A PRELIMINARY STUDY OF ZOOBENTHOS IN THE POYANG LAKE, THE LARGEST FRESHWATER LAKE OF CHINA, AND ITS ADJOINING REACHES OF CHANGJIANG RIVER①

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Abstract Benthic samples were collected from the Poyang Lake and adjoining Changjiang River course in April, 1998. Altogether 33 taxa belonging to 5 phyla were identified, among which 28 taxa including 1 nemertean, 1 nematode, 10 annelids, 6 molluscs and 10 arthropods were found in the lake. The occurrence of some taxa with marine nature implies that the lake should have been historically influenced by marine fauna. The standing crop in entire lake was 555ind/m^2 in density and 151.1g/m^2 in wet biomass. Molluscs were the most abundant group, comprising 62% in total zoobenthic density and 99% in biomass. Zoobenthos in the river course was less abundant. In terms of the functional feeding groups, collector-filterers and scrapers were predominant in the lake, whereas shredders and collector-gatherers was relatively rich in the river. As an invaluable pool of aquatic invertebrates, the authors are of the opinion that Poyang Lake should be more intensively conserved and needs further studies.

Key words Zoobenthos, Taxonomic composition, Standing crops, Functional feeding groups, Poyang Lake, Changjiang River

1 Introdution

Located in northern Jiangxi Province at the junction of middle and lower reaches of Changjiang (the Yangtze) River, Poyang Lake (28°25′-29°45′N, 115°48′-116°44′E) covers an area of 3283km^2 at a water-level of 21.71m ASL, with maximum length of 173km, maximum width of 73km and shore development (D_L) of 5.9. Being the largest freshwater shallow lake in the country and one of the two large lakes still connecting the main river-trunk of Changjiang, Poyang Lake plays an important role in the maintenance of aquatic biodiversity. However, it is threatened by various environmental impacts such as sedimentation, pollution and reclamation from lake district. For the sake of conservation and rational utilization, limnological studies of the lake are essential. Actually, some surveys mainly for fishery purposes have been carried out since 1960s. In terms of zoobenthos, works were chiefly concentrated on mollusc taxonomy (Lin, 1962; Tchang & Li, 1965; Wu, 1998), but few were done on entire benthic community. In 1997—1999, a project on the comprehensive limnology of Poyang Lake and adjoining reaches of Chanjiang River was conducted. This paper presents some preliminary results on zoobenthos.

Bottom samples were collected with a weighted Petersen grab(1/16m^2) from 17 sites inside the lake and adjoining river (Fig.1). After being sieved with a 420 μm sieve, worms were sorted manually in a

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white porcelain dish and preserved in 10% formalin. Specimens were then blotted and weighed with an electronic balance. Weights of small worms were calculated by means of length-weight reationships.

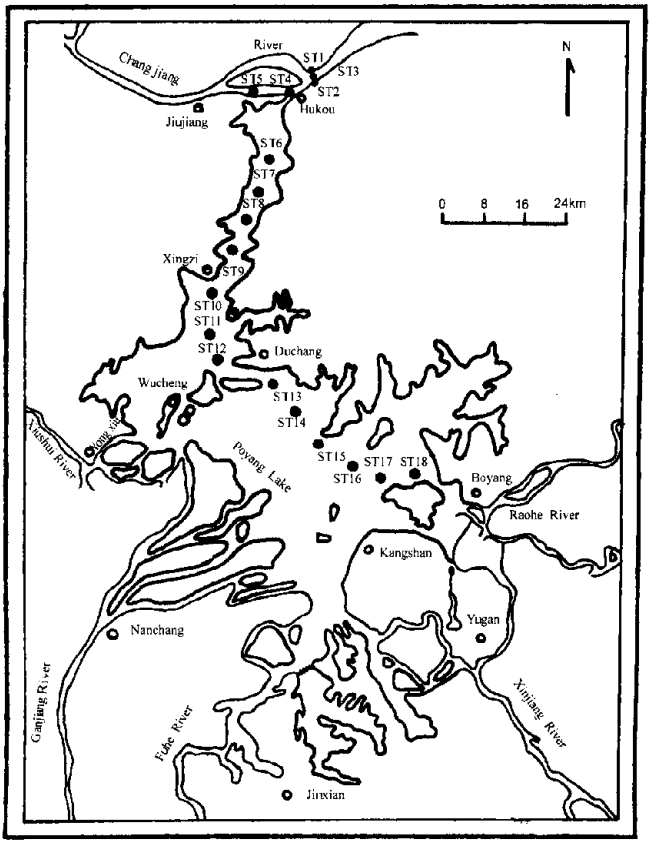

Fig. 1 Sampling stations in Poyang Lake and adjoining main river of Changjiang
(No sample was collected from ST 2 due to rapid current)

The major physico-chemical parameters of the lake (ST 6-18) and the river (ST1, 3—5) during sampling were as follows: depth, 5.1 ± 0.8 (mean ± S.E.), 6.4 ± 1.1m; sediment, clay or sand, silt or sand; velocity, 0.3 ± 0.04, 0.5 ± 0.08m/s; Secchi disk transparency, 120 ± 12, 56 ± 18cm; pH, 7.4 ± 0.02, 7.3 ± 0.02; conductivity, 95 ± 5, 207 ± 45μS/cm; total phosphorus, 0.09 ± 0.01, 0.26 ± 0.09mg/L; total nitrogen, 0.83 ± 0.04, 1.27 ± 0.16mg/L.

2 Taxonomic composition

Altogether 33 taxa belonging to 5 phyla were identified (Tab. 1). In the entire lake, a total of 28 taxa including 10 annelids, 6 molluscs, 10 arthropods and 2 miscellaneous animals were found, among which several aspects are worthy to be mentioned. First, here are some taxa with marine nature. The occurrence of the phylum Nemertea, which has been recorded from the estuary of Zhujiang (the Pearl) River by Gibson & Qi (1991), is regarded as the first record of this animal in inland freshwater habitat. *Nephtys polybranchia* was commonly found in the lake, which is considered to be the upper distributional limit of

freshwater polychaetes. A new species of *Parodontophora*, formerly regarded as marine nematode genus, is also described. Since most members of the above-mentioned invertebrates are marine inhabitants, it is reasonable to infer that the lake should have been historically influenced by marine fauna. Secondly, the occurrence of *Haplotaxis* is remarkable. This oligochaete is usually referred to subterranean forms, and no previous record from a shallow lake. Thirdly, animals preferring lotic water or hard bottom contribute greatly to the fauna, among which are *Corbicula*, Gammaridae, Thricoptera, etc. In the river, the occurrence of *Limnodrilus amblysetus* is interesting. It was formerly reported from the upper reaches of Changjiang (Brinkhurst et al., 1990), and probably is endemic to the river.

The species richness of the river (ST1,3—5), the lake outlet (ST6—12) and the lake proper (ST 13—18) are compared (Fig. 2). Species number of the lake proper ranked first, being twice as those of the others. Of the entire fauna, 42% occurred only inside the lake. They were chiefly composed of Oligochaeta and Arthropoda, such as *Haplotaxis*, *Spirosperma*, Gammaridae and some insects. Molluscs were frequent in lake outlet and lake proper, but did not occurred in the river. Faunistically, lake outlet is transitional between lake proper and the river.

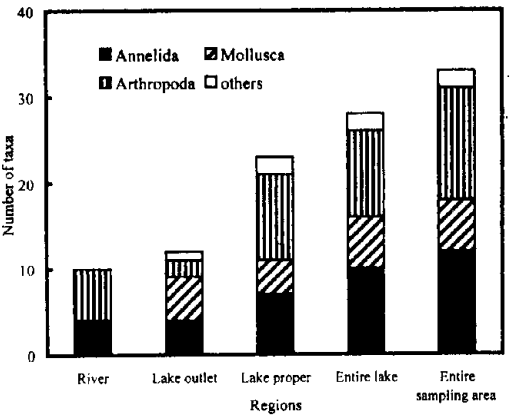

Fig.2 Taxonomic composition of zoobenthos in different regions of Poyang Lake and adjoining main river of Changjiang

Combining the present result with our unpublished materials, more than 120 taxa of zoobenthos have been known from Poyang Lake. In comparison with other Chinese shallow lakes, it has the highest richness in zoobenthic species, with molluscs about 7—16 times higher than those in other lakes, including many molluscan species having been recorded in China (Wu, 1998). The occurrence of uncommon animals like nemerteans and haplotaxids also indicates that the lake is maintaining conditions more naturally than most waters suffering from pollution or severed from the main river of Changjiang. As and invaluable pool of aquatic invertebrates, it should be more intensively conserved and needs further studies.

Tab. 1 Taxa, densities (ind/m^2) and wet biomass (g/m^2) (in parentheses) of zoobenthos from Poyang Lake and adjoining main river of Changjiang (1998.4). Abbreviation: uw = unweighed.

Stations	ST1	ST3	ST4	ST5	ST6	ST7	ST8	ST9	ST10	ST11	ST12	ST13	ST14	ST15	ST16	ST17	ST18
Nemertea																	
Enopla	0	0	0	0	0	0	0	0	0	0	0	0	0	48	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.4)	(0)	(0)	(0)
Nematoda	0	0	0	0	0	0	0	0	0	80	0	0	0	48	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(uw)	(0)	(0)	(0)	(uw)	(0)	(0)	(0)
Annelida																	
Polychaeta																	
Nephtyidae																	
Nephtys	0	0	448	0	0	16	0	0	48	336	0	16	0	0	48	0	0
polybranchia	(0)	(0)	(2.9)	(0)	(0)	(.3)	(0)	(0)	(.07)	(.5)	(0)	(.06)	(0)	(0)	(.4)	(0)	(0)

(Continued)

Stations	ST1	ST3	ST4	ST5	ST6	ST7	ST8	ST9	ST10	ST11	ST12	ST13	ST14	ST15	ST16	ST17	ST18
Oligochaeta																	
Haplotaxidae																	
Haplotaxis	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.08)	(0)	(0)	(0)
Naididae																	
Pristina	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0
longiseta	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.0003)	(0)	(0)	(0)
Slavina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0
appendiculata	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.0008)	(0)
Tubificidae																	
Branchiura	16	0	0	0	16	0	0	0	64	48	0	0	0	0	0	0	0
sowerbyi	(.02)	(0)	(0)	(0)	(.1)	(0)	(0)	(0)	(.4)	(.4)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Teneridrilus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0
mastrix	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.02)	(0)	(0)
Limnodrilus	128	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
amblysetus	(.6)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Limnodrilus	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
grandisetosus	(.01)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Spirosperma	0	0	0	0	0	0	0	0	0	0	0	112	0	384	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.02)	(0)	(2.2)	(0)	(0)	(0)
Hirudinea																	
Glossiphoniidae																	
Batracobdella	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0.3)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Glossiphonia	0	0	0	0	0	0	0	0	0	0	0	0	0	32	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.3)	(0)	(0)	(0)
Helobdella	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0
nuda	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mollusca																	
Gastropoda																	
Viviparidae																	
Bellamya	0	0	0	0	0	0	0	0	0	32	0	0	0	16	0	16	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(9.7)	(0)	(0)	(0)	(48.0)	(0)	(60.8)	(0)
Bithyniidae																	
Parafossarulus	0	0	0	0	560	0	112	560	400	0	288	240	32	336	0	0	0
	(0)	(0)	(0)	(0)	(84.6)	(0)	(31.3)	(185.6)	(49.1)	(0)	(38.9)	(30.4)	(12.2)	(89.5)	(0)	(0)	(0)
Stenothyridae																	
Stenothyra	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(.1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Planorbidae																	
Hippeutis	0	0	0	0	0	0	0	0	0	0	0	0	0	128	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1.0)	(0)	(0)	(0)
Bivalvia																	
Mytillidae																	
Limnoperna	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0
lacustris	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.3)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)

(Continued)

Stations	ST1	ST3	ST4	ST5	ST6	ST7	ST8	ST9	ST10	ST11	ST12	ST13	ST14	ST15	ST16	ST17	ST18
Corbiculidae																	
Corbicula	0	0	0	0	240	0	112	272	16	48	48	576	272	16	96	0	0
fluminea	(0)	(0)	(0)	(0)	(101.6)	(0)	(98.6)	(290.6)	(2.4)	(89.7)	(128.2)	(373.4)	(98.2)	(16.0)	(104.0)	(0)	(0)
Arthropoda																	
Copepoda																	
Harpacticoida	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	(.001)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Amphipoda																	
Gammaridae	0	0	0	0	0	0	0	0	0	0	0	0	64	0	0	0	496
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.3)	(0)	(0)	(0)	(.8)
Insecta																	
Ephemeroptera																	
Ephemeridae																	
Ephemera	0	32	16	0	224	0	0	0	0	256	0	0	0	0	16	0	0
	(0)	(.9)	(.8)	(0)	(5.8)	(0)	(0)	(0)	(0)	(7.4)	(0)	(0)	(0)	(0)	(.4)	(0)	(0)
Odonata																	
Anisoptera																	
Gomphidae	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	(.04)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Zygoptera																	
Coenagrion	0	0	0	0	0	0	0	0	0	0	0	0	0	96	0	0	0
-idae	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.06)	(0)	(0)	(0)
Trichoptera																	
Leptoceridae																	
Athripsodes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.06)
Psychomyiidae																	
Lype	0	0	0	0	0	0	0	0	0	0	0	0	0	32	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.03)	(0)	(0)	(0)
Diptera																	
Ceratopogon																	
-idae																	
Bezzia	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	(0)	(0)	(.003)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Chironomidae																	
Crypto	0	16	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0
-chironomus	(0)	(.005)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.01)	(0)	(0)	(0)
Dicrotendipes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.006)
Para	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0
-chironomus	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.03)	(0)	(0)	(0)
Polypedium	0	32	0	0	16	0	0	0	0	16	16	0	0	16	32	0	0
	(0)	(.006)	(0)	(0)	(.008)	(0)	(0)	(0)	(0)	(.008)	(.005)	(0)	(0)	(.003)	(.006)	(0)	(0)
Zavrelia	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.005)	(0)	(0)	(0)
Total	192	80	480	0	1072	16	224	848	528	848	352	944	368	1232	208	32	544
	(.7)	(.9)	(3.7)	(0)	(192.2)	(.3)	(129.9)	(476.5)	(52.0)	(107.8)	(167.1)	(403.9)	(110.7)	(157.6)	(104.8)	(60.8)	(0.9)

3 Standing crops

The densities and biomass of each taxa and major groups are given in Tab. 1-2. The standing crop in entire lake was 555ind/m^2 in density and 151.1g/m^2 in wet biomass. The most abundant group was molluscs, comprising 62% of the total in density and 99% in biomass. Among them, there were two predominant species *Corbicula fluminea* and *Parafossarulus* sp., being 77%, 62% in frequency of occurrence, 24%, 35% in density and 66%, 27% in biomass, respectively. For densities and biomass of several uncommon taxa, polychaetes were 6% and 0.1%, gammarids were 8% and 0.1%, ephemerids were 7% and 1%, respectively. As to the difference between lake proper and outlet, the former are more abundant in annelids and arthropods, but less in molluscs. Zoobenthos as a whole in the adjoining main river, was conspicuously less abundant than that in the lake, being 34% in density and 1% in biomass, and annelids predominated.

Tab. 2 Densities(D, ind/m^2) and wet biomass (B, g/m^2) of taxonomic groups of zoobenthos in Poyang Lake and adjoining main river of Changjiang, with their S.E.(±) and percentages (%, in parentheses)

Stations	River(ST1, 3—5)		Lake outlet (ST6—12)		Lake proper (ST13—18)		Entire lake (ST6—18)		Entire sampling area (ST1, 3—18)	
	D	B	D	B	D	B	D	B	D	B
Annelida	152±106 (80.9)	.9±.7 (66.7)	80±58 (14.4)	.3±.1 (.2)	109±71 (19.7)	.5±.4 (.4)	93±43 (16.8)	.4±.2 (.3)	107±40 (22.9)	.5±.2 (.4)
Mollusca	0±0 (0)	0±0 (0)	389±126 (70.0)	158.7±58.3 (98.7)	288±131 (51.9)	138.9±57.1 (99.4)	342±88 (61.6)	149.6±39.4 (99.0)	262±76 (55.8)	114.4±33.7 (98.7)
Arthropoda	36±16 (19.1)	.4±.2 (33.3)	75±47 (13.6)	1.9±1.2 (1.2)	141±85 (25.5)	.3±.1 (.2)	106±46 (19.1)	1.1±.7 (.8)	89±35 (19.1)	1.0±.5 (.8)
Others	0±0 (0)	0±0 (0)	11±11 (2.1)	0±0 (0)	16±16 (2.9)	.1±.06 (.04)	14±9 (2.4)	.03±.03 (.02)	10±7 (2.2)	.02±.02 (.02)
Total	188±105 (100)	1.3±.8 (100)	555±145 (100.1)	160.9±58.2 (100.1)	554±186 (100)	139.8±57.1 (100.04)	555±111 (99.9)	151.1±39.3 (100.12)	468±95 (100)	115.9±33.7 (99.2)

4 Funtional feeding groups

On the basis of feeding strategies, zoobenthos is divided into four groups, viz. shredder, collector-filterer, collector-gatherer and predator (Morse, et al., 1994; Liang & Wang, 1999), and each taxa was assigned to particular feeding groups. They were then summed up to form the proportions of different groups in the zoobenthic community (Tab. 3). In entire lake, collector-filterers and scrapers represented by *Corbicula* and *Parafossarulus* were predominant, being 24%, 39% in density and 66%, 33% in biomass, respectively. It seems attributable to the absence of macrophytes and the prevalence of hard bottom in sampling area. Lake proper was more plentiful in shredders than the outlet, with alike collector-gatherers and

less scrapers. The river was relatively rich in shredders and collector-gatherers, probably owing to the richness of allochthonous organic particles. Predators were in low proportions both in the lake and in the river, less than 7% in density and 1% in biomass, repectively.

Tab. 3 Numbers of taxa (S), densities(D, ind/m^2)and wet biomass (B, g/m^2) of functional feeding groups of zoobenthos in Poyang Lake and adjoining main river of Changjiang, with their S.E.(±) and percentages (%, in parentheses)

Stations	River(ST1, 3-5)			Lake outlet(ST6-12)			Lake proper(ST13-18)			Entire lake ST6-18			Entire sampling area (ST1,3-18)		
	S	D	B	S	D	B	S	D	B	S	D	B	S	D	B
Shredders	1	112±112	.7±.7	1	57±47	.1±.07	2	104±79	.3±.1	2	79±43	.2±.07	2	86±40	.3±.2
	(10)	(59.6)	(54.6)	(8.3)	(10.3)	(.08)	(8.7)	(18.8)	(.2)	(7.1)	(14.2)	(.1)	(6.1)	(18.5)	(.3)
Collector-filterers	0	0±0	0±0	2	107±43	101.6±36.8	1	160±93	98.6±58.3	2	132±47	100.2±31.9	2	101±38	76.7±26.4
	(0)	(0)	(0)	(16.7)	(19.3)	(63.2)	(4.3)	(28.8)	(70.5)	(7.1)	(23.7)	(66.3)	(6.1)	(21.5)	(66.1)
Collector-gatherers	5	60±36	.6±.2	4	105±60	2.0±1.3	10	120±77	.5±.4	11	112±46	1.3±.7	13	100±36	1.1±.5
	(50)	(31.9)	(44.5)	(33.3)	(18.9)	(1.2)	(43.5)	(21.6)	(.3)	(39.3)	(20.2)	(.9)	(39.4)	(21.3)	(1.0)
Scrapers	1	4±4	.0002±.0002	3	281±91	57.0±23.8	6	139±86	40.3±21.8	7	215±64	49.3±15.8	8	166±53	37.7±13.1
	(10)	(2.1)	(.02)	(25.0)	(50.6)	(35.5)	(26.1)	(25.0)	(28.9)	(25.0)	(38.8)	(32.6)	(24.2)	(35.3)	(32.5)
Predators	3	12±4	.01±.009	2	5±5	.02±.02	4	32±32	.1±.1	6	17±27	.07±.06	8	16±11	.05±.04
	(30)	(6.4)	(.9)	(16.7)	(.8)	(.01)	(17.4)	(5.8)	(.09)	(21.4)	(3.1)	(.04)	(24.2)	(3.4)	(.05)
Total	10	188±105	1.3±.8	12	555±145	160.9±68.0	23	555±186	139.8±24.1	28	555±111	151.1±39.3	33	469±95	115.85±34.12
	(100)	(100)	(100.02)	(100)	(99.9)	(99.99)	(100)	(100)	(99.99)	(99.9)	(100)	(99.94)	(100)	(100)	(99.95)

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