	0.3 0.3-0.4 2	
Oysters Ostreidae	79.3 0.3-606.0 52	54.8 8.9-101.6 27	844.0 71.0-2000.0 31	0.6 0.1-1.3 19	3.3 0.1-6.5 14	0.1 0.0-0.2 9	
Parrotfishes Scaridae						0.1	0.1
Perches Percidae	1.7 0.0-3.7 6	7.6 4.8-10.0 4	12.0	0.0 0.0-0.0 3	0.2 0.0-0.4 5	1.2 0.1-15.7 56	0.6
Perches, climbing Anabantidae	1.3 1.0-1.6 2	18.6 3.4-76.0 7					
Periwinkles Littorinidae				0.8	28.4		
Picarels Centracanthidae						0.3	
Pikes Esocidae	2.0 0.7-3.4 9	7.5 0.4-43.1 10	13.2 4.0-19.0 4	0.3	1.0 0.2-3.2 8	1.7 0.0-15.2 36	1.1 0.8-1.4 3
Pomfrets Bramidae	1.6 1.4-1.8 2	16.4				0.2	
Porgies Sparidae	0.1	8.2 1.6-19.0 13	1.2 1.0-1.6 3	0.3 0.3-0.4 3	0.0	0.3 0.1-0.4 9	
Prawns Mixed species	77.2 0.1-110.3 14	51.6 9.5-135.0 35				0.3 0.1-1.0 9	
Puffers Tetraodontidae		6.0					
Rabbitfishes Seganoidae		4.9 4.9-5.0 2					
Rays, eagle Myliobatidae	0.7	53.0	1.8			0.3	
Rays, electric Torpedinidae	3.5	57.0	57.0				
Rays, sting Dasybatidae		21.8 5.0-61.5 4					
Sablefishes Anoplopomatidae	1.2	12.0		0.5 0.4-0.6 3		0.1	0.1
Salmons, Australian Arripiddae	0.1 0.0-0.1 3	10.0 10.0-10.0 3					
Sandfishes Trichodontidae		15.0					
Saurles Scomberesocidae		22.6 8.0-30.0 3				0.0	
Sawfishes Pristidae		12.0					

Table 1.—continued.

	Copper	Iron	Zinc	Iodine	Manganese	Mercury	Organic mercury
				ppm			
Scallops Pectinidae	1.6 0.1-3.1 7	19.0 10.0-30.0 4	23.3 17.0-29.5 2	0.2 0.2-0.2 2	8.3 0.0-39.0 5	0.0 0.0-0.1 5	0.0
Scombrops boops		10.0					
Scorpionfishes and Rockfishes Scorpaenidae		5.0 5.0-5.0 2	2.8	0.5 0.0-1.5 10		0.5 0.1-1.2 5	
Sculpins Cottidae							0.1 0.0-0.1 2
Sea cucumbers Mixed species	28.0	22.0 2.9-82.0 6			4.0		
Sea Robins Triglidae				1.2			
Sharks, cat Scyliorhinidae					6.1	1.3 0.7-1.9 2	
Sharks, dogfish Squalidae	1.0	13.2 11.5-15.0 2	5.2	2.6		0.8 0.4-1.2 7	0.1
Sharks, hammerhead Sphyrnidae	0.6 0.5-0.8 2	27.0 9.2-44.8 2	2.9 2.1-3.8 2			0.9 0.6-1.3 3	
Sharks, mackerel Lamnidae						1.2 0.1-2.1 3	
Sharks, requiem Carcharhinidae		19.2 8.4-45.3 13	24.6 2.8-66.0 3		0.5 0.0-1.1 3	0.7 0.1-1.5 8	
Sharks, sand tiger Odontaspididae		13.6 12.5-14.3 3			0.2		
Sharks, whale Rhincodontidae		8.0					
Sheathfishes Siluridae	.09	10.0					
Shrimps Mixed species	4.6 0.1-13.1 9	20.2 7.0-40.0 22	19.3 7.4-42.0 7	0.7 0.2-1.5 7	0.7 0.0-1.9 4	0.2 0.0-0.5 12	
Silversides Atherinidae		40.0 7.0-73.0 2					
Skates Rajidae	0.4 0.1-0.7 2	12.0 10.0-14.0 2	5.8 3.0-9.8 3	0.2	0.0	0.4 0.2-0.8 3	0.1
Sleepers Eleotridae	3.8	15.2 4.3-26.0 2			0.0		
Smelts Osmeridae	0.8	28.5 4.1-50.0 5	20.0	0.2 0.0-0.3 2	0.1	0.0 0.0-0.1 8	
Smelts, deep sea Bathylagidae						0.4	
Snails Mixed species	23.4 4.0-62.2 3	71.3 41.0-86.9 3	25.0	0.1	16.8 16.0-17.6 2		
Snake Mackerels Gempylidae	0.1	10.0		0.2	0.0		
Snappers Lutjanidae	0.7 0.0-1.6 4	22.8 4.0-75.9 8	2.3	0.3 0.3-0.3 3	0.1 0.0-0.1 2	0.4 0.3-0.6 2	

Table 1.—continued.

	Copper	Iron	Zinc	Iodine	Manganese	Mercury	Organic mercury
				ppm			
Snooks Centropomidae		11.2 2.7-41.3 9			0.0 0.0-0.0 2		
Soapies Leiognathidae		7.8 7.0-10.0 4					
Soles Soleidae	0.0	7.3 1.8-10.0 3	0.8	0.0		0.1 0.1-0.3 8	
Spadefishes Ephippidae	0.1	11.8 7.0-20.0 5			0.0		
Squids Mixed species	10.9 2.9-15.0 3	32.0 5.0-185.6 11	23.8 7.6-84.0 6	0.2	0.6 0.2-0.8 3	0.2 0.1-0.3 4	
Squirrelfishes Holocentridae						0.2 0.2-0.2 2	0.2
Stargazers Uranoscopidae						1.3	
Sturgeons Acipenseridae				0.6		0.1	
Suckers Catostomidae				0.0 0.0-0.0 5		0.3 0.0-1.3 13	0.3 0.2-0.4 2
Sunfishes and black basses Centrarchidae	1.4	3.4		0.0 0.0-0.1 5	0.3	0.3 0.0-0.6 21	0.5 0.1-1.1 4
Surfperches Embiotocidae				0.1 0.1-0.1 2			
Surgeonfishes Acanthuridae		5.0 4.9-5.0 2					
Swordfishes Xiphiidae		11.0				0.9 0.2-2.0 25	1.1
Tarpons Elopidae		20.9 3.5-63.0 4	7.6				
Therapons Theraponidae		33.4 5.5-86.0 6					
Threadfins Polynemidae	0.1	16.8 2.0-72.0 12			0.0		
Tilefishes Branchiostegidae		7.2 0.3-14.0 2	0.0				
Tonguefishes Cynoglossidae		12.0				0.8 0.1-2.3 3	
Topshells Trachidae	7.4 6.1-8.7 2						
Triggerfishes and filefishes Balistidae	0.2 0.0-0.6 3	7.0 1.1-10.0 3	1.5		0.0 0.0-0.0 2		
Trouts and salmons Salmonidae	1.7 0.2-4.0 21	11.8 1.5-45.0 27	10.4 1.4-26.0 8	0.5 0.0-4.6 53	0.4 0.1-0.7 7	0.5 0.0-3.3 40	0.6 0.0-1.6 5

Table 1.—continued.

	Copper	Iron	Zinc	Iodine	Manganese	Mercury	Organic mercury
				ppm			
Tunas *Euthynnus* sp.	0.5	40 0	0.2		0.2	0.3 0.2-0.4 9	
Tunas *Thunnus* sp.		27.5 2.7-80.0 9	0.8	0.3 0.2-0.4 3	0.3 0.1-0.5 2	0.5 0.1-1.4 35	0.5 0.5-0.5 2
Viperfishes Chauliodontidae	37.3	32.2 3.5-61.0 2		0.5			
Weevers Trachinidae						2.0	
Whales Mixed species						0.9 0.2-1.7 4	
Whitings Sillagonidae	0.1 0.1-0.2 3	9 8 0 9-22.0 6	7.9 0.6-21.8 4	0.9			0.1
Wolffishes Anarhichadidae				0.9		0.1	0.1
Wrasses Labridae				0.2 0.1-0.3 2			

Table 2. — Composition of the edible portion of raw (fresh or frozen) crustaceans, finfish, and mollusks. III. Microelements: Lead, arsenic, fluorine, silver, cadmium, cobalt, and selenium.

	Lead	Arsenic	Fluorine	Silver	Cadmium	Cobalt	Selenium
				ppm			
Abalone Haliotidae					0.1	0.0	
Anchovies Engraulidae	0.9						
Basses, sea Serranidae		0.8 0.3-1.3 2	0.2		0.1 0.1-0.1 2	0.1	0.4
Basses, temperate Percichthyidae	0.8 0.7-0.9 2	0.4			0.0 0.0-0.0 2		0.4 0.4-0.4 2
Beardfishes Polymixiidae	0.6	0.0					
Bigeyes Priacanthidae						1.0	
Bluefishes Pomatomidae	1.6 0.1-2.3 3						
Burbots Lota	0.9						
Catfishes, freshwater Ictaluridae	0.6 0.6-0.7 2	1.2 0.1-2.2 2			0.1 0.1-0.1 3	0.0	
Chimaeras Chimaeridae		7.0					
Clams, donax Donacidae		2.6					
Clams, mactra Mactridae	4.3 1.2-7.4 2						
Clams, razor Solenidae		3.3					
Clams, softshell Myacidae	0.8	12.7					

Table 2.—continued.

	Lead	Arsenic	Fluorine	Silver	Cadmium	Cobalt	Selenium
				ppm			
Clams, Venus Veneridae	0.8 0.2-2.6 6	2.0 0.9-5.6 8			0.2 0.0-0.6 11	0.3	0.6
Cockles Cardiidae		9.8 2.1-17.6 2				0.4	
Cod, Atlantic *Gadus morhua*	0.3 0.2-0.3 3	2.1 0.9-3.4 3			0.0 0.0-0.1 3		0.8 0.4-1.2 2
Cods *Gadus* sp.		0.6 0.5-0.6 2	3.4 0.7-7.0 3	0.0	0.2 0.1-0.2 2	0.6 0.0-1.2 2	0.4
Codfishes Gadidae	0.5 0.2-1.6 10	2.3 0.3-5.8 11	3.8 0.7-7.0 4	0.0 0.0-0.0 3	0.1 0.0-0.5 13	0.3 0.0-1.2 4	0.7 0.4-1.2 3
Crabs Mixed species	0.5 0.3-0.8 5	12.2 3.8-35.6 8			3.6 0.0-22.4 13	0.0	
Crayfishes Mixed species	1.6 0.3-11.6 9	12.8 0.4-44.5 8		0.3	0.1 0.0-0.2 9	1.5 0.1-2.8 2	0.7
Cusk eels and brotulas Ophidiidae	0.2	0.6					
Cutlassfishes and hairtails Trichiuridae				0.0			
Cuttlefishes Mixed species		8.2					
Drums Sciaenidae	0.3 0.1-0.4 2	2.0 0.0-8.9 5					
Eels, conger Congridae		0.2		0.0	0.1		
Eels, freshwater Anguillidae		0.4 0.3-0.6 2			0.0		
Eels, snake Ophichthidae		0.2 0.2-0.3 2			0.1 0.0-0.1 2		
Featherbacks Notopteridae			0.5				
Flounders Pleuronectidae	0.4 0.2-0.5 3	2.5 0.1-4.5 5	0.4	0.0 0.0-0.0 2	0.0 0.0-0.0 3	0.8 0.5-1.2 2	0.7 0.3-1.4 3
Gars Lepisoteidae		0.4		0.0			
Gobies Gobiidae				0.0			
Greenlings Hexagrammidae		0.4 0.3-0.6					
Grenadiers Macrouridae				0.0			
Grunts Pomadasyidae		0.0					
Guitarfishes Rhinobatidae		3.0			0.1		
Haddock *Melanogrammus aeglefinnus*	0.3 0.2-0.5 3	2.6 0.6-4.5 2	5.1		0.1 0.0-0.1 3	0.2	
Hakes *Merluccius* sp.	0.4 0.4-0.5 2				0.0 0.0-0.1 2		
Herrings Clupeidae					0.1		

Table 2.—continued.

	Lead	Arsenic	Fluorine	Silver	Cadmium	Cobalt	Selenium
				ppm			
Jacks and pompanos Carangidae	0.4	0.2 0.0-0 5 2			0.0	0.0 0.0-0.0 2	
Mackerels *Scomber* sp.			1.5				
Mackerels *Scomberomorus* sp.		0 4			0.1		
Mackerels and tunas Scombridae		0.4 0 3-0.6 3	1.5	0.0			
Minnows and carps Cyprinidae		0.6			0.1 0.0-0.1 2	0.0	
Mullets Mugilidae	6.0	4.1 0.3-8.0 2	3.0 1.1-4.9 2		0.1 0.0-0.1 2		
Mussels Mytilidae	1.1 0.1-2.4 4	29.7 1.7-63 0 5			0.7 0.2-1.9 4	0.1	
Octopuses Mixed species		8.1 1.6-14.5 2			0.0	0.1	
Oysters Ostreidae	24.9 0.2-100.0 12	9 1 0.5-42.7 10	1.1 0.7-1.6 2			0.2	0.7
Perches Percidae	0.6 0.5-0.6 2	0.3 0.1-0.6 2	0.7		0.6 0.0-1.2 4		0.3
Periwinkles Littorinidae	1.5	22.0					
Pikes Esocidae	0.6 0.5-0.9 4	0.1 0 1-0.1 2					0.2 0.2-0.4 3
Porgies Sparidae		0.5					
Prawns Mixed species		21.6 1.3-55.8 3					
Rays, eagle Myliobatidae		1.3					
Sablefishes Anoplopomatidae			0.0				
Saurles Scomberesocidae						0.6	
Scallops Pectinidae	0.3 0.2-0.5 6	8.8 0.4-33.6 7			2.8 0.0-10.6 5	2.3	
Scorpionfishes and rockfishes Scorpaenidae	1.5 1.2-1.7 2	0.5 0.3-1.3 6	0.9 0.2-1.5 2		0.2 0.1-0.3 2		
Sharks, cow Hexanchidae		4.1 3.2-4.6 3					
Sharks, dogfish Squalidae		2 7 0.6-4.3 3	5.3		0.2 0.2-0.3 2		
Sharks, hammerhead Sphyrnidae		2.1 0.6-3.6 2			0.1 0.0-0.1 2		
Sharks, requiem Carcharinidae		0.9 0.3-1.6 2			0.3 0.0-0.6 2		

Table 2.—continued.

	Lead	Arsenic	Fluorine	Silver	Cadmium	Cobalt	Selenium
				ppm			
Shrimps Mixed species	0.5 0.4-0.5 4	8.7 1.8-29.8 8			0.1 0.0-0.2 8	0.2 0.1-0.4 4	1.2 0.6-1.9 2
Silversides Atherinidae		0.3 0.2-0.3 3					
Skates Rajidae		10.3 4.4-16.2 2			0.3 0.1-0.5 2		
Smelts Osmeridae	0.5	0.2			0.1		0.2
Snappers Lutjanidae	0.5	0.4			0.1		
Soles Soleidae		0.9					
Squids mixed species		1.5 0.4-2.6 3		0.1	0.1 0.1-0.1 2	0.6 0.1-1.0 2	
Sturgeons Acipenseridae	0.8				0.1 0.0-0.1 2		
Sunfishes and black basses Centrarchidae					0.0 0.0-0.0 4	3.7	0.4
Swordfishes Xiphiidae	0.2				0.0 0.0-0.0 2	0.0	
Tarpons Elopidae		3.7 0.7-6.6 2					
Trouts and salmons Salmonidae	0.5 0.2-0.9 5	0.9 0.1-2.7 8			0.0 0.0-0.1 9		0.3 0.2-0.4 2
Tunas *Euthynnus* sp.		0.3			0.1		
Whelks Mixed Species	11.1 0.1-22.0 2	18.9					
Whitings Sillagonidae		0.7			0.0	0.0	

Table 3.—Composition of the edible portion of raw (fresh or frozen) crustaceans, finfish, and mollusks: III. Microelements: Chromium, vanadium, tin, aluminum, nickel, barium, and molybdenum.

	Chromium	Vanadium	Tin	Aluminum	Nickel	Barium	Molybdenum
				ppm			
Abalones Haliotidae				111.6			
Catfishes, freshwater Ictaluridae	0.2	0.0	0.0	0.9			
Clams, softshell Myacidae	0.4		3.2				
Clams, Venus Veneridae	0.3 0.2-0.4 5			254.7	0.6		

Table 3.—continued.

	Chromium	Vanadium	Tin	Aluminum	Nickel	Barium	Molybdenum
				ppm			
Cods, Atlantic *Gadus morhua*	0.1 0.1-0.1 2						
Cods *Gadus* sp.		0.5 0.0-1.0 2	1.6 0.0-3.7 4	2.5 1.8-3.1 2			
Codfishes Gadidae	0.1 0.0-0.3 8	0.6 0.0-1.3 5	1.4 0.0-3.7 9	4.1 0.1-21.8 9	0.0 0.0-0.1 2	0.2	3.0
Crabs Mixed species	0.1 0.1-0.2 2			35.9			0.6
Crayfishes Mixed species	0.1	2.9 0.0-8.5 3	1.2 0.9-1.5 2	45.9 1.4-90.3 2	0.1 0.0-0.1 2		0.2
Cusk eels and brotulas Ophidiidae				1.8			
Cutlassfishes and hairtails Trichiuridae		0.0	0.0	1.8			
Eels, conger Congridae		0.0	0.0	2.8			
Eels, freshwater Anguillidae		0.0					
Flounders Bothidae	0.3			1.0		0.2	
Flounders Pleuronectidae	0.1 0.0-0.2 5	0.1 0.0-0.5 5	0.9 0.0-3.2 6	11.0 10.0-32.3 4			0.2 0.0-0.4 2
Gars Lepisoteidae		0.0	0.0	2.6			
Gobies Gobiidae		0.0	0.0	1.9			
Grenadiers Macrouridae		0.0	0.0	1.9			
Grunts Pomadasyidae		0.0	0.3	2.6			
Haddocks *Melanogrammus aeglefinnus*	0.1 0.0-0.3 4	0.0		1.0	0.1		0.2
Hakes *Merluccius* sp.	0.1 0.1-0.1 2		1.9	0.3 0.1-0.5 2	0.0		
Jacks and pompanos Carangidae				5.3 1.2-9.3 2			
Mackerels and tunas Scombridae		0.0 0.0-0.0 3	0.0	89.8 1.2-178.2 2			
Minnows and carps Cyprinidae		0.9 0.0-1.8 2	9.1 0.0-18.2 2	25.7 1.3-46.1 3			
Mussels Mytilidae		0.3		2.9	0.5 0.5-0.5 2		
Oysters Ostreidae	0.1 0.1-0.1 2	0.1	1.4	13.4	0.5		
Perches Percidae	0.1		0.6		0.2		
Pikes Esocidae			2.2 0.5-5.4 3		0.2 0.2-0.2 3		

Table 3.—continued.

	Chromium	Vanadium	Tin	Aluminum	Nickel	Barium	Molybdenum
				ppm			
Prawns Mixed species							0.5 0.3-0.8 5
Sablefishes Anoplopomatidae		0.0	0.0	3.1			
Saurles Scomberesocidae				1.1			
Scallops Pectinidae	0.1 0.1-0.1 5	2.1 2.1-2.1 2			0.0		
Scorpionfishes and rockfishes Scorpaenidae	0.1 0.1-0.1 2						
Sea cucumbers Mixed species				43.8			
Sharks, requiem Carcharhinidae		0.7 0.3-1.1 2		11.5 11.4-11.6 2			
Shrimps Mixed species	0.1 0.0-0.1 7	1.9			0.0		0.0
Smelts Osmeridae	0.8		12.2		0.2		
Snappers Lutjanidae	0.1						
Soles Soleidae			3.2				
Squids Mixed species			0.3	17.5 1.3-47.4 3			0.3
Swordfishes Xiphiidae					0.0		
Trouts and salmons Salmonidae	0.1 0.0-0.2 3		1.6 0.4-3.6 3	2.1 1.2-3.0 2	0.2 0.2-0.2 2		0.0
Whitings Sillagonidae		0.0			0.0		

Table 4.—References by species for microelement contents of finfish, crustaceans, and mollusks.

Abalones (Haliotidae)	6, 85, 86, 90, 106, 109, 142, 187
Anchovies (Engraulidae)	37, 41, 58, 85, 97, 106, 110, 124, 134, 154, 172, 179, 210
Argentines (Argentinidae)	224
Barracudas (Sphyraenidae)	85, 87, 90, 106, 107, 199
Basses, sea (Serranidae)	8, 21, 37, 45, 46, 47, 75, 85, 87, 106, 107, 108, 124, 142, 146, 151, 155, 172, 210, 223
Basses, temperate (Percichthyidae)	96, 114, 143, 144, 149, 206, 223, 224
Batfishes (Ogeocephalidae)	107
Beardfishes (Polymixiidae)	196
Bigeyes (Priacanthidae)	208
Billfishes (Istiophoridae)	106, 162, 198, 201
Bluefishes (Pomatomidae)	45, 58, 107, 113, 124, 150, 151, 155, 206, 223
Bombay ducks (*Harpodon nehereus*)	106, 136, 186
Bowfins (Amiidae)	96, 206
Burbots (Lota)	10, 25, 60, 96, 137, 207, 215, 218
Butterfishes (Stromateidae)	10, 41, 95, 106, 136, 186
Butterflyfishes (Chaetodontidae)	26, 85, 106, 134
Caesios (Caesionidae)	85, 106
Catfishes, airbreathing (Claridae)	107, 134, 167, 168
Catfishes, airbreathing (Heteropneustidae)	159, 167, 169
Catfishes, freshwater (Ictaluridae)	4, 5, 24, 59, 67, 72, 88, 96, 113, 155, 159, 167, 168, 169, 171, 191, 203, 206
Catfishes, sea (Ariidae)	10, 26, 41, 85, 106, 107, 134, 136, 151, 169, 186
Cavefishes (Amblyopsidae)	168
Characins (Characidae)	87
Chimaeras (Chimaeridae)	103
Chubs, sea (Kyphosidae)	45
Cichlids (Cichlidae)	106, 107
Clams, arkshell (Arcidae)	85
Clams, donax (Donacidae)	48, 118
Clams, freshwater (mixed species)	86, 106
Clams, mactra (Mactridae)	58, 106, 178
Clams, razor (Solenidae)	58, 74, 90, 106, 109, 141, 206
Clams, softshell (Myacidae)	34, 44, 55, 130, 176
Clams, tellin (Tellinidae)	106
Clams, Venus (Veneridae)	6, 24, 25, 26, 29, 30, 44, 48, 53, 63, 76, 82, 85, 86, 90, 103, 104, 106, 108, 115, 118, 124, 142, 172, 175, 176, 177, 180, 181, 182, 183, 187, 191, 206, 210, 211

Table 4.—continued.

Cockles (Cardiidae)	20, 23, 38, 48, 58, 85, 106, 119
Cods, Atlantic (*Gadus morhua*)	13, 15, 24, 116, 133, 137, 183, 204, 224
Cods (*Gadus* sp.)	10, 13, 35, 69, 85, 90, 115, 151, 207
Codfishes (Gadidae)	8, 10, 11, 13, 19, 24, 25, 35, 44, 45, 46, 51, 67, 69, 70, 76, 85, 87, 90, 94, 100, 104, 106, 109, 112, 113, 115, 116, 121, 124, 129, 149, 150, 151, 152, 155, 156, 160, 166, 172, 178, 179, 182, 191, 194, 200, 206, 214, 215, 224
Crabs (mixed species)	23, 24, 25, 26, 32, 33, 38, 45, 51, 66, 85, 86, 90, 92, 101, 103, 104, 109, 128, 130, 135, 142, 152, 156, 161, 172, 186, 187, 191, 198, 200, 205, 206, 213, 224
Crayfishes (mixed species)	21, 22, 23, 24, 25, 28, 32, 38, 41, 45, 48, 58, 63, 67, 80, 85, 90, 104, 105, 106, 110, 113, 115, 129, 150, 155, 156, 172, 174, 175, 177, 178, 180, 181, 182, 184 , 186, 191, 194, 195, 196, 198, 207, 224
Cusk eels and brotulas (Ophidiidae)	67, 87, 115, 196
Cutlassfishes and hairtails (Trichiuridae)	2, 41, 67, 85, 106, 186
Cuttlefishes (mixed species)	20, 35, 48, 58, 147, 172, 222
Dolphins (Coryphaenidae)	106, 151, 162, 198
Dories (Zeidae)	35, 45, 58
Drepanes (Drepanidae)	85, 106, 107
Drums (Sciaenidae)	2, 10, 12, 14, 26, 45, 47, 58, 59, 71, 85, 87, 90, 95, 96, 106, 107, 114, 124, 136, 169, 186, 196, 201, 206, 210, 223
Eels, conger (Congridae)	35, 45, 58, 67, 69, 106, 120, 149, 200, 210, 223
Eels, freshwater (Anguillidae)	10, 35, 64, 93, 106, 107, 109, 138, 166, 172, 220, 223, 224
Eels, moray (Muraenidae)	85
Eels, pike conger (Muraenesocidae)	85, 120, 186, 201
Eels, snake (Ophichthidae)	4, 85, 88, 106, 134, 159, 167, 168, 169, 223
Eels, snipe (Nemichthyidae)	221
Eels, spiny (Notacanthidae)	88, 134
Eels, swamp (Flutidae)	105
Eelpouts (Zoarcidae)	149, 224
Featherbacks (Notopteridae)	88, 106, 134, 165, 167, 170
Flatheads (Percophididae)	45, 85, 106, 151, 201
Flounders (Bothidae)	35, 68, 85, 87, 106, 151, 172
Flounders (Pleuronectidae)	8, 10, 15, 17, 24, 25, 26, 31, 41, 45, 46, 51, 63, 67, 69, 70, 73, 77, 85, 90, 100, 103, 106, 107, 109, 110, 112, 113, 115, 120, 124, 129, 134, 135, 137, 142, 149, 152, 154, 155, 158, 172, 174, 176, 177, 178, 179, 200, 204, 206, 215
Flyingfishes and halfbeaks (Exocoetidae)	45, 58, 85, 106, 199
Gars (Lepisoteidae)	57, 59, 67, 206
Gillrakers (Chironcentridae)	186
Goatfishes (Mullidae)	35, 85, 134, 154, 162, 210
Gobies (Gobiidae)	10, 33, 35, 67, 85, 87, 106, 134, 167, 168, 169, 186, 206
Goosefishes (Lophiidae)	13, 35, 106, 210, 224
Greenlings (Hexagrammidae)	10, 24, 90, 149, 154, 201
Grenadiers (Macrouridae)	67
Grunts (Pomadasyidae)	26, 45, 47, 67, 85, 87, 106, 107
Guitarfishes (Rhinobatidae)	201
Gurnards, flying (Dactylopteridae)	15, 35, 45, 47, 106, 201, 210
Haddocks (*Melanogrammus aeglefinnus*	10,13,15,24,25,33,51,54,68,69, 73, 94, 110, 113, 115, 120, 124, 135, 148, 149, 155, 160, 172, 176, 181, 200, 204, 207, 216, 224
Hakes (*Merluccius* sp.)	15, 22, 24, 35, 58, 67, 70, 71, 154, 210, 224
Herrings (Clupeidae)	10, 45, 58, 59, 85, 87, 90, 95, 96, 106, 107, 113, 114, 115, 124, 126, 149, 156, 159, 169, 186, 201, 206, 224
Jacks and pompanos (Carangidae)	2, 14, 26, 33, 35, 41, 47, 58, 67, 85, 87, 90, 106, 107, 110, 145, 151, 162, 169, 186, 196, 201, 206
Lampreys (Petromyzontidae)	59, 106
Lanternfishes (Myctophidae)	154
Lings (Molva)	10, 13, 120, 200, 206
Lizardfishes (Synodontidae)	85, 106, 201
Longarays (Ambassidae)	85
Lumpfishes and snailfishes (Cyclopteridae)	106, 224
Mackerels (*Scomber* sp.)	2, 13, 35, 45, 87, 90, 106, 115, 135, 160, 186, 198, 201, 207
Mackerels (*Scomberomorus* sp.)	2, 12, 87, 106, 134, 151, 186, 198, 201, 207, 223
Mackerels (Scombridae)	2, 12, 13, 15, 24, 25, 35, 36, 41, 45, 47, 51, 52, 67, 69, 71, 76, 81, 85, 87, 90, 104, 105, 106, 107, 109, 110, 113, 115, 124, 132, 134, 135, 136, 142, 151, 153, 155, 160, 172, 173, 186, 195, 196, 198, 200, 201, 206, 223
Milkfishes (Chanidae)	85, 106
Minnows and carps (Cyprinidae)	4, 7, 9, 10,16, 25, 57, 59, 67, 88, 90, 96, 106, 108, 110, 114, 126, 134, 137, 141, 142, 159, 165, 167, 168, 169, 170, 171, 206, 215, 224
Mojarras (Gerreidae)	85, 106
Mooneyes (Hiodontidae)	25, 96
Mullets (Mugilidae)	1, 10, 26, 35, 41, 45, 46, 47, 51, 85, 88, 95, 106, 110, 120, 123, 134, 135, 136, 151, 152, 154, 159, 162, 167, 169, 170, 186, 196, 198, 201, 206, 210, 223
Mussels (Mytilidae)	20, 22, 23, 33, 35, 38, 41, 45, 48, 49, 90, 106, 118, 124, 130, 172, 174, 175, 187, 205, 206
Needlefishes (Belonidae)	10, 85, 106, 159
Nemipterids (Nemipteridae)	85, 106, 201
Octopuses (mixed species)	35, 48, 58, 71, 86, 90, 106, 110
Oysters (Ostreidae)	25, 26, 31, 38, 39, 42, 45, 48, 50, 58, 62, 63, 75, 76, 78, 80, 82, 83, 84, 85, 86, 90, 99, 102, 104, 105, 106, 107, 109, 111, 113, 115, 116, 117, 119, 120, 121, 129, 135, 141, 150, 155, 156, 164, 175, 178, 179, 180, 181, 183, 190, 191, 206, 219
Parrotfishes (Scaridae)	85, 87, 106, 162
Perches (Percidae)	9, 10, 16, 18, 25, 45, 46, 59, 69, 72, 96, 113, 114, 124, 137, 149, 155, 163, 206, 209, 215, 216, 218, 224
Perches, climbing (Anabantidae)	106, 123, 134, 167, 168, 169, 170
Periwinkles (Littorinidae)	20, 38, 128, 207
Picarels (Centracanthidae)	35
Pikes (Esocidae)	25, 31, 46, 59, 60, 69, 72, 91, 92, 93, 96, 100, 113, 114, 124, 137, 149, 155, 160, 172, 185, 197, 206, 209, 215, 216, 218
Pomfrets (Bramidae)	106, 170, 198
Porgies (Sparidae)	3, 25, 45, 58, 71, 85, 106, 145, 151, 201, 206
Prawns (mixed species)	12, 35, 38, 41, 43, 45, 58, 71, 87, 106, 107, 110, 137, 186, 188, 189, 221
Puffers (Tetraodontidae)	106
Rabbitfishes (Seganoidae)	85, 106
Rays, eagle (Myliobatidae)	41, 223
Rays, electric (Torpedinidae)	61, 164
Rays, sting (Dasybatidae)	33, 85, 106, 107, 186
Sablefishes (Anoplopomatidae)	10, 67, 90, 115, 154
Salmons, Australian (Arripiddae)	45
Sandfishes (Trichodontidae)	106
Sauries (Scomberesocidae)	67, 76, 106, 154
Sawfishes (Pristidae)	110
Scallops (Pectinidae)	13, 20, 23, 24, 31, 33, 38, 45, 69, 71, 90, 104, 109, 113, 115, 118, 119, 124, 130, 176, 177, 179, 182, 183, 191, 205, 206, 224
Scombrops boops	106
Scorpionfishes and rockfishes (Scorpaenidae)	10, 13, 24, 26, 35, 46, 58, 90, 103, 106, 115, 116, 154, 155, 160, 172, 191, 199
Sculpins (Cottidae)	183
Sea cucumbers (mixed species)	106, 123, 142, 202
Sea robins	10
Sharks, cat (Scyliorhinidae)	20, 35
Sharks, cow (Hexanchidae)	103
Sharks, dogfish (Squalidae)	10, 24, 25, 35, 94, 103, 106, 152, 154, 198, 223, 224
Sharks, hammerhead (Sphyrnidae)	85, 186, 198, 223
Sharks, mackerel (Lamnidae)	154, 198
Sharks, requiem (Carcharhinidae)	12, 35, 45, 47, 67, 85, 87, 106, 142, 154, 186, 198, 223
Sharks, sand tiger (Odontaspididae)	41, 106
Sharks, whale (Rhincodontidae)	155
Sheathfishes (Siluridae)	106, 169
Shrimps (mixed species)	3, 13, 24, 26, 32, 35, 38, 41, 45, 48, 51, 52, 58, 76, 85, 86, 90, 104, 106, 108, 109, 113, 121, 123, 124, 129, 131, 135, 150, 152, 155, 156, 172, 176, 180, 181, 182, 183, 184, 186, 187, 191, 194, 198, 200, 206, 210
Silversides (Atherinidae)	71, 106, 184
Skates (Rajidae)	10, 31, 33, 35, 45, 70, 103, 106, 152, 206, 223, 224
Sleepers (Eleotridae)	134, 159
Smelts (Osmeridae)	24, 59, 76, 90, 136, 146, 149, 206, 209
Smelts, deep sea (Bathylagidae)	221
Snails (mixed species)	20, 23, 85, 106, 107, 118, 158, 172
Snake mackerels (Gempylidae)	45, 151
Snappers (Lutjanidae)	10, 27, 45, 51, 85, 87, 107, 110, 113, 124, 135, 155, 156, 193, 198

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Snooks (Centropomidae)	41. 45. 85. 106. 136. 167. 168. 169. 171
Soapies (Leiognathidae)	85. 95. 106
Soles (Soleidae)	45. 58. 71. 145. 178. 201. 210
Spadefishes (Ephippidae)	7. 45. 85. 87. 106
Squids (mixed species)	35. 43. 48. 58. 67. 71. 85. 86. 87. 90. 106. 109. 142. 147. 210. 221
Squirrelfishes (Holocentridae)	154. 162
Stargazers (Uranoscopidae)	35
Sturgeons (Acipenseridae)	5. 10. 59. 90. 114
Suckers (Catostomidae)	9. 10. 16. 25. 59. 96. 100. 203. 206. 224
Sunfishes and black basses (Centrarchidae)	9. 10. 16. 59. 60. 72. 88. 96. 98. 114 149. 183. 203. 206. 224
Surfperches (Embiotocidae)	10
Surgeonfishes (Acanthuridae)	85. 106
Swordfishes (Xiphiidae)	1. 24. 58. 65. 92. 106. 124. 139. 175. 196
Tarpons (Elopidae)	26. 28. 41. 85. 106
Therapons (Theraponidae)	85. 106. 154
Threadfins (Polynemidae)	12. 41. 45. 85. 106. 107. 186
Tilefishes (Branchiostegidae)	106. 201
Tonguefishes (Cynoglossidae)	25. 106
Topshells (Trachidae)	118. 207
Triggerfishes and filefishes (Balistidae)	45. 169. 202
Trouts and salmons (Salmonidae)	10. 16. 24. 25. 26. 31. 40. 46. 56. 67. 71. 72. 75. 89. 96. 100. 103. 104. 106. 109. 113. 114. 115. 121. 124. 133. 135. 137. 140. 146. 149. 155. 160. 163. 172. 185. 186. 187. 191. 200. 201. 206. 209. 215. 217. 218. 224
Tunas (*Euthynnus* sp.)	24. 106. 125. 156. 157. 162. 221. 223
Tunas (*Thunnus* sp.)	10. 24. 41. 58. 76. 79. 85. 90. 105. 106. 125. 146. 157. 162. 198. 199. 201. 206
Viperfishes (Chauliodontidae)	134. 135
Weevers (Trachinidae)	35
Whales (mixed species)	25
Whelks (mixed species)	38. 106. 128
Whitings (Sillagonidae)	26. 41. 45. 85. 86. 106. 124. 152. 170. 201. 224
Wolffishes (Anarhichadidae)	10. 13. 160. 224
Wrasses (Labridae)	115. 206

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