

Supplementary Materials:

A DNA Mini-Barcoding System for Authentication of Processed Fish Products

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Table S1 The U.S. Food and Drug Administration (FDA) authenticated fish tissue samples used for primers designing and testing

Sample ID	Species ID	Genbank Accession number	Sample ID	Species ID	Genbank Accession number	Sample ID	Species ID	Genbank Accession number	Sample ID	Species ID	Genbank Accession number
FDA 14	<i>Rhomboplites aurorubens</i>	HQ025004	FDA 44	<i>Echeneis neucratoides</i>	KF461171	FDA 74	<i>Lagocephalus laevigatus</i>	KF461191	FDA 106	<i>Carcharhinus isodon</i>	KF461150
FDA 15	<i>Morone saxatilis</i>	HQ024976	FDA 45	<i>Centropristis ocyurus</i>	KF461154	FDA 75	<i>Brama dussumieri</i>	KF461140	FDA 107	<i>Carcharhinus leucas</i>	KF461151
FDA 17	<i>Paralichthys lethostigma</i>	HQ024992	FDA 46	<i>Rypticus saponaceus</i>	KF461229	FDA 76	<i>Paralichthys lethostigma</i>	KF461217	FDA 108	<i>Dasyatis sabina</i>	KF461169
FDA 18	<i>Morone americana</i>	HQ024972	FDA 47	<i>Prionotus rubio</i>	KF461223	FDA 77	<i>Rhomboplites aurorubens</i>	KF461227	FDA 109	<i>Carcharhinus acronotus</i>	KF461148
FDA 19	<i>Centropristis striata</i>	HQ024936	FDA 48	<i>Chilomycterus schoepfii</i>	KF461157	FDA 78	<i>Balistes vetula</i>	KF461139	FDA 134	<i>Mugil cephalus</i>	n/a*
FDA 20	<i>Oreochromis niloticus</i>	HQ024988	FDA 49	<i>Lutjanus campechanus</i>	KF461194	FDA 79	<i>Chaetodipterus faber</i>	KF461156	FDA 135	<i>Epinephelus flavolimbatus</i>	n/a*
FDA 21	<i>Urophycis chuss</i>	HQ025024	FDA 50	<i>Lutjanus synagris</i>	KF461200	FDA 80	<i>Scomberomorus cavalla</i>	KF461231	FDA 136	<i>Mycteroperca bonaci</i>	n/a*
FDA 22	<i>Merluccius bilinearis</i>	HQ024964	FDA 52	<i>Hemanthias leptus</i>	KF461187	FDA 81	<i>Pareques umbrosus</i>	KF461219	FDA 146	<i>Symphoricarhinus spilurus</i>	n/a*
FDA 23	<i>Micropogonias undulatus</i>	HQ024968	FDA 54	<i>Helicolenus dactylopterus</i>	KF461186	FDA 82	<i>Caulolatilus chrysops</i>	KF461153	FDA 147	<i>Macolor macularis</i>	n/a*
FDA 25	<i>Leiostomus xanthurus</i>	HQ024956	FDA 55	<i>Kyphosus incisor</i>	KF461190	FDA 83	<i>Trachinotus carolinus</i>	KF461244	FDA 151	<i>Diagramma pictum</i>	n/a*
FDA 26	<i>Stenotmus chrysops</i>	HQ025020	FDA 56	<i>Bagre marinus</i>	KF461135	FDA 84	<i>Selene setapinnis</i>	KF461235	FDA 153	<i>Lutjanus rivulatus</i>	n/a*
FDA 27	<i>Pomatomus saltatrix</i>	HQ025000	FDA 57	<i>Elops saurus</i>	KF461177	FDA 86	<i>Euthynnus alletteratus</i>	KF461180	FDA 156	<i>Epinephelus polyphekadion</i>	n/a*
FDA 24	<i>Salmo salar</i>	HQ025008	FDA 58	<i>Lutjanus griseus</i>	KF461196	FDA 87	<i>Lobotes surinamensis</i>	KF461193	FDA 158	<i>Lutjanus argentimaculatus</i>	n/a*
FDA 29	<i>Ocyurus chrysurus</i>	HQ024984	FDA 59	<i>Balistes capriscus</i>	KF461137	FDA 88	<i>Scomberomorus maculatus</i>	KF461233	FDA 159	<i>Epinephelus undulosus</i>	n/a*
FDA 32	<i>Scomberomorus regalis</i>	HQ025016	FDA 60	<i>Hyperoglyphe bythites</i>	KF461189	FDA 89	<i>Ophichthus gomesii</i>	KF461209	FDA 160	<i>Lutjanus bohar</i>	n/a*
FDA 33	<i>Mugil cephalus</i>	HQ024980	FDA 61	<i>Calamus leucosteus</i>	KF461142	FDA 90	<i>Centropristis ocyurus</i>	KF461155	FDA 162	<i>Epinephelus coioides</i>	n/a*
FDA 34	<i>Peprilus paru</i>	HQ024996	FDA 62	<i>Pomatomus saltatrix</i>	KF461220	FDA 91	<i>Pagrus pagrus</i>	KF461214	FDA 164	<i>Lutjanus malabaricus</i>	n/a*
FDA 35	<i>Haemulon plumierii</i>	HQ024940	FDA 63	<i>Archosargus probatocephalus</i>	KF461133	FDA 92	<i>Scorpaena dispar</i>	KF461234	FDA 165	<i>Lutjanus synagris</i>	n/a*
FDA 36	<i>Lagodon rhomboides</i>	HQ024952	FDA 64	<i>Selene vomer</i>	KF461236	FDA 95	<i>Cynoscion arenarius</i>	KF461163	FDA 166	<i>Epinephelus guttatus</i>	n/a*
FDA 37	<i>Archosargus probatocephalus</i>	HQ024932	FDA 66	<i>Rachycentron canadum</i>	KF461225	FDA 97	<i>Haemulon aurolineatum</i>	KF461185	FDA 168	<i>Cynoscion nebulosus</i>	KF461166
FDA 38	<i>Sciaenops ocellatus</i>	HQ025012	FDA 70	<i>Lutjanus griseus</i>	KF461197	FDA 98	<i>Chloroscombrus chrysurus</i>	KF461158	FDA 169	<i>Corniger spinosus</i>	KF461160
FDA 39	<i>Ictalurus punctatus</i>	HQ024944	FDA 71	<i>Canthidermis maculata</i>	KF461143	FDA 99	<i>Ariopsis felis</i>	KF461134	FDA 170	<i>Synodus foetens</i>	KF461243
FDA 42	<i>Elagatis bipinulata</i>	KF461174	FDA 72	<i>Pristigenys alta</i>	KF461224	FDA 100	<i>Sphyrna tiburo</i>	KF461242	FDA 178	<i>Lepidocybium flavobrunneum</i>	KF461192
FDA 43	<i>Opsanus pardus</i>	KF461213	FDA 73	<i>Holocentrus rufus</i>	KF461188	FDA 102	<i>Carcharhinus brevipinna</i>	KF461149	FDA 182	<i>Conger oceanicus</i>	KF461159

*Sequences located here: http://www.accessdata.fda.gov/scripts/fdcc/?set=seafood_barcode_data

Table S2 Detailed results of *in silico* analysis of the taxonomic resolution achieved by the six mini-barcoding regions when compared across 200 species from 124 genera using DNA barcodes from authenticated FDA reference samples. Analysis was carried out based on sequence identity cut-off levels of 98% and 100%


98%	FDA	Primer sets						FDA	Primer sets						FDA	Primer sets						
	Species	A	B	C	D	E	F	Species	A	B	C	D	E	F	Species	A	B	C	D	E	F	
1	Aethaloperca rogaa							41	Diagramma pictum						81	Lethrinus erythraeanthus						
2	Alectis ciliaris							42	Dissostichus eleginoides						82	Lethrinus lentjan						
3	Anarhichas lupus							43	Echeneis neucratoides						83	Lethrinus microdon						
4	Aprion virescens							44	Echiophis punctifer						84	Limanda ferruginea						
5	Archosargus probatocephalus							45	Elagatis bipinnulata						85	Lobotes surinamensis						
6	Ariopsis felis							46	Elops saurus						86	Lophius americanus						
7	Bagre marinus							47	Eopsetta jordani						87	Lophius litulon						
8	Balistes capriscus							48	Epinephelus bleekeri						88	Lutjanus argentimaculatus						
9	Balistes vetula							49	Epinephelus flavolimbatus						89	Lutjanus bohar						
10	Brama dussumieri							50	Epinephelus maculatus						90	Lutjanus campechanus						
11	Brosme brosme							51	Epinephelus adscensionis						91	Lutjanus griseus						
12	Brotula barbata							52	Epinephelus coioides						92	Lutjanus guttatus						
13	Calamus leucosteus							53	Epinephelus drummondhayi						93	Lutjanus jocu						
14	Canthidermis maculata							54	Epinephelus guttatus						94	Lutjanus malabaricus						
15	Canthidermis sufflamen							55	Epinephelus polyphkadion						95	Lutjanus peru						
16	Caranx caninus							56	Epinephelus quoyanus						96	Lutjanus rivulatus						
17	Caranx crysos							57	Epinephelus rivulatus						97	Lutjanus synagris						
18	Caranx hippos							58	Epinephelus undulosus						98	Macolor macularis						
19	Carcharhinus acronotus							59	Euthynnus affinis						99	Malacanthus plumieri						
20	Carcharhinus brevipinna							60	Euthynnus alletteratus						100	Melanogrammus aeglefinus						
21	Carcharhinus isodon							61	Gadus macrocephalus						101	Menticirrhus americanus						
22	Carcharhinus leucas							62	Gadus morhua						102	Merluccius bilinearis						
23	Carcharhinus limbatus							63	Gempylus serpens						103	Micropogonias undulatus						
24	Caulolatilus chrysops							64	Glyptocephalus cynoglossus						104	Microstomus pacificus						
25	Centropristis ocyurus							65	Gymnothorax kolpos						105	Morone americana						
26	Centropristis striata							66	Haemulon aurolineatum						106	Morone saxatilis						
27	Cephalopholis argus							67	Haemulon plumieri						107	Mugil cephalus						
28	Cephalopholis fulva							68	Helicolenus dactylopterus						108	Muraena retifera						
29	Cephalopholis sonnerati							69	Hemanthias leptus						109	Mycteroperca bonaci						
30	Chaetodipterus faber							70	Holocentrus rufus						110	Mycteroperca microlepis						
31	Chanoschanos							71	Hyperoglyphe bythites						111	Narcine bancroftii						
32	Chilomycterus schoepfi							72	Ictalurus furcatus						112	Neomerinthe hemingwayi						
33	Chloroscombrus chrysurus							73	Ictalurus punctatus						113	Ocyurus chrysurus						
34	Conger oceanicus							74	Ictiobus cyprinellus						114	Oncorhynchus gorboscha						
35	Corniger spinosus							75	Katsuwonus pelamis						115	Oncorhynchus kisutch						
36	Cynoscion arenarius							76	Kyphosus incisor						116	Oncorhynchus mykiss						
37	Cynoscion nebulosus							77	Lagocephalus laevigatus						117	Ophichthus gomesii						
38	Dasyatis americana							78	Lagodon rhomboides						118	Ophichthus rex						
39	Dasyatis sabina							79	Leiostomus xanthurus						119	Ophiodon elongatus						
40	Diagramma melanacrum							80	Lepidocybium flavobrunneum						120	Opsanus beta						

 Recovered to species level


 Recovered to genus level

 Not recovered

98%	FDA	Primer sets							FDA	Primer sets					
	Species	A	B	C	D	E	F		Species	A	B	C	D	E	F
121	<i>Opsanus pardus</i>							161	<i>Sebastes maliger</i>						
122	<i>Oreochromis mossambicus</i>							162	<i>Sebastes norvegicus</i>						
123	<i>Oreochromis niloticus</i>							163	<i>Sebastes pinniger</i>						
124	<i>Pagrus pagrus</i>							164	<i>Selene peruviana</i>						
125	<i>Pampus argenteus</i>							165	<i>Selene setapinnis</i>						
126	<i>Pangasius bocourti</i>							166	<i>Selene vomer</i>						
127	<i>Pangasius conchophilus</i>							167	<i>Semicossyphus pulcher</i>						
128	<i>Pangasius hypophthalmus</i>							168	<i>Seriola dumerili</i>						
129	<i>Paralichthys albigutta</i>							169	<i>Seriola lalandi</i>						
130	<i>Paralichthys lethostigma</i>							170	<i>Seriola rivoliana</i>						
131	<i>Paranthias furcifer</i>							171	<i>Siganus javus</i>						
132	<i>Pareques umbrosus</i>							172	<i>Sphoeroides nephelus</i>						
133	<i>Pepilus paru</i>							173	<i>Sphoeroides spengleri</i>						
134	<i>Platichthys stellatus</i>							174	<i>Sphoeroides testudineus</i>						
135	<i>Pleuronectes americanus</i>							175	<i>Sphyaena argentea</i>						
136	<i>Pleuronectes vetulus</i>							176	<i>Sphyaena barracuda</i>						
137	<i>Pogonias cromis</i>							177	<i>Sphyaena guachancho</i>						
138	<i>Pollachius virens</i>							178	<i>Sphyrna lewini</i>						
139	<i>Pomadasys kaakan</i>							179	<i>Sphyrna tiburo</i>						
140	<i>Pomatomus saltatrix</i>							180	<i>Stenotomus chrysops</i>						
141	<i>Prionotus rubio</i>							181	<i>Symphoricthys spilurus</i>						
142	<i>Pristigensys alta</i>							182	<i>Symphorus nematophorus</i>						
143	<i>Rachycentron canadum</i>							183	<i>Synodus foetens</i>						
144	<i>Reinhardtius stomias</i>							184	<i>Takifugu chinensis</i>						
145	<i>Rhizoprionodon terraenovae</i>							185	<i>Takifugu niphobles</i>						
146	<i>Rhomboplites aurorbens</i>							186	<i>Takifugu ocellatus</i>						
147	<i>Ruvettus pretiosus</i>							187	<i>Takifugu pardalis</i>						
148	<i>Rypticus saponaceus</i>							188	<i>Takifugu poecilonotus</i>						
149	<i>Salmo salar</i>							189	<i>Takifugu porphyreus</i>						
150	<i>Sciaenops ocellatus</i>							190	<i>Takifugu snyderi</i>						
151	<i>Scomber japonicus</i>							191	<i>Takifugu vermicularis</i>						
152	<i>Scomberomorus cavalla</i>							192	<i>Takifugu zanthopterus</i>						
153	<i>Scomberomorus maculatus</i>							193	<i>Theragra chalcogramma</i>						
154	<i>Scomberomorus regalis</i>							194	<i>Thunnus alalunga</i>						
155	<i>Scophthalmus aquosus</i>							195	<i>Thunnus albacares</i>						
156	<i>Scorpaena dispar</i>							196	<i>Trachinotus carolinus</i>						
157	<i>Sebastes aleutianus</i>							197	<i>Trichiurus lepturus</i>						
158	<i>Sebastes alutus</i>							198	<i>Urophycis chuss</i>						
159	<i>Sebastes entomelas</i>							199	<i>Variola louti</i>						
160	<i>Sebastes flavidus</i>							200	<i>Zeus faber</i>						

 Recovered to species level

 Recovered to genus level

 Not recovered

100%	FDA	Primer sets							FDA	Primer sets							FDA	Primer sets					
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8	Balistes capricus							48	Epinephalus bleekeri							88	Lutjanus argentimaculatus						
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124	<i>Pagrus pagrus</i>							164	<i>Selene peruviana</i>						
125	<i>Pampus argenteus</i>							165	<i>Selene setapinnis</i>						
126	<i>Pangasius bocourti</i>							166	<i>Selene vomer</i>						
127	<i>Pangasius conchophilus</i>							167	<i>Semicossyphus pulcher</i>						
128	<i>Pangasius hypophthalmus</i>							168	<i>Seriola dumerilii</i>						
129	<i>Paralichthys albigutta</i>							169	<i>Seriola lalandi</i>						
130	<i>Paralichthys lethostigma</i>							170	<i>Seriola rivoliana</i>						
131	<i>Paranthias furcifer</i>							171	<i>Siganus javus</i>						
132	<i>Pareques umbrosus</i>							172	<i>Sphoeroides nephelus</i>						
133	<i>Peprilus paru</i>							173	<i>Sphoeroides spengleri</i>						
134	<i>Platichthys stellatus</i>							174	<i>Sphoeroides testudineus</i>						
135	<i>Pleuronectes americanus</i>							175	<i>Sphyaena argentea</i>						
136	<i>Pleuronectes vetulus</i>							176	<i>Sphyaena barracuda</i>						
137	<i>Pogonias cromis</i>							177	<i>Sphyaena guachancho</i>						
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148	<i>Rypticus saponaceus</i>							188	<i>Takifugu poecilonotus</i>						
149	<i>Salmo salar</i>							189	<i>Takifugu porphyreus</i>						
150	<i>Sciaenops ocellatus</i>							190	<i>Takifugu snyderi</i>						
151	<i>Scomber japonicus</i>							191	<i>Takifugu vermicularis</i>						
152	<i>Scomberomorus cavalla</i>							192	<i>Takifugu zanthopterus</i>						
153	<i>Scomberomorus maculatus</i>							193	<i>Theragra chalcogramma</i>						
154	<i>Scomberomorus regalis</i>							194	<i>Thunnus alalunga</i>						
155	<i>Scophthalmus aquosus</i>							195	<i>Thunnus albacares</i>						
156	<i>Scorpaena dispar</i>							196	<i>Trachinotus carolinus</i>						
157	<i>Sebastes aleutianus</i>							197	<i>Trichiurus lepturus</i>						
158	<i>Sebastes alutus</i>							198	<i>Urophycis chuss</i>						
159	<i>Sebastes entomelas</i>							199	<i>Variola louti</i>						
160	<i>Sebastes flavidus</i>							200	<i>Zeus faber</i>						

Recovered to species level

Recovered to genus level

Not recovered

