The following supplement accompanies the article

Ichthyophonus parasite phylogeny based on ITS rDNA structure prediction and alignment identifies six clades, with a single dominant marine type

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Table S1. Fish species reported as hosts of parasites in the genus *Ichthyophonus*. List includes infections reported under pseudonyms. DIA = diadromous, SW = salt water (marine), FW = freshwater. Dash indicates provenance of infected host not available from publication.

Family Species (common name)	Region	Habitat	Citation
Anguillidae			
Anguilla japonica (Japanese eel)	Taiwan	DIA	1
Clupeidae			
Alosa pseudoharengus (alewife)	NW Atlantic	DIA	2,3,4
A. sapidissima (American shad)	NE Pacific, NW Atlantic	DIA	5, 6, 7
Clupea harengus (Atlantic herring)	N Atlantic	SW	2, 3, 4, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23
C. pallasii (Pacific herring)	NE Pacific	SW	6, 7, 24, 25, 26, 27, 28, 29, 30, 31, 32
Sprattus sprattus (sprat)	NE Atlantic	SW	8, 19, 21
Tenualosa ilisha (hilsa shad)	Iraq	FW	33
Cyprinidae			
Acanthobrama centisquama	Iraq	FW	33
A. marmid (kalashpa)	Iraq	FW	33
Alburnus caeruleus	Iraq	FW	33
Aspius vorax (shelej)	Iraq	FW	33
Barbus barbulus (abu-barattum)	Iraq	FW	33
B. grypus (shabbout)	Iraq	FW	33
Capoeta damascina (gel khorok)	Iraq	FW	33
C. trutta (barg bidy)	Iraq	FW	33
Carasobarbus luteus (himri)	Iraq	FW	33
Carassius auratus (goldfish)	Africa, France, Iraq	FW	33, 34, 35, 36
C. carassius (crucian carp)	India, Iraq	FW	33, 35, 37
Cyprinion macrostomum	Iraq	FW	33
Cyprinus carpio (common carp)	Iraq,Utah	FW	33, 35, 38
Danio rerio (zebra danio)	–	FW	35
Hypophthalmichthys nobilis (bighead carp)	Africa	FW	36
Luciobarbus esocinus (mangar)	Iraq	FW	33
L. xanthopterus (gattan)	Iraq	FW	33
Mesopotamichthys sharpeyi (bunni)	Iraq	FW	33
Pethia conchonius (rosy barb)	–	FW	35
P. stoliczkana (sonnenfleckbarbe)	–	FW	35

Puntius johorensis (striped barb)	–	FW	35
P. semifasciolatus (Chinese barb)	–	FW	35
Rhodeus amarus (bitterfisch)	–	FW	35
Systomus tetrazona (sumatra barb)	–	FW	35
Tanichthys albonubes (white cloud mountain minnow)	–	FW	35
Tinca tinca (tench)	–	FW	35
Trigonostigma heteromorpha (harlequin rasbora)	–	FW	35
Lebiasinidae			
Nannostomus trifasciatus (threestripe pencilfish)	–	FW	35
Characidae			
Aphyocharax anisitsi (bloodfin tetra)	–	FW	35
Gymnocorymbus ternetzi (black tetra)	–	FW	35
Hemigrammus ocellifer (head-and-tailight tetra)	–	FW	35
H. unilineatus (feather fin tetra)	–	FW	35
Hyphessobrycon anisitsi (Buenos Aires tetra)	–	FW	35
H. flammeus (flame tetra)	–	FW	35
H. rosaceus (rosy tetra)	–	FW	35
Paracheirodon innesi (neon tetra)	–	FW	35
Loricariidae			
Ancistrus brevipinnis (cascudo)	–	FW	35
Bagridae			
Mystus pelusius (abu-zummair)	Iraq	FW	33
Siluridae			
Silurus triostegus (esbele)	Iraq	FW	33
Salmonidae			
Oncorhynchus kisutch (coho salmon)	NW Pacific	DIA	25, 39
O. mykiss (rainbow trout)	France, Germany, Japan, Greece, United States	FW	1, 6, 15, 23, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48
O. nerka (sockeye salmon)	NE Pacific	DIA	39, 49
O. tshawytscha (Chinook salmon)	NE Pacific	DIA	5, 24, 27, 29, 39, 50, 51
Salmo salar (Atlantic salmon)	NE Atlantic, Barents Sea	DIA	14, 15, 52, 53
S. trutta (brown trout/sea trout)	NE Atlantic, Germany, Switzer-land, Tasmania	DIA/FW	35, 54, 55, 56, 57
Salvelinus fontinalis (brook trout)	Germany, Canada	DIA	35, 57, 58
S. malma (Dolly Varden)	Japan	FW	42
Osmeridae			
Hypomesus pretiosus (surf smelt)	NE Pacific	SW	28
Plecoglossidae			
Plecoglossus altivelis (ayu)	Japan	FW	59
Lotidae			
Lota lota (burbot)	North America	FW	50

Gadidae			
Gadus macrocephalus (Pacific cod)	NE Pacific	SW	7, 60
G. morhua (Atlantic cod)	NE Atlantic, NW Atlantic	SW	14, 15, 35, 61
Melanogrammus aeglefinus (haddock)	NE Atlantic, NW Atlantic	SW	14, 15, 16, 22, 35, 54, 62
Merlangius merlangus (whiting)	NE Atlantic	SW	15
Micromesistius poutassou (blue whiting)	NE Atlantic	SW	14, 15, 22
Gadus chalcogrammus (walleye pollock)	NE Pacific	SW	7, 63, 64
Melamphaidae			
Scopelogadus beanii (Bean's bigscale)	Atlantic Ocean	SW	22, 65
Gobiidae			
Brachygobius xanthozona (bumblebee fish)	–	FW	35
Mullidae			
Mullus barbatus barbatus (red mullet)	–	SW	35
Trichiuridae			
Aphanopus carbo (black scabbard fish)	NE Atlantic	SW	66
Scombridae			
Scomber colias (Atlantic chub mackerel)	Mediterranean	SW	40
S. scombrus (Atlantic mackerel)	NE Atlantic, NW Atlantic	SW	3, 14, 67, 68, 69
Mastacembelidae			
Mastacembelus mastacembelus (mar mahi)	Iraq	FW	33
Osphronemidae			
Betta splendens (Siamese fighting fish)	–	FW	35
Macropodus opercularis (paradise fish)	–	FW	35
Trichogaster fasciata (banded gourami)	–	FW	35
Trichopodus trichopterus (three spot gourami)	–	FW	35
Anabantidae			
Anabas testudineus (climbing perch)	–	FW	35
Carangidae			
Seriola dumerili (greater amberjack)	–	SW	35
S. quinqueradiata (yellowtail)	Japan, NW Pacific	SW	1, 70, 71
Trachinotus ovatus (pompano)	NE Atlantic	SW	68
Trachurus trachurus (Atlantic horse mackerel)	Mediterranean, NE Atlantic	SW	40, 68
Citharidae			
Citharus linguatula (spotted flounder)	Mediterranean	SW	72

Scophthalmidae			
Scophthalmus maximus (turbot)	NE Atlantic	SW	73, 74
Paralichthyidae			
Citharichthys stigmaeus (speckled sanddab)	NE Pacific	SW	28
Pleuronectidae			
Hippoglossus stenolepis (Pacific halibut)	NE Pacific	SW	7, 60
Limanda ferruginea (yellowtail flounder)	NW Atlantic	SW	22, 61, 62, 75, 76, 77
Platichthys flesus (European flounder)	NE Atlantic	SW	19, 54
P. stellatus (starry flounder)	NE Pacific	SW	32
Pleuronectes platessa (European plaice)	NE Atlantic	SW	14, 15, 16, 22, 74, 78
Pseudopleuronectes americanus (winter flounder)	NW Atlantic	SW	2, 79
Reinhardtius hippoglossoides (Greenland halibut)	NE Pacific, NW Atlantic	SW	7
Cichlidae			
Hemichromis bimaculatus (jewelfish)	France	FW	34
Oreochromis mossambicus (Mozambique tilapia)	–	FW	35
O. niloticus (Nile tilapia)	Africa	FW	36, 80
Pterophyllum scalare (freshwater angelfish)	France	FW	34, 35
Rocio octofasciata (Jack Dempsey)	France	FW	34, 35
Melanotaeniidae			
Melanotaenia nigrans (black-baded rainbowfish)	–	FW	35
Telmatherinidae			
Marosatherina ladigesi (Celebes rainbowfish)	–	FW	35
Aplocheilidae			
Aplocheilus panchax (blue panchax)	–	FW	35
Poeciliidae			
Heterandria formosa (least killifish)	–	FW	35, 81
Limia nigrofasciata (blackbarred limia)	–	FW	35
Poecilia reticulate (guppy)	–	FW	35, 82
P. sphenops (molly)	–	FW	35
Xiphophorus hellerii (green swordtail)	–	FW	35, 83
X. maculatus (southern platyfish)	–	FW	35, 82
Fundulidae			
Fundulus heteroclitus (mummichog)	NW Atlantic	SW	4
Ambassidae			
Parambassis lala (highfin glassy perchlet)	–	FW	35

Mugilidae			
Chelon subviridis (greenback mullet)	Iraq	FW	33
Liza abu (abu mullet)	Iraq	FW	33, 84
L. aurata (golden grey mullet)	Mediterranean	SW	73
L. saliens (leaping mullet)	Mediterranean	SW	73, 85
Mugil capito (thinlip grey mullet)	Mediterranean	SW	73, 85
M. cephalus (flathead grey mullet)	SW Indian Ocean	SW	35, 86
Pomacentridae			
Dascyllus trimaculatus (threespot dascyllus)	–	SW	35
Premnas biaculeatus (spinecheek anemonefish)	–	SW	35
Moronidae			
Dicentrarchus labrax (European seabass)	Mediterranean	SW	35, 73, 87
Sparidae			
Acanthopagrus schlegelii (blackhead seabream)	Japan	SW	1
Dentex dentex (common dentex)	Mediterranean	SW	35, 88
Diplodus annularis (annular seabream)	–	SW	35
Pagrus pagrus (red porgy)	–	SW	35
Sarpa salpa (salema)	NE Atlantic	SW	68
Sparus aurata (gilthead seabream)	Mediterranean, NE Atlantic	SW	35, 40, 73
Spondyliosoma cantharus (black seabream)	–	SW	35
Scatophagidae			
Scatophagus argus (spotted scat)	–	SW	35
S. tetracanthus (scatty)	–	SW	35
Sciaenidae			
Leiostomus xanthurus (spot)	NW Atlantic	SW	89, 90
Lutjanidae			
Pristipomoides filamentosus (opakapaka)	Hawaii	SW	91
Oplegnathidae			
Oplegnathus fasciatus (barred knifejaw)	Japan	SW	92
Serranidae			
Serranus scriba (painted comber)	–	SW	35
Percidae			
Perca fluviatilis (European perch)	–	FW	35
Trachinidae			
Echiichthys vipera (lesser weever)	–	SW	35

Sebastidae			
Sebastes alutus (Pacific Ocean perch)	NE Pacific	SW	24, 93
S. auriculatus (brown rockfish)	NE Pacific	SW	26
S. caurinus (copper rockfish)	NE Pacific	SW	6, 26
S. emphaeus (Puget Sound rockfish)	NE Pacific	SW	27, 28, 32
S. flavidus (yellowtail rockfish)	NE Pacific	SW	7, 24, 93
S. maliger (quillback rockfish)	NE Pacific	SW	60
S. melanops (black rockfish)	NE Pacific	SW	60
S. pinniger (canary rockfish)	NE Pacific	SW	93
S. reedi (yellowmouth rockfish)	NE Pacific	SW	93
S. ruberrimus (yellow eye rockfish)	NE Pacific	SW	60
Zoarcidae			
Zoarces americanus (eelpout)	NW Atlantic	SW	94
Hexagrammidae			
Ophiodon elongatus (lingcod)	NE Pacific	SW	26, 60
Cottidae			
Cottus aleuticus (coastrange sculpin)	NE Pacific	SW	30
C. asper (prickly sculpin)	NE Pacific	FW	39
Leptocottus armatus (Pacific staghorn sculpin)	NE Pacific	SW	7, 95
Myoxocephalus joak (plain sculpin)	NE Pacific	SW	7
M. octodecemspinosus (longhorn sculpin)	NW Atlantic	SW	61
M. polyacanthocephalus (great sculpin)	NE Pacific	SW	7

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Table S2. Partitions, alignment length, and substitution models used in phylogenetic analysis of *Ichthyophonus* rDNA sequences. Complete sequence included internal transcribed spacer (ITS) 1 and 2, and the 5.8s portion of the large sub-unit. Loop partition consists of unpaired regions of the molecule, and stems are paired bases. Akaike Information Criteria (AIC) was used to select the best fit model for each partition from 24 candidate models[a].

Partition	Aligned length (nt)	Substitution Model
Complete sequence	719	GTR+I[b]
ITS1	245	HKY+Γ[c]
5.8S	162	K80[d]
ITS2	312	HKY+Γ
Loops	375	HKY+Γ
Stems	341	HKY+I[e]

[a]24 candidate models reviewed in Posada & Crandall (2001).
[b]General time-reversible model with a proportion of invariable sites (I).
[c]Model from Hasegawa et al. (1985, with rate heterogeneity (Γ)
[d]Model from Kimura (1980).
[e]Model from Hasegawa et al (1985) with a proportion of invariable sites (I).

Table S3. 2ln Bayes Factor comparisons and ln likelihood (ln*L*) of ITS gene trees resulting from 4 partitioning strategies. 2ln Bayes Factor > 10 indicates very strong evidence against H_0 (Kass & Raftery 1995). Nearly identical values of duplicate MCMC's were omitted for brevity.

H_0	2ln Bayes Factor				ln*L*
	6 Partitions[a]	3 Partitions[b]	2 Partitions[c]	No Part.	
No partitioning	788.6	84.8	476.8	—	–1779.763
2 Partitions	311.8	–392.0	—		–1541.351
3 Partitions	703.8	—			–1737.362
6 Partitions	—				–1385.442

[a]Partitioned by stem and loop within each region (ITS1, 5.8S, ITS2)
[b]Partitioned by region (ITS1, 5.8S, ITS2)
[c]Partitioned by stem and loop

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