

Research Article

Length–Mass and Length–Weight Relationships of Japanese Freshwater Fishes

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Relationships between weights (W , dry weight [DW] and wet weight [WW] and lengths L , standard length [SL], head length [HL], and caudal peduncle depth [CD]) and these between DW and WW were examined in 61 freshwater fishes using formula $W = aL^b$ and $DW = aWW^b$, respectively. The parameters of the SL–DW, SL–WW, HL–DW, HL–WW, CD–DW, CD–WW, and WW–DW relationships were determined for 60, 61, 57, 58, 50, 50, and 61 taxa, respectively, with the criterion where the estimated R-square was greater than 0.8. For the genus or higher taxonomic level, parameters of the SL–DW and SL–WW relationships were determined for 20 taxonomic groups with the same criterion to each species. For the three eel-like species, the SL–DW and SL–WW relationships were largely consistent with the pooled taxonomic data. In contrast, noneel-like species exhibited variations in these relationships across species. Systematic variations in the SL–DW and SL–WW relationships were observed at the order and family levels, except in Salmonidae, Cobitidae, and Cottidae. However, at the genus level, these relationships were generally consistent among species. These intragroup variations should be considered when applying these equations to ecological and taxonomic studies.

Keywords: cypriniformes; eel-like form species; perciformes; siluriformes; stream fish

1. Introduction

Fishes are major consumers in freshwater communities, and the data on the relationships between their length and weight are highly valuable for stream ecology studies. For example, these relationships can be used to convert abundance data into biomass estimates by measuring only certain body parts such as standard length (SL), fork length, head length (HL), skull length, and otolith diameter in collected specimens [1–10]. Additionally, body part length is used to estimate the size of prey found in the stomachs of piscivorous predators [1, 7]. This study estimates the relationships between length and both wet weight (WW) and dry weight (DW). WW is particularly important in fisheries research because it provides essential parameters, such as the biomass and production of fishes, for estimating their

distribution and dynamics in natural environments and aquaculture systems [2, 4, 5]. In contrast, DW is valuable for conducting quantitative assessment at the community and ecosystem levels, particularly in studies analyzing consumer–resource relationships. Such studies include the quantitative descriptions of food webs, estimations of nutrient and energy fluxes, and assessments of interaction strength [11, 12].

The relationships between the length and weight of freshwater fishes have been reported for several regions, such as North [10, 13] and Central America [9], Central Asia [8], and New Zealand [2]. The Japanese Archipelago, an island system extending more than 2000 km in a northeast–southwest direction along the eastern margin of East Asia, harbors more than 300 species of freshwater fishes, including endemic species such as *Niwaella delicata*

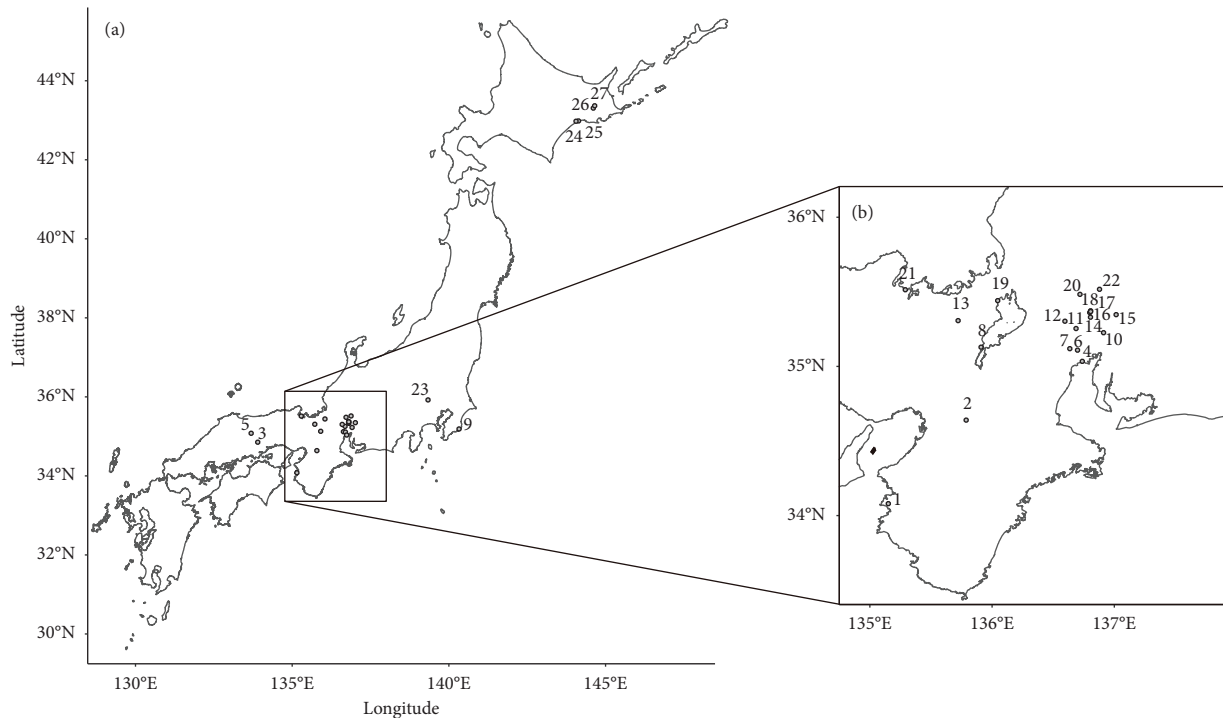


FIGURE 1: Location of sampling sites. Numbers consist of the site no. in Table 1.

and *Liobagrus reinii* [14]. These taxa are likely to exhibit unique length–weight relationships due to their prolonged or flattened morphologies. However, only a few studies have examined these relationships in Japan [7, 15]. Consequently, researchers often rely on data from fish species in other regions or must collect their own data for target species. Using length–weight relationships from non-target species or different regions may lead to inaccuracies, as demonstrated in studies on macroinvertebrates [16, 17].

In the present study, we examined the relationships between weights (W , both DW and WW) and lengths (L , body length, HL, and depth of the caudal peduncle) for 61 freshwater fish species using formula $W = aL^b$. HL and caudal peduncle depth (CD) are particularly useful for reconstructing fish mass when only the anterior or posterior parts of prey are found in the stomachs of predators. Furthermore, we compared the regression coefficients for the length–mass relationships between species.

2. Materials and Methods

Fish sampling was conducted in streams in the Hokkaido and Honshu Islands, Japan, from January to October 2024 (Figure 1) (Table S1). To minimize damage to local populations, only predominant fish species were captured at each site using hand nets (2-mm mesh opening), seine nets (15-mm mesh opening), cast nets (8- or 15-mm mesh opening), traps, and an electrofisher (LR-20B, Smith-Root). The fish were transported to the laboratory alive, kept in aerated tanks at room temperature (20°C) overnight to allow for gut evacuation, anesthetized with clove oil, and preserved in a freezer (−20°C) until subsequent analysis.

Previous studies on the gastric evacuation rates of Japanese fishes have demonstrated that, under these conditions, most stomach contents are evacuated within 12 h or less, regardless of stomach fullness at the time of capture [18–20]. For invasive alien species (*Micropterus nigricans* and *Lepomis macrochirus*), which are subject to transport regulations, the fish were held on-site in a bag overnight, anesthetized with clove oil, iced, and then transported to the laboratory.

SL, HL, and CD were measured to the nearest 0.1 mm using a slide caliper for each specimen. WW was measured to the nearest 0.1 g for individuals ≥ 10.0 g and to the nearest 0.001 g for individuals < 10.0 g using an electric balance. DW was measured after drying specimens at 60°C for 72 h in a constant-temperature oven, a duration sufficient for the weight loss of the largest specimen to stabilize. Relationships between the lengths of body parts (L , mm) and weights (g) were examined for species with more than eight individuals using the following formula:

$$\ln W = \ln a + b \ln L. \quad (1)$$

The relationship between WW (g) and DW (g) was examined using the following formula:

$$\ln DW = \ln a + b \ln WW. \quad (2)$$

For the genus or higher taxonomic level, the SL–DW and SL–WW relationships also were examined for the taxa including more than two next lower level taxa. The relationships pooling the all species were separately examined for the eel-like form taxa (*Lethenteron* sp., *Anguilla japonica*, and *Monopterus albus*) and the others due to the obvious

TABLE 1: Taxa, number of specimens, and the range of standard lengths of fishes examined in this study, including the determined relationships with the criterion that the R-squared value was greater than 0.8.

Taxon	Order	Family	Genus	N	Range of standard length (mm)	Determination	Site no.
<i>Lethenteron</i> sp.	Petromyzontiformes	Petromyzontidae	Lethenteron	9	57.4–116.0	SL → DW, SL → WW, HL → DW, HL → WW, WW → DW	27, 25, 26
<i>Anguilla japonica</i>	Anguilliformes	Anguillidae	Anguilla	9	203.8–417.9	SL → DW, SL → WW, HL → DW, HL → WW, WW → DW	11, 18
<i>Barbatula barbatula</i>	Cypriniformes	Balitoridae	Barbatula	19	31.1–110.1	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, WW → DW	25, 26, 24
<i>Lefua echigonia</i>	Cypriniformes	Balitoridae	Lefua	12	17.1–48.9	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, WW → DW	22
<i>Cobitis biwae</i>	Cypriniformes	Cobitidae	Cobitis	20	59.6–88.5	SL → DW, SL → WW, HL → DW, HL → WW, WW → DW	18
<i>Cobitis minamorii</i>	Cypriniformes	Cobitidae	Cobitis	30	22.0–61.5	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, WW → DW	18, 11
<i>Misgurnus</i> sp.	Cypriniformes	Cobitidae	Misgurnus	18	41.3–161.0	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW	18, 22, 20
<i>Niwaella delicata</i>	Cypriniformes	Cobitidae	Niwaella	22	54.4–88.2	SL → DW, SL → WW, HL → DW, HL → WW, WW → DW	13
<i>Abbottina rivularis</i>	Cypriniformes	Cyprinidae	Abbottina	18	28.5–92.1	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, WW → DW	18
<i>Acheilognathus rhombeus</i>	Cypriniformes	Cyprinidae	Acheilognathus	14	40.1–73.9	SL → DW, SL → WW, HL → DW, CD → DW, CD → WW, WW → DW	18, 19
<i>Biwia zezera</i>	Cypriniformes	Cyprinidae	Biwia	16	40.4–56.0	SL → DW, SL → WW, HL → DW, HL → WW, WW → DW	18
<i>Carassius cuvieri</i>	Cypriniformes	Cyprinidae	Carassius	1	94.7–94.7	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW	18
<i>Carassius</i> sp.	Cypriniformes	Cyprinidae	Carassius	15	23.5–122.5	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, WW → DW	18
<i>Cyprinus carpio</i>	Cypriniformes	Cyprinidae	Cyprinus	13	26.2–141.3	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, WW → DW	18
<i>Gnathopogon elongatus</i>	Cypriniformes	Cyprinidae	Gnathopogon	16	59.3–86.0	SL → DW, SL → WW, HL → DW, HL → WW, WW → DW	18
<i>Hemibarbus barbus</i>	Cypriniformes	Cyprinidae	Hemibarbus	16	24.9–148.0	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, WW → DW	18, 11
<i>Hemibarbus longirostris</i>	Cypriniformes	Cyprinidae	Hemibarbus	4	46.9–114.0	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, WW → DW	13
<i>Nipponocypris sieboldii</i>	Cypriniformes	Cyprinidae	Nipponocypris	9	48.5–87.0	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, WW → DW	20
<i>Nipponocypris temminckii</i>	Cypriniformes	Cyprinidae	Nipponocypris	26	47.5–115.8	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, WW → DW	13, 18
<i>Opsariichthys platypus</i>	Cypriniformes	Cyprinidae	Opsariichthys	27	36.9–111.6	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, WW → DW	18
<i>Opsariichthys uncirostris</i>	Cypriniformes	Cyprinidae	Opsariichthys	20	134.3–247.0	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, WW → DW	19
<i>Pseudogobio esocinus</i>	Cypriniformes	Cyprinidae	Pseudogobio	18	30.8–137.7	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, WW → DW	18

TABLE 1: Continued.

Taxon	Order	Family	Genus	N	Range of standard length (mm)	Determination	Site no.
<i>Pseudorasbora parva</i>	Cypriniformes	Cyprinidae	<i>Pseudorasbora</i>	16	25.5–85.0	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	18, 16, 20
<i>Pungtungia herzi</i>	Cypriniformes	Cyprinidae	<i>Pungtungia</i>	14	22.0–101.6	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	15, 13, 3, 5
<i>Rhodeus ocellatus</i>	Cypriniformes	Cyprinidae	<i>Rhodeus</i>	17	23.5–47.6	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	18
<i>Rhynchocypris lagowskii</i>	Cypriniformes	Cyprinidae	<i>Rhynchocypris</i>	9	30.4–74.9	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	18
<i>Rhynchocypris oxycephalus</i>	Cypriniformes	Cyprinidae	<i>Rhynchocypris</i>	23	29.4–96.9	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	13
<i>Sarcocheilichthys variegatus</i>	Cypriniformes	Cyprinidae	<i>Sarcocheilichthys</i>	12	47.0–102.7	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	18, 7, 11
<i>Squalidus chankaensis</i>	Cypriniformes	Cyprinidae	<i>Squalidus</i>	23	35.0–94.5	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	18, 11, 20, 17
<i>Squalidus gracilis</i>	Cypriniformes	Cyprinidae	<i>Squalidus</i>	12	45.0–59.2	SL → DW, SL → WW, HL → DW, HL → WW, WW → DW	16
<i>Tanakia lanceolata</i>	Cypriniformes	Cyprinidae	<i>Tanakia</i>	2	23.5–25.6	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	20
<i>Tanakia limbata</i>	Cypriniformes	Cyprinidae	<i>Tanakia</i>	18	19.5–41.0	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	20
<i>Tribolodon hakonensis</i>	Cypriniformes	Cyprinidae	<i>Tribolodon</i>	13	38.6–165.1	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	13
<i>Liobagrus reinii</i>	Siluriformes	Amblycipitidae	<i>Liobagrus</i>	23	39.9–94.9	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	13
<i>Tachysurus nudiceps</i>	Siluriformes	Bagridae	<i>Tachysurus</i>	12	31.9–130.0	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	18, 16
<i>Tachysurus tokiensis</i>	Siluriformes	Bagridae	<i>Tachysurus</i>	12	31.9–94.0	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	9
<i>Silurus asotus</i>	Siluriformes	Siluridae	<i>Silurus</i>	13	43.2–210.2	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	18, 16
<i>Oncorhynchus masou</i>	Salmoniformes	Salmonidae	<i>Oncorhynchus</i>	13	49.4–109.6	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	27, 26, 18, 25
<i>Salvelinus leucomaenis</i>	Salmoniformes	Salmonidae	<i>Salvelinus</i>	20	42.0–110.9	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	27, 26
<i>Plecoglossus altivelis</i>	Osmeriformes	Osmeridae	<i>Plecoglossus</i>	15	47.4–154.0	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	18
<i>Gasterosteus</i> sp.	Gasterosteiformes	Gasterosteidae	<i>Gasterosteus</i>	10	22.0–25.7	SL → DW, SL → WW, HL → DW, HL → WW, WW → DW	24
<i>Pungitius</i> sp.	Gasterosteiformes	Gasterosteidae	<i>Pungitius</i>	20	19.7–47.5	SL → DW, SL → WW, HL → DW, HL → WW, WW → DW	26, 25
<i>Pungitius tymensis</i>	Gasterosteiformes	Gasterosteidae	<i>Pungitius</i>	26	17.0–55.6	SL → DW, SL → WW, HL → DW, HL → WW, WW → DW	26, 25
<i>Monopterus albus</i>	Synbranchiformes	Synbranchidae	<i>Monopterus</i>	11	174.0–614.0	SL → DW, SL → WW, HL → DW, HL → WW, WW → DW	2

TABLE 1: Continued.

Taxon	Order	Family	Genus	N	Range of standard length (mm)	Determination	Site no.
<i>Chelon affinis</i>	Mugiliformes	Mugilidae	Chelon	2	41.2–57.9	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	21
<i>Mugil cephalus</i>	Mugiliformes	Mugilidae	Mugil	21	46.2–114.2	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	21, 7
<i>Oryzias latipes</i>	Beloniformes	Adrianichthyidae	Oryzias	21	10.9–22.2	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	14
<i>Gambusia affinis</i>	Cyprinodontiformes	Poeciliidae	Gambusia	30	11.8–32.3	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	6
<i>Lepomis macrochirus</i>	Perciformes	Centrarchidae	Lepomis	12	43.2–123.4	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	18
<i>Micropterus nigricans</i>	Perciformes	Centrarchidae	Micropterus	17	31.9–224.0	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	18
<i>Channa argus</i>	Perciformes	Channidae	Channa	3	99.2–176.9	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	18
<i>Cottus nozawae</i>	Perciformes	Cottidae	Cottus	14	38.2–103.1	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	27, 25
<i>Cottus pollux</i>	Perciformes	Cottidae	Cottus	21	24.0–118.9	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	13
<i>Rheopresbe kazika</i>	Perciformes	Cottidae	Rheopresbe	16	32.5–66.3	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	7
<i>Eleotris oxycephala</i>	Perciformes	Eleotridae	Eleotris	12	42.4–156.6	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	1, 11
<i>Acanthogobius flavimanus</i>	Perciformes	Gobiidae	Acanthogobius	15	34.4–112.6	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	11, 21, 7
<i>Gymnogobius castaneus</i>	Perciformes	Gobiidae	Gymnogobius	3	21.9–50.7	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	26
<i>Gymnogobius petschiliensis</i>	Perciformes	Gobiidae	Gymnogobius	5	39.9–79.3	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	6, 12, 1
<i>Gymnogobius</i> sp.	Perciformes	Gobiidae	Gymnogobius	11	34.7–45.5	SL → DW, SL → WW, HL → DW, HL → WW, WW → DW	23
<i>Gymnogobius urotaenia</i>	Perciformes	Gobiidae	Gymnogobius	15	25.0–85.2	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	11, 18
<i>Luciogobius guttatus</i>	Perciformes	Gobiidae	Luciogobius	2	44.9–48.0	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	1
<i>Rhinogobius brunneus</i>	Perciformes	Gobiidae	Rhinogobius	3	12.0–24.3	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	11
<i>Rhinogobius fluminis</i>	Perciformes	Gobiidae	Rhinogobius	39	24.1–54.4	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	18, 13
<i>Rhinogobius giurinus</i>	Perciformes	Gobiidae	Rhinogobius	26	24.1–67.3	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	11, 7, 12, 6, 10
<i>Rhinogobius nagoyae</i>	Perciformes	Gobiidae	Rhinogobius	23	30.5–52.2	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	1, 7
<i>Rhinogobius</i> sp.	Perciformes	Gobiidae	Rhinogobius	4	25.5–47.2	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	26
<i>Sicyopterus japonicus</i>	Perciformes	Gobiidae	Sicyopterus	15	45.9–72.5	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	1
<i>Tridentiger brevispinis</i>	Perciformes	Gobiidae	Tridentiger	42	27.5–86.4	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	7, 11, 18, 19, 12

TABLE 1: Continued.

Taxon	Order	Family	Genus	N	Range of standard length (mm)	Determination	Site no.
<i>Lateolabrax japonicus</i>	Perciformes	Lateolabracidae	Lateolabrax	4	46.7–69.4	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	11, 7
<i>Odontobutis obscura</i>	Perciformes	Odontobutidae	Odontobutis	20	28.6–120.8	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	8
<i>Coreoperca kawanebari</i>	Perciformes	Siniperacidae	Coreoperca	16	19.6–79.0	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	15
<i>Oreochromis niloticus</i>	Cichliformes	Cichlidae	Oreochromis	15	18.0–44.6	SL → DW, SL → WW, HL → DW, HL → WW, CD → DW, CD → WW, WW → DW	4
<i>Takifugu niphobles</i>	Tetraodontiformes	Tetraodontidae	Takifugu	5	24.3–31.9		21

Note: Site no. consists of the numbers in the sampling locations in Figure 1.

Abbreviations: CD, caudal peduncle depth; DW, dry weight; HL, head length; SL, standard length; WW, wet weight.

TABLE 2: Parameters and R-squared values of the relationship between standard length (SL, mm) and dry (DW, g) and wet (WW, g) weights in each species, using the equation $\ln DW = \ln a + b \ln SL$ or $\ln WW = \ln a + b \ln SL$.

Taxon	$\ln DW = \ln a + b \ln SL$			$\ln WW = \ln a + b \ln SL$		
	$\ln a$	b	R-square	$\ln a$	b	R-square
<i>Lethenteron</i> sp.	-15.599	3.085	0.918	-12.493	2.808	0.966
<i>Anguilla japonica</i>	-15.431	3.061	0.971	-13.582	2.978	0.976
<i>Carassius</i> sp.	-13.166	3.290	0.997	-10.776	3.071	0.999
<i>Cyprinus carpio</i>	-13.290	3.269	0.996	-11.195	3.171	0.996
<i>Acheilognathus rhombeus</i>	-13.093	3.274	0.980	-11.480	3.227	0.988
<i>Rhodeus ocellatus</i>	-14.318	3.671	0.970	-12.280	3.492	0.982
<i>Tanakia limbata</i>	-12.358	3.101	0.968	-12.319	3.451	0.979
<i>Hemibarbus barbus</i>	-13.407	3.149	0.993	-11.137	2.981	0.996
<i>Abbottina rivularis</i>	-12.501	3.021	0.986	-10.676	2.922	0.995
<i>Biwia zezera</i>	-14.299	3.420	0.969	-11.577	3.098	0.970
<i>Pseudogobio esocinus</i>	-13.373	3.104	0.992	-11.612	3.058	0.995
<i>Squalidus chankaensis</i>	-13.729	3.262	0.972	-11.910	3.195	0.983
<i>Squalidus gracilis</i>	-11.268	2.686	0.927	-10.287	2.821	0.950
<i>Sarcocheilichthys variegatus</i>	-13.196	3.206	0.966	-11.520	3.134	0.988
<i>Pseudorasbora parva</i>	-14.047	3.411	0.997	-11.976	3.241	0.998
<i>Pungtungia herzi</i>	-13.511	3.274	0.989	-12.104	3.243	0.992
<i>Gnathopogon elongatus</i>	-14.119	3.421	0.974	-11.411	3.110	0.972
<i>Nipponocypris sieboldii</i>	-15.714	3.788	0.996	-11.636	3.165	0.990
<i>Nipponocypris temminckii</i>	-12.809	3.075	0.976	-11.218	3.058	0.991
<i>Opsariichthys platypus</i>	-13.929	3.263	0.991	-11.767	3.096	0.996
<i>Opsariichthys uncirostris</i>	-11.716	2.865	0.920	-10.173	2.845	0.952
<i>Rhynchocypris lagowskii</i>	-13.387	3.219	0.998	-11.472	3.105	0.995
<i>Rhynchocypris oxycephalus</i>	-12.684	3.011	0.994	-11.567	3.113	0.995
<i>Tribolodon hakonensis</i>	-13.357	3.141	0.995	-11.125	2.989	0.998
<i>Misgurnus</i> sp.	-13.924	3.150	0.963	-13.012	3.259	0.969
<i>Cobitis biwae</i>	-15.150	3.448	0.910	-12.975	3.274	0.936
<i>Cobitis minamorii</i>	-14.038	3.178	0.975	-12.760	3.231	0.978
<i>Niwaella delicata</i>	-15.584	3.493	0.826	-12.436	3.071	0.882
<i>Lefua echigonia</i>	-13.865	3.306	0.985	-12.452	3.252	0.989
<i>Barbatula barbatula</i>	-14.253	3.253	0.983	-11.417	2.974	0.990
<i>Silurus asotus</i>	-13.423	3.028	0.995	-10.337	2.741	0.997
<i>Tachysurus nudiceps</i>	-13.522	3.208	0.980	-11.202	3.023	0.995
<i>Tachysurus tokiensis</i>	-13.565	3.180	0.976	-11.297	3.047	0.986
<i>Liobagrus reinii</i>	-13.665	3.166	0.985	-11.559	3.029	0.994
<i>Salvelinus leucomaenis</i>	-14.102	3.306	0.994	-11.183	3.040	0.996
<i>Oncorhynchus masou</i>	-15.672	3.709	0.965	-12.058	3.266	0.976
<i>Plecoglossus altivelis</i>	-16.070	3.704	0.996	-12.622	3.313	0.995
<i>Gasterosteus</i> sp.				-12.656	3.391	0.870
<i>Pungitius</i> sp.	-14.868	3.501	0.969	-11.316	2.946	0.983
<i>Pungitius tymensis</i>	-13.757	3.246	0.985	-11.831	3.163	0.991
<i>Monopterus albus</i>	-14.832	2.911	0.975	-13.272	2.891	0.981
<i>Mugil cephalus</i>	-12.698	3.027	0.979	-10.674	2.956	0.961
<i>Oryzias latipes</i>	-13.337	3.328	0.980	-10.857	3.008	0.981
<i>Gambusia affinis</i>	-13.110	3.276	0.980	-11.206	3.093	0.977
<i>Odontobutis obscura</i>	-12.042	2.988	0.986	-10.008	2.870	0.994
<i>Eleotris oxycephala</i>	-13.098	3.161	0.998	-11.701	3.180	0.998
<i>Acanthogobius flavimanus</i>	-13.446	3.162	0.999	-10.799	2.913	0.998
<i>Gymnogobius urotaenia</i>	-14.864	3.531	0.994	-12.534	3.346	0.995
<i>Gymnogobius</i> sp.	-14.421	3.483	0.935	-12.772	3.483	0.938
<i>Tridentiger brevispinis</i>	-12.091	2.940	0.979	-10.627	2.939	0.983
<i>Rhinogobius flumineus</i>	-12.339	2.965	0.967	-10.725	2.917	0.973
<i>Rhinogobius giurinus</i>	-13.827	3.391	0.981	-11.602	3.165	0.984
<i>Rhinogobius nagoyae</i>	-12.840	3.123	0.925	-11.022	3.020	0.919
<i>Sicyopterus japonicus</i>	-11.555	2.796	0.939	-11.182	3.065	0.959
<i>Lepomis macrochirus</i>	-12.764	3.263	0.981	-11.206	3.225	0.984
<i>Micropterus nigricans</i>	-13.351	3.280	0.997	-11.098	3.110	0.996
<i>Coreoperca kawamebari</i>	-13.265	3.366	0.995	-11.544	3.268	0.997
<i>Cottus nozawae</i>	-14.203	3.444	0.994	-12.611	3.452	0.993
<i>Cottus pollux</i>	-13.827	3.377	0.993	-11.788	3.217	0.994
<i>Rheopresbe kazika</i>	-13.230	3.266	0.987	-11.178	3.110	0.990
<i>Oreochromis niloticus</i>	-12.707	3.249	0.989	-10.444	3.040	0.992

TABLE 3: Parameters and R-squared values of the relationship between head length (HL, mm) and dry (DW, g) and wet (WW, g) weights in each species, using the equation $\ln DW = \ln a + b \ln HL$ or $\ln WW = \ln a + b \ln HL$.

Taxon	$\ln DW = \ln a + b \ln HL$			$\ln WW = \ln a + b \ln HL$		
	$\ln a$	b	R-square	$\ln a$	b	R-square
<i>Lethenteron</i> sp.	-13.543	4.014	0.803	-10.924	3.758	0.894
<i>Anguilla japonica</i>	-8.649	2.989	0.977	-6.985	2.909	0.982
<i>Carassius</i> sp.	-9.794	3.473	0.986	-7.647	3.247	0.992
<i>Cyprinus carpio</i>	-9.525	3.212	0.996	-7.542	3.117	0.996
<i>Acheilognathus rhombeus</i>	-9.197	3.610	0.804			
<i>Rhodeus ocellatus</i>	-8.949	3.626	0.877	-7.198	3.461	0.893
<i>Tanakia limbata</i>	-8.425	3.29	0.941	-7.962	3.673	0.958
<i>Hemibarbus barbus</i>	-9.114	3.089	0.968	-7.100	2.932	0.977
<i>Abbottina rivularis</i>	-8.708	3.167	0.963	-7.057	3.082	0.984
<i>Biwia zezera</i>	-8.513	3.157	0.861	-6.447	2.909	0.892
<i>Pseudogobio esocinus</i>	-9.151	2.982	0.987	-7.453	2.937	0.989
<i>Squalidus chankaensis</i>	-9.905	3.596	0.951	-8.139	3.513	0.957
<i>Squalidus gracilis</i>	-6.728	2.312	0.921	-5.134	2.284	0.835
<i>Sarcocheilichthys variegatus</i>	-8.130	3.159	0.948	-6.595	3.098	0.976
<i>Pseudorasbora parva</i>	-10.124	3.799	0.983	-8.268	3.617	0.988
<i>Pungtungia herzi</i>	-8.875	3.268	0.981	-7.472	3.220	0.974
<i>Nipponocypris sieboldii</i>	-12.445	4.481	0.979	-8.964	3.766	0.984
<i>Nipponocypris temminckii</i>	-8.570	3.025	0.911	-7.044	3.022	0.934
<i>Opsariichthys platypus</i>	-9.532	3.317	0.966	-7.644	3.164	0.982
<i>Opsariichthys uncirostris</i>	-8.187	2.923	0.916	-6.750	2.924	0.963
<i>Rhynchocypris lagowskii</i>	-8.609	3.031	0.962	-6.810	2.902	0.945
<i>Rhynchocypris oxycephalus</i>	-8.626	3.019	0.983	-7.381	3.124	0.987
<i>Tribolodon hakonensis</i>	-9.146	3.114	0.992	-7.116	2.963	0.995
<i>Misgurnus</i> sp.	-8.254	3.156	0.959	-7.171	3.276	0.970
<i>Cobitis biwae</i>	-8.975	3.288	0.893	-7.093	3.116	0.915
<i>Cobitis minamorii</i>	-8.345	2.965	0.971	-6.992	3.025	0.981
<i>Niwaella delicata</i>				-6.156	2.926	0.842
<i>Lefua echigonia</i>	-9.907	4.132	0.963	-8.612	4.094	0.981
<i>Barbatula barbatula</i>	-11.353	4.130	0.969	-8.735	3.764	0.970
<i>Silurus asotus</i>	-8.454	2.896	0.978	-5.717	2.583	0.951
<i>Tachysurus nudiceps</i>	-8.591	3.031	0.974	-6.527	2.847	0.983
<i>Tachysurus tokiensis</i>	-9.057	3.182	0.982	-6.963	3.043	0.987
<i>Liobagrus reinii</i>	-9.434	3.411	0.988	-7.485	3.253	0.991
<i>Salvelinus leucomaenis</i>	-10.488	3.628	0.980	-7.872	3.34	0.985
<i>Oncorhynchus masou</i>	-10.810	3.745	0.948	-7.760	3.292	0.956
<i>Plecoglossus altivelis</i>	-13.00	4.493	0.962	-9.943	4.041	0.970
<i>Pungitius</i> sp.	-11.131	3.817	0.939	-8.164	3.209	0.951
<i>Pungitius tymensis</i>	-10.357	3.519	0.946	-8.564	3.448	0.963
<i>Monopterus albus</i>	-7.498	2.888	0.956	-5.999	2.872	0.964
<i>Mugil cephalus</i>	-9.315	3.152	0.975	-7.320	3.061	0.946
<i>Oryzias latipes</i>	-8.417	3.659	0.895	-6.435	3.326	0.907
<i>Gambusia affinis</i>	-7.802	2.797	0.963	-6.207	2.648	0.966
<i>Odontobutis obscura</i>	-8.709	2.934	0.975	-6.831	2.827	0.988
<i>Eleotris oxycephala</i>	-8.957	3.046	0.992	-7.540	3.065	0.993
<i>Acanthogobius flavimanus</i>	-8.786	2.895	0.990	-6.502	2.666	0.989
<i>Gymnogobius urotaenia</i>	-8.949	2.950	0.982	-6.938	2.799	0.985
<i>Gymnogobius</i> sp.	-8.355	2.763	0.850	-6.648	2.739	0.838
<i>Tridentiger brevispinis</i>	-7.593	2.649	0.968	-6.134	2.651	0.974
<i>Rhinogobius flumineus</i>	-7.689	2.618	0.873	-6.183	2.589	0.888
<i>Rhinogobius giurinus</i>	-8.185	2.864	0.932	-6.398	2.698	0.952
<i>Rhinogobius nagoyae</i>				-6.124	2.579	0.827
<i>Sicyopterus japonicus</i>	-7.989	3.052	0.928	-7.169	3.303	0.925
<i>Lepomis macrochirus</i>	-9.232	3.277	0.970	-7.678	3.228	0.966
<i>Micropterus nigricans</i>	-10.091	3.330	0.978	-8.037	3.166	0.982
<i>Coreoperca kawamebari</i>	-10.063	3.487	0.990	-8.439	3.387	0.993
<i>Cottus nozawae</i>	-8.641	2.953	0.974	-7.075	2.972	0.982
<i>Cottus pollux</i>	-9.418	3.303	0.990	-7.593	3.148	0.992
<i>Rheopresbe kazika</i>	-10.997	3.595	0.983	-9.039	3.420	0.984
<i>Oreochromis niloticus</i>	-9.363	3.155	0.942	-7.362	2.971	0.957

TABLE 4: Parameters and R-squared values of the relationship between caudal peduncle depth (CD, mm) and dry (DW, g) and wet (WW, g) weights in each species, using the equation $\ln DW = \ln a + b \ln CD$ or $\ln DW = \ln a + b \ln CD$.

Taxon	$\ln DW = \ln a + b \ln CD$			$\ln DW = \ln a + b \ln CD$		
	$\ln a$	b	R -square	$\ln a$	b	R -square
<i>Carassius</i> sp.	-5.684	2.824	0.998	-3.789	2.633	0.998
<i>Cyprinus carpio</i>	-5.560	2.809	0.992	-3.694	2.725	0.992
<i>Acheilognathus rhombeus</i>	-5.067	2.736	0.949	-3.635	2.732	0.982
<i>Rhodeus ocellatus</i>	-4.927	2.655	0.858	-3.391	2.559	0.891
<i>Tanakia limbata</i>	-6.311	3.392	0.864	-5.586	3.773	0.874
<i>Hemibarbus barbus</i>	-6.691	3.558	0.989	-4.770	3.362	0.988
<i>Abbottina rivularis</i>	-5.691	3.139	0.957	-4.075	3.029	0.961
<i>Pseudogobio esocinus</i>	-5.374	3.099	0.987	-3.717	3.044	0.983
<i>Squalidus chankaensis</i>	-5.340	2.971	0.889	-3.690	2.908	0.899
<i>Sarcocheilichthys variegatus</i>	-5.669	3.017	0.952	-4.074	2.903	0.943
<i>Pseudorasbora parva</i>	-5.468	2.824	0.969	-3.819	2.678	0.967
<i>Pungtungia herzi</i>	-6.242	3.140	0.981	-4.903	3.109	0.983
<i>Nipponocypris sieboldii</i>	-6.680	3.833	0.917	-4.179	3.255	0.940
<i>Nipponocypris temminckii</i>	-5.628	3.113	0.945	-4.013	3.064	0.940
<i>Opsariichthys platypus</i>	-5.749	3.124	0.953	-4.011	2.966	0.959
<i>Opsariichthys uncirostris</i>	-6.648	3.558	0.893	-5.254	3.575	0.946
<i>Rhynchocypris lagowskii</i>	-6.147	3.206	0.951	-4.490	3.095	0.949
<i>Rhynchocypris oxycephalus</i>	-5.513	2.653	0.976	-4.150	2.742	0.976
<i>Tribolodon hakonensis</i>	-5.620	3.048	0.949	-3.746	2.892	0.946
<i>Misgurnus</i> sp.	-5.229	2.508	0.972	-4.009	2.594	0.976
<i>Cobitis minamorii</i>	-5.327	2.509	0.967	-3.892	2.543	0.963
<i>Lefua echigonia</i>	-5.517	2.687	0.973	-4.230	2.633	0.969
<i>Barbatula barbatula</i>	-5.688	2.924	0.960	-3.560	2.656	0.955
<i>Silurus asotus</i>	-3.438	2.495	0.848	-1.390	2.319	0.896
<i>Tachysurus nudiceps</i>	-5.588	3.292	0.953	-3.756	3.118	0.977
<i>Tachysurus tokiensis</i>	-5.604	2.948	0.969	-3.652	2.811	0.969
<i>Liobagrus reinii</i>	-7.132	3.028	0.962	-5.295	2.891	0.967
<i>Salvelinus leucomaenis</i>	-5.273	2.735	0.941	-3.060	2.513	0.942
<i>Oncorhynchus masou</i>	-6.053	3.262	0.934	-3.514	2.835	0.920
<i>Plecoglossus altivelis</i>	-5.495	3.203	0.976	-3.162	2.865	0.974
<i>Pungitius tymensis</i>	-2.905	2.704	0.854	-1.258	2.635	0.860
<i>Mugil cephalus</i>	-5.471	3.052	0.953	-3.480	2.901	0.886
<i>Oryzias latipes</i>	-5.718	2.970	0.956	-3.977	2.691	0.962
<i>Gambusia affinis</i>	-6.761	3.323	0.939	-5.209	3.135	0.934
<i>Odontobutis obscura</i>	-5.779	2.979	0.972	-3.944	2.833	0.960
<i>Eleotris oxycephala</i>	-5.329	2.776	0.997	-3.887	2.792	0.997
<i>Acanthogobius flavimanus</i>	-5.984	3.221	0.985	-3.922	2.967	0.984
<i>Gymnogobius urotaenia</i>	-6.249	3.205	0.990	-4.369	3.037	0.991
<i>Tridentiger brevispinis</i>	-5.542	2.797	0.954	-4.080	2.798	0.960
<i>Rhinogobius flumineus</i>	-5.331	2.737	0.893	-3.832	2.693	0.899
<i>Rhinogobius giurinus</i>	-5.548	2.996	0.942	-3.892	2.809	0.953
<i>Rhinogobius nagoyae</i>	-4.819	2.395	0.845	-3.251	2.306	0.832
<i>Sicyopterus japonicus</i>	-5.080	2.441	0.833	-4.120	2.694	0.863
<i>Lepomis macrochirus</i>	-5.413	2.861	0.981	-3.940	2.828	0.984
<i>Micropterus nigricans</i>	-5.900	3.049	0.997	-4.035	2.891	0.996
<i>Coreoperca kawamebari</i>	-5.997	3.206	0.978	-4.493	3.116	0.982
<i>Cottus nozawae</i>	-4.799	3.210	0.911	-3.181	3.214	0.909
<i>Cottus pollux</i>	-4.934	2.985	0.966	-3.319	2.845	0.968
<i>Rheopresbe kazika</i>	-4.314	2.864	0.968	-2.679	2.720	0.967
<i>Oreochromis niloticus</i>	-5.474	2.771	0.933	-3.694	2.605	0.945

TABLE 5: Parameters and R-squared values of the relationship between wet weight (WW, g) and dry weight (DW, g) in each species, using the equation $\ln DW = \ln a + b \ln WW$.

Taxon	$\ln a$	b	R-square
<i>Lethenteron</i> sp.	-1.870	1.115	0.979
<i>Anguilla japonica</i>	-1.473	1.029	0.997
<i>Carassius</i> sp.	-1.620	1.072	0.999
<i>Cyprinus carpio</i>	-1.751	1.030	1.000
<i>Acheilognathus rhombeus</i>	-1.437	1.008	0.980
<i>Rhodeus ocellatus</i>	-1.410	1.055	0.995
<i>Tanakia limbata</i>	-1.287	0.902	0.996
<i>Hemibarbus barbus</i>	-1.641	1.057	0.998
<i>Abbottina rivularis</i>	-1.465	1.034	0.991
<i>Biwia zezera</i>	-1.519	1.097	0.986
<i>Pseudogobio esocinus</i>	-1.586	1.016	0.999
<i>Squalidus chankaensis</i>	-1.560	1.010	0.968
<i>Squalidus gracilis</i>	-1.458	0.937	0.944
<i>Sarcocheilichthys variegatus</i>	-1.416	1.027	0.985
<i>Pseudorasbora parva</i>	-1.440	1.052	0.997
<i>Pungtungia herzi</i>	-1.288	1.007	0.991
<i>Gnathopogon elongatus</i>	-1.556	1.094	0.991
<i>Nipponocypris sieboldii</i>	-1.778	1.190	0.995
<i>Nipponocypris temminckii</i>	-1.530	1.006	0.985
<i>Opsariichthys platypus</i>	-1.524	1.054	0.995
<i>Opsariichthys uncirostris</i>	-1.478	1.008	0.968
<i>Rhynchocypris lagowskii</i>	-1.496	1.033	0.997
<i>Rhynchocypris oxycephalus</i>	-1.496	0.967	0.999
<i>Tribolodon hakonensis</i>	-1.668	1.052	0.999
<i>Misgurnus</i> sp.	-1.353	0.967	0.997
<i>Cobitis biwae</i>	-1.496	1.061	0.988
<i>Cobitis minamorii</i>	-1.491	0.982	0.995
<i>Niwaella delicata</i>	-1.457	1.160	0.974
<i>Lefua echigonia</i>	-1.208	1.014	0.992
<i>Barbatula barbatula</i>	-1.767	1.095	0.996
<i>Silurus asotus</i>	-1.999	1.101	0.991
<i>Tachysurus nudiceps</i>	-1.639	1.064	0.989
<i>Tachysurus tokiensis</i>	-1.774	1.047	0.996
<i>Liobagrus reinii</i>	-1.586	1.047	0.995
<i>Salvelinus leucomaenis</i>	-1.939	1.087	0.996
<i>Oncorhynchus masou</i>	-1.981	1.136	0.990
<i>Plecoglossus altivelis</i>	-1.943	1.111	0.990
<i>Gasterosteus</i> sp.	-1.273	1.066	0.922
<i>Pungitius</i> sp.	-1.422	1.188	0.985
<i>Pungitius tymensis</i>	-1.614	1.026	0.993
<i>Monopterus albus</i>	-1.477	1.010	0.999
<i>Mugil cephalus</i>	-1.732	0.998	0.968
<i>Oryzias latipes</i>	-1.329	1.104	0.994
<i>Gambusia affinis</i>	-1.247	1.056	0.997
<i>Odontobutis obscura</i>	-1.623	1.041	0.992
<i>Eleotris oxycephala</i>	-1.465	0.994	1.000
<i>Acanthogobius flavimanus</i>	-1.724	1.084	0.998
<i>Gymnogobius urotaenia</i>	-1.637	1.054	0.997
<i>Gymnogobius</i> sp.	-1.650	0.998	0.992
<i>Tridentiger brevispinis</i>	-1.463	1.001	0.997
<i>Rhinogobius flumineus</i>	-1.437	1.015	0.991
<i>Rhinogobius giurinus</i>	-1.398	1.069	0.993
<i>Rhinogobius nagoyae</i>	-1.441	1.026	0.992
<i>Sicyopterus japonicus</i>	-1.358	0.917	0.988
<i>Lepomis macrochirus</i>	-1.429	1.012	0.999
<i>Micropterus nigricans</i>	-1.641	1.053	0.998
<i>Coreoperca kawamebari</i>	-1.375	1.031	0.999
<i>Cottus nozawae</i>	-1.616	0.996	0.997
<i>Cottus pollux</i>	-1.451	1.048	0.996
<i>Rheopresbe kazika</i>	-1.493	1.051	0.999
<i>Oreochromis niloticus</i>	-1.543	1.067	0.993

TABLE 6: Number of taxa, parameters, R-squared values of the relationship between standard length (SL, mm) and dry weight (DW, g) at the genus or higher taxonomic level, using the equation $\ln DW = \ln a + b \ln SL$.

Taxon	Order	Family	Genus	Species	N	lna	b	R-square
Non-eel	10	19	46	57	1041	-12.369	2.950	0.928
Eel	3	3	3	3	29	-15.183	2.992	0.990
Cypriniformes	1	3	23	28	486	-12.594	2.982	0.907
Perciformes	1	6	12	16	314	-13.235	3.234	0.962
Siluriformes	1	3	3	4	60	-12.915	2.991	0.966
Cyprinidae	1	1	18	22	365	-12.306	2.961	0.956
Gobiidae	1	1	5	8	186	-12.664	3.054	0.951
Balitoridae	1	1	2	2	31	-12.448	2.829	0.956
Cobitidae	1	1	3	4	90	-13.923	3.141	0.974
Cottidae	1	1	2	3	51	-13.193	3.229	0.988
Centrarchidae	1	1	2	2	29	-13.112	3.274	0.972
Salmonidae	1	1	2	2	33	-14.612	3.442	0.979
<i>Cobitis</i> spp.	1	1	1	2	50	-14.288	3.245	0.986
<i>Cottus</i> spp.	1	1	1	2	35	-13.943	3.396	0.992
<i>Gymnogobius</i> spp.	1	1	1	2	26	-14.153	3.375	0.984
<i>Nipponocypris</i> spp.	1	1	1	2	35	-13.337	3.204	0.972
<i>Opsariichthys</i> spp.	1	1	1	2	47	-14.213	3.336	0.995
<i>Pungitius</i> spp.	1	1	1	2	46	-13.948	3.275	0.964
<i>Rhinogobius</i> spp.	1	1	1	3	88	-13.275	3.235	0.969
<i>Rhynchocypris</i> spp.	1	1	1	2	32	-12.760	3.036	0.994
<i>Squalidus</i> spp.	1	1	1	2	35	-13.238	3.154	0.949
<i>Tachysurus</i> spp.	1	1	1	2	24	-14.012	3.311	0.990

TABLE 7: Number of taxa, parameters, and R-squared values of the relationship between standard length (SL, mm) and wet weight (WW, g) at the genus or higher taxonomic level, using the equation $\ln WW = \ln a + b \ln SL$.

Taxon	Order	Family	Genus	Species	N	lna	b	R-square
Non-eel	10	19	47	58	1051	-10.844	2.943	0.938
Eel	3	3	3	3	29	-11.942	2.675	0.992
Cypriniformes	1	3	23	28	486	-11.129	2.981	0.913
Perciformes	1	6	12	16	314	-11.523	3.173	0.969
Siluriformes	1	3	3	4	60	-10.606	2.829	0.981
Cyprinidae	1	1	18	22	365	-10.859	2.965	0.968
Gobiidae	1	1	5	8	186	-11.009	3.007	0.975
Balitoridae	1	1	2	2	31	-11.992	3.119	0.993
Cobitidae	1	1	3	4	90	-12.187	3.064	0.971
Cottidae	1	1	2	3	51	-11.318	3.129	0.989
Gasterosteidae	1	1	2	3	56	-11.604	3.066	0.971
Centrarchidae	1	1	2	2	29	-11.020	3.129	0.978
Salmonidae	1	1	2	2	33	-11.476	3.118	0.988
<i>Cobitis</i> spp.	1	1	1	2	50	-12.642	3.198	0.988
<i>Cottus</i> spp.	1	1	1	2	35	-11.875	3.253	0.988
<i>Gymnogobius</i> spp.	1	1	1	2	26	-11.850	3.197	0.984
<i>Nipponocypris</i> spp.	1	1	1	2	35	-11.273	3.073	0.991
<i>Opsariichthys</i> spp.	1	1	1	2	47	-12.535	3.289	0.996
<i>Pungitius</i> spp.	1	1	1	2	46	-11.530	3.046	0.962
<i>Rhinogobius</i> spp.	1	1	1	3	88	-11.241	3.068	0.973
<i>Rhynchocypris</i> spp.	1	1	1	2	32	-11.436	3.084	0.995
<i>Squalidus</i> spp.	1	1	1	2	35	-11.550	3.117	0.968
<i>Tachysurus</i> spp.	1	1	1	2	24	-11.235	3.030	0.996

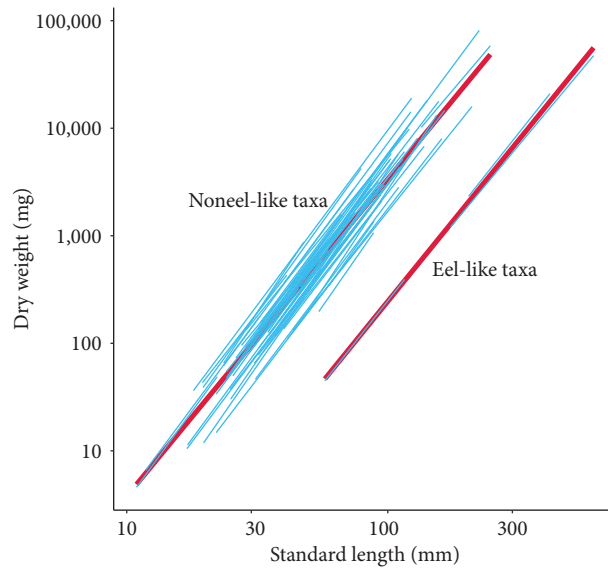


FIGURE 2: Relationships between standard length (SL, mm) and dry weight (DW, g) in eel-like and non-eel-like taxa (bold red lines) and in individual species (thin blue lines).

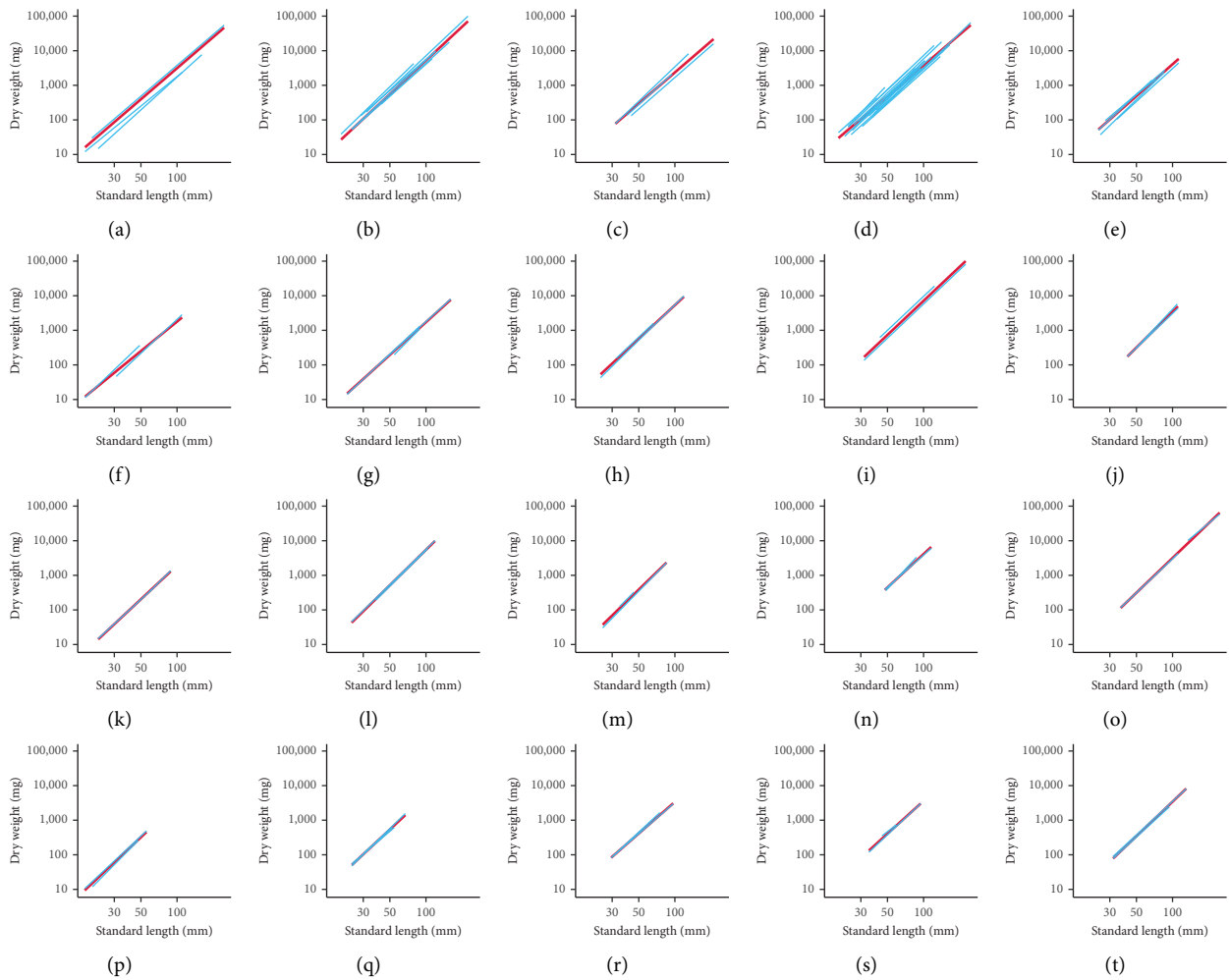


FIGURE 3: Relationships between standard length (SL, mm) and dry weight (DW, g) at the genus or higher taxonomic level (bold red lines) and at the next lower taxonomic level (thin blue lines).

difference in morphology [2]. We determined the parameters for the relationships where the estimated R-square was greater than 0.8.

3. Results and Discussion

Body lengths and weights of 1118 individuals, representing 73 taxa, 55 genera, 25 families, and 14 orders, were measured throughout the sampling (Table 1). The parameters of the SL–DW, SL–WW, HL–DW, HL–WW, CD–DW, CD–WW, and WW–DW relationships were determined for 60, 61, 57, 58, 50, 50, and 61 taxa, respectively (Tables 2, 3, 4, and 5). The parameters, $\ln a$ and b for SL–WW relationships in non-eel-like species ranged from -13.582 to -10.008 and 2.741 to 3.492 , respectively, and were generally consistent with previous studies [3–5, 8]. At the genus or higher taxonomic levels, parameters of the SL–DW and SL–WW relationships were determined for 20 taxonomic groups (Tables 6 and 7). For the three eel-like species, the SL–DW and SL–WW relationships were almost consistent with the pooled taxonomic data (Figure 2). In contrast, non-eel-like species showed variations in these relationships across species, with a considerable number showing notable deviations from the pooled taxonomic relationships (Figure 2). For instance, in the representative compressiform and elongate species, *Coreoperca kawamebari* and *Niwaella delicata*, the estimated DWs for a 100-mm SL individual based on the SL–DW relationship equations were 9.36 g and 1.65 g, respectively. Intentional variation in SL–DW and SL–WW relationships was observed at the order and family levels, except in Salmonidae, Cobitidae, and Cottidae (Figures 3(g), 3(h), 3(j)). However, at the genus level, the SL–DW and SL–WW relationships were largely consistent among species (Figures 3(k), 3(l), 3(m), 3(n), 3(o), 3(p), 3(q), 3(r), 3(s), and 3(t)). These intra-group variations in relationships should be taken into consideration when applying these equations.

This study estimated relationships between body length measurements and weights for over 50 taxa of Japanese freshwater fishes, including some non-native species. These taxa represent only a portion of the freshwater fish fauna in Japan (< 16%). However, the study covered approximately 61% (11/18) of orders and 37% (25/67) of families [14, 21], thereby encompassing a significant portion of fish species that primarily inhabit freshwater environments. Although considerable intra-group variation was observed, as discussed above, we suggest that the data from this study provide valuable reference points for estimating key parameters in fisheries and ecological sciences, particularly for predominant freshwater fish species in Japan. However, this study did not account for intra-specific factors such as sex, gonad development, and nutritional conditions. When examining local populations of a specific species in detail, careful application of the estimated equations presented in this study may be required.

Data Availability Statement

Raw data and the r-code for the examinations of this study are archived at https://github.com/hikarunakagawa/fish_length_mass.

Conflicts of Interest

The authors declare no conflicts of interest.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. (*Supporting Information*)

Table S1: Raw data for examining the length–mass and length–weight relationships.

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