

# Grzimek's Animal Life Encyclopedia

**Second Edition**



**Volume 4  
Fishes I**

**Dennis A. Thoney, Advisory Editor  
Paul V. Loiselle, Advisory Editor  
Neil Schlager, Editor**

**Joseph E. Trumpey, Chief Scientific Illustrator**



**Michael Hutchins, Series Editor**

**In association with the American Zoo and Aquarium Association**



**THOMSON**  
—★—  
**GALE**



# Contents

Foreword .....	viii	Order PRISTIOPHORIFORMES	
How to use this book .....	xi	Sawsharks.....	167
Advisory boards.....	xiv	Order RAJIFORMES	
Contributing writers.....	xvi	Skates and rays.....	173
Contributing illustrators.....	xviii	Order COELACANTHIFORMES	
<b>Volume 4: Fishes I</b>		Coelacanths .....	189
What is a fish? .....	3	Order CERATODONTIFORMES	
Evolution and systematics .....	9	Australian lungfish .....	197
Structure and function.....	14	Order LEPIDOSIRENIFORMES	
Life history and reproduction .....	29	Lungfishes .....	201
Freshwater ecology .....	36	Order POLYPTERIFORMES	
Marine ecology .....	42	Bichirs.....	209
Distribution and biogeography .....	52	Order ACIPENSERIFORMES	
Behavior.....	60	Sturgeons and paddlefishes .....	213
Fishes and humans.....	72	Order LEPISOSTEIFORMES	
Order MYXINIFORMES		Gars .....	221
Hagfishes .....	77	Order AMIIFORMES	
Order PETROMYZONIFORMES		Bowfins .....	229
Lampreys.....	83	Order OSTEOGLOSSIFORMES	
Order CHIMAERIFORMES		Bony tongues and relatives.....	231
Chimaeras.....	91	Order ELOPIIFORMES	
Order HETERODONTIFORMES		Ladyfish and tarpon.....	243
Horn or bullhead sharks.....	97	Order ALBULIFORMES	
Order ORECTOLOBIFORMES		Bonefishes and relatives.....	249
Carpet sharks.....	105	Order ANGUILLIFORMES	
Order CARCHARHINIFORMES		Eels and morays .....	255
Ground sharks.....	113	Order SACCOPHARYNGIFORMES	
Order LAMNIFORMES		Swallowers and gulpers.....	271
Mackerel sharks.....	131	Order CLUPEIFORMES	
Order HEXANCHIFORMES		Herrings .....	277
Six- and sevengill sharks.....	143	Order GONORYNCHIFORMES	
Order SQUALIFORMES		Milkfish and relatives.....	289
Dogfish sharks.....	151	Order CYPRINIFORMES	
Order SQUATINIFORMES		I: Minnows and carps .....	297
Angelsharks .....	161	II: Loaches and relatives.....	321

## Contents

Order CHARACIFORMES		
Characins .....	335	
Order SILURIFORMES		
Catfishes .....	351	
Order GYMNOTIFORMES		
South American knifefishes and electric eels .....	369	
Order ESOCIFORMES		
Pikes and mudminnows .....	379	
Order OSMERIFORMES		
Smelts, galaxiids, and relatives .....	389	
Order SALMONIFORMES		
Salmon .....	405	
Order STOMIIFORMES		
Dragonfishes and relatives .....	421	
Order AULOPIIFORMES		
Lizardfishes and relatives .....	431	
Order MYCTOPHIFORMES		
Lanternfishes .....	441	
Order LAMPRIDIFORMES		
Opah and relatives .....	447	
For further reading .....	457	
Organizations .....	462	
Contributors to the first edition .....	464	
Glossary .....	471	
Fishes family list .....	476	
Geologic time scale .....	480	
Index .....	481	
<b>Volume 5: Fishes II</b>		
Foreword .....	viii	
How to use this book .....	xi	
Advisory boards .....	xiv	
Contributing writers .....	xvi	
Contributing illustrators .....	xviii	
Order POLYMIXIIFORMES		
Beardfishes .....	1	
Order PERCOPSIFORMES		
Troutperches and relatives .....	5	
Order OPHIDIIFORMES		
Cusk-eels and relatives .....	15	
Order GADIFORMES		
Grenadiers, hakes, cods, and relatives .....	25	
Order BATRACHOIDIFORMES		
Toadfishes .....	41	
Order LOPHIIFORMES		
Anglerfishes .....	47	
Order MUGILIFORMES		
Mullets .....	59	
Order ATHERINIFORMES		
Rainbowfishes and silversides .....	67	
Order BELONIFORMES		
Needlefishes and relatives .....	79	
Order CYPRINODONTIFORMES		
Killifishes and live-bearers .....	89	
Order STEPHANOBERYCIFORMES		
Whalefishes and relatives .....	105	
Order BERYCIFORMES		
Roughies, flashlightfishes, and squirrelfishes .....	113	
Order ZEIFORMES		
Dories .....	123	
Order GASTEROSTEIFORMES		
Sticklebacks, seahorses, and relatives .....	131	
Order SYNBRANCHIFORMES		
Swamp and spiny eels .....	151	
Order SCORPAENIFORMES		
I: Gurnards and flatheads .....	157	
II: Scorpionfishes and relatives .....	163	
III: Greenlings, sculpins, and relatives .....	179	
Order PERCIFORMES		
Suborder PERCOIDEI		
I: Perches and darters, North American basses and sunfishes, pygmy sunfishes, and temperate basses .....	195	
II: Bluefishes, dolphinfishes, roosterfishes, and remoras .....	211	
III: Grunters, temperate basses and perches, snooks and giant perches, and relatives .....	219	
IV: Goatfishes, butterflyfishes, angelfishes, chubs, and relatives .....	235	
V: Groupers, sea basses, trevallies, snappers, emperors, and relatives .....	255	
Suborder LABROIDEI		
I: Cichlids and surfperches .....	275	
II: Damselfishes, wrasses, parrotfishes, and rock whittings .....	293	
Suborder ZOARCOIDEI		
Eelpouts and relatives .....	309	
Suborder NOTOTHENIOIDEI		
Southern cod-icefishes .....	321	
Suborder TRACHINOIDEI		
Weeverfishes and relatives .....	331	
Suborder BLENNIOIDEI		
Blennies .....	341	
Suborder ICOSTEOIDEI		
Ragfish .....	351	
Suborder GOBIESOCOIDEI		
Clingfishes and singleslits .....	355	



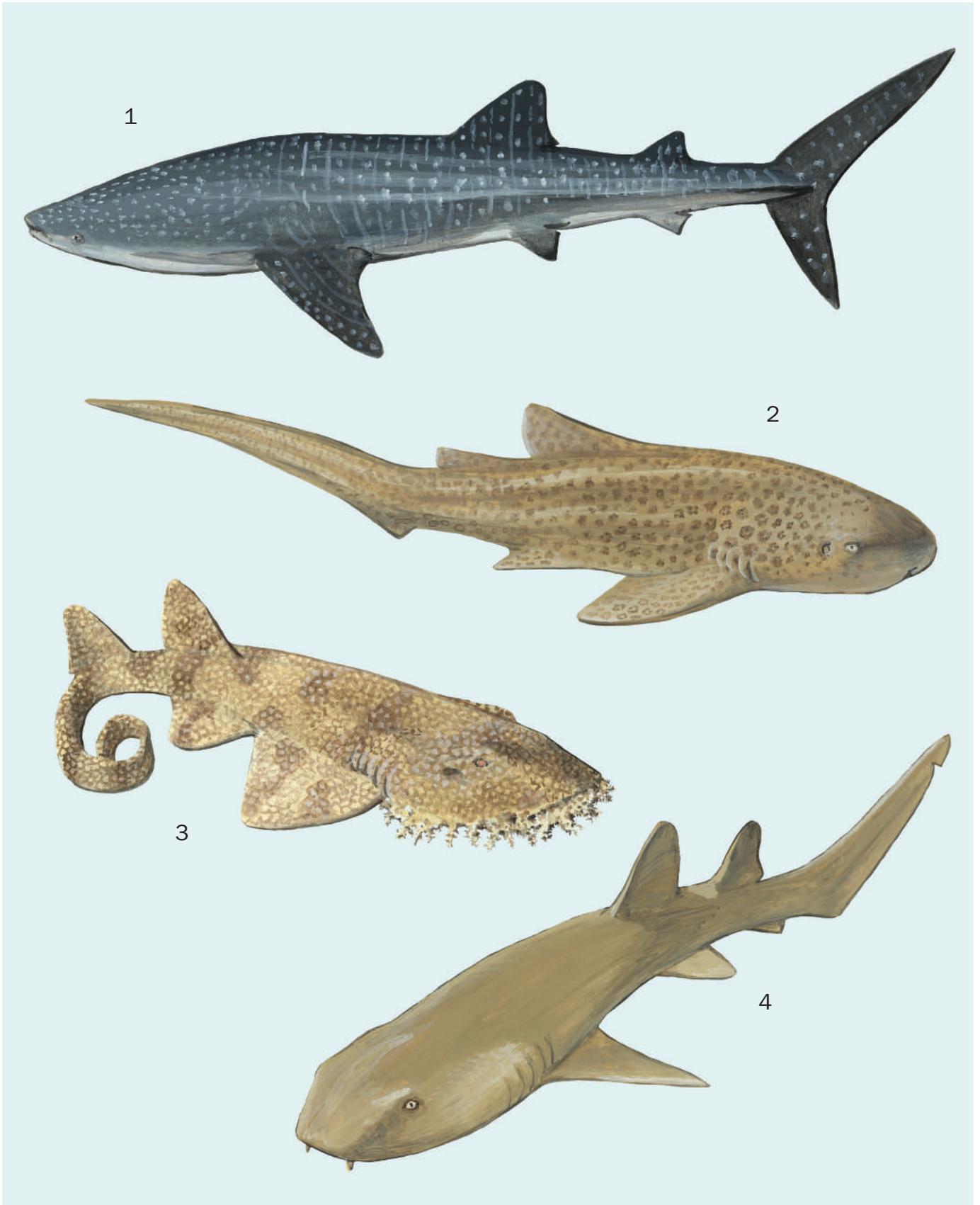
1. Silver lamprey (*Ichthyomyzon unicuspis*); 2. Pouched lamprey (*Geotria australis*); 3. Sea lamprey (*Petromyzon marinus*); 4. Short-headed lamprey (*Mordacia mordax*). (Illustration by Emily Damstra)



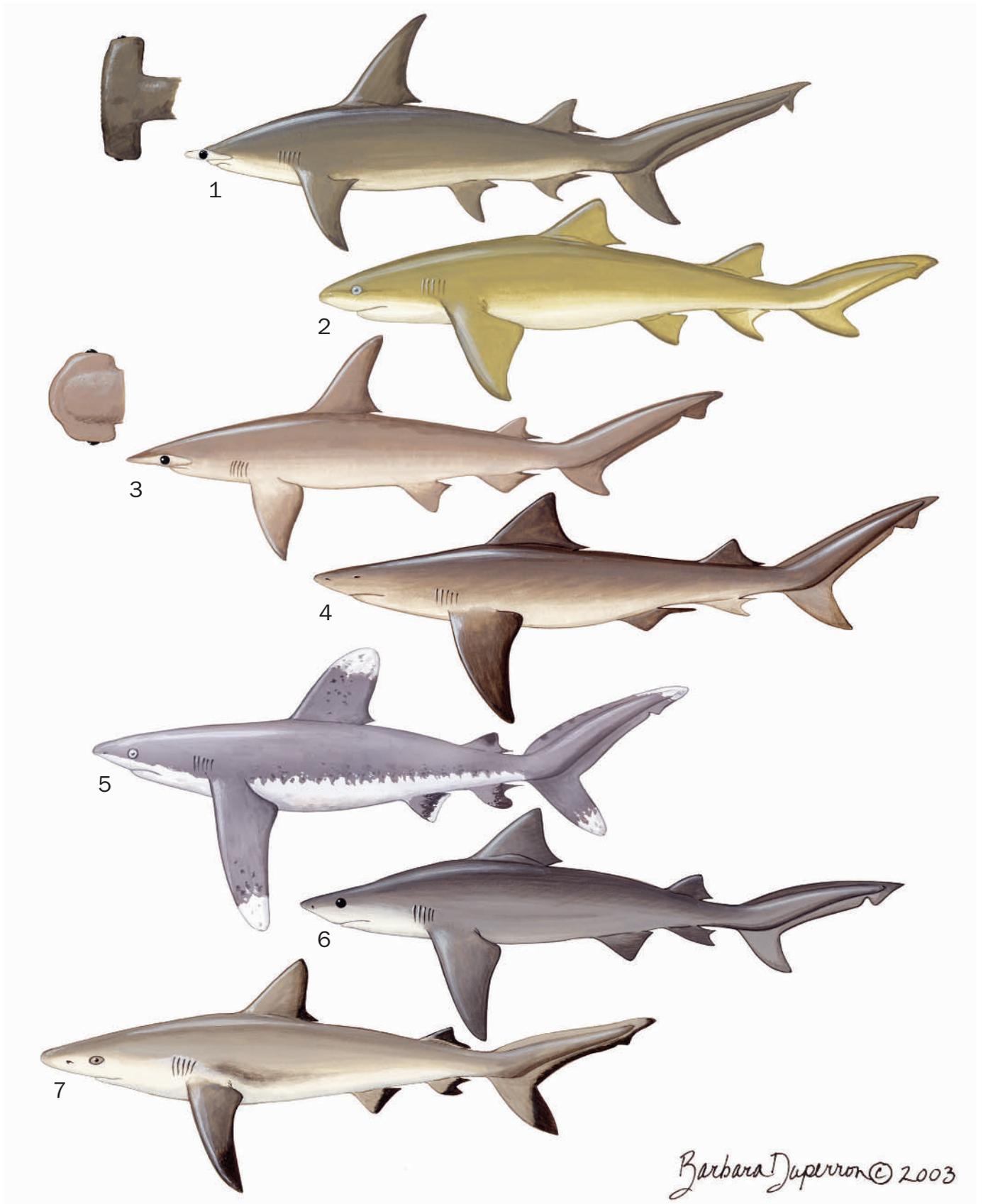
1. Female spotted ratfish (*Hydrolagus colliei*); 2. Female Pacific spookfish (*Rhinochimaera pacifica*); 3. Female ghost shark (*Callorhynchus milii*). (Illustration by Dan Erickson)



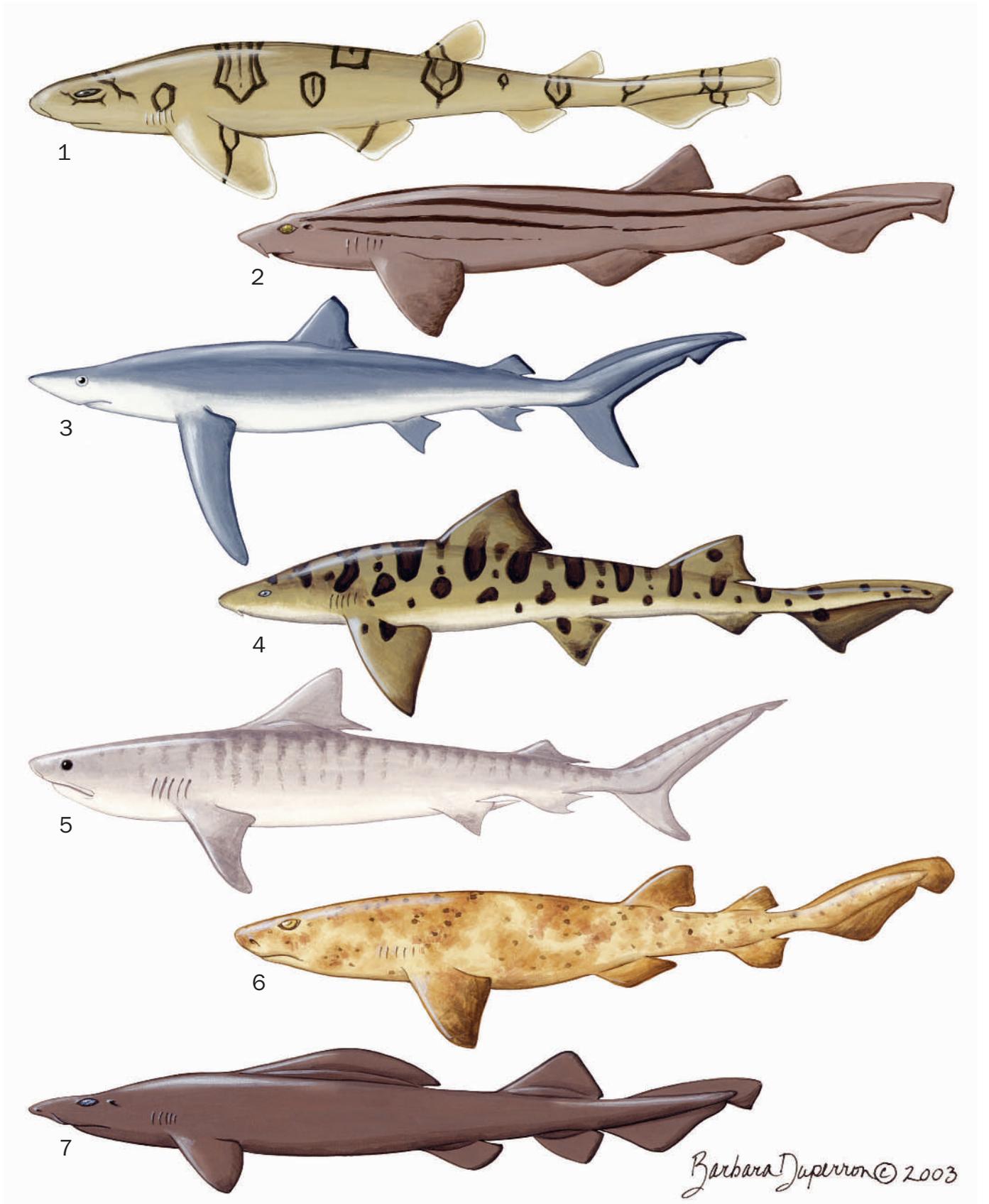
1. California bullhead shark (*Heterodontus francisci*); 2. Port Jackson shark (*Heterodontus portusjacksoni*). (Illustration by Dan Erickson)



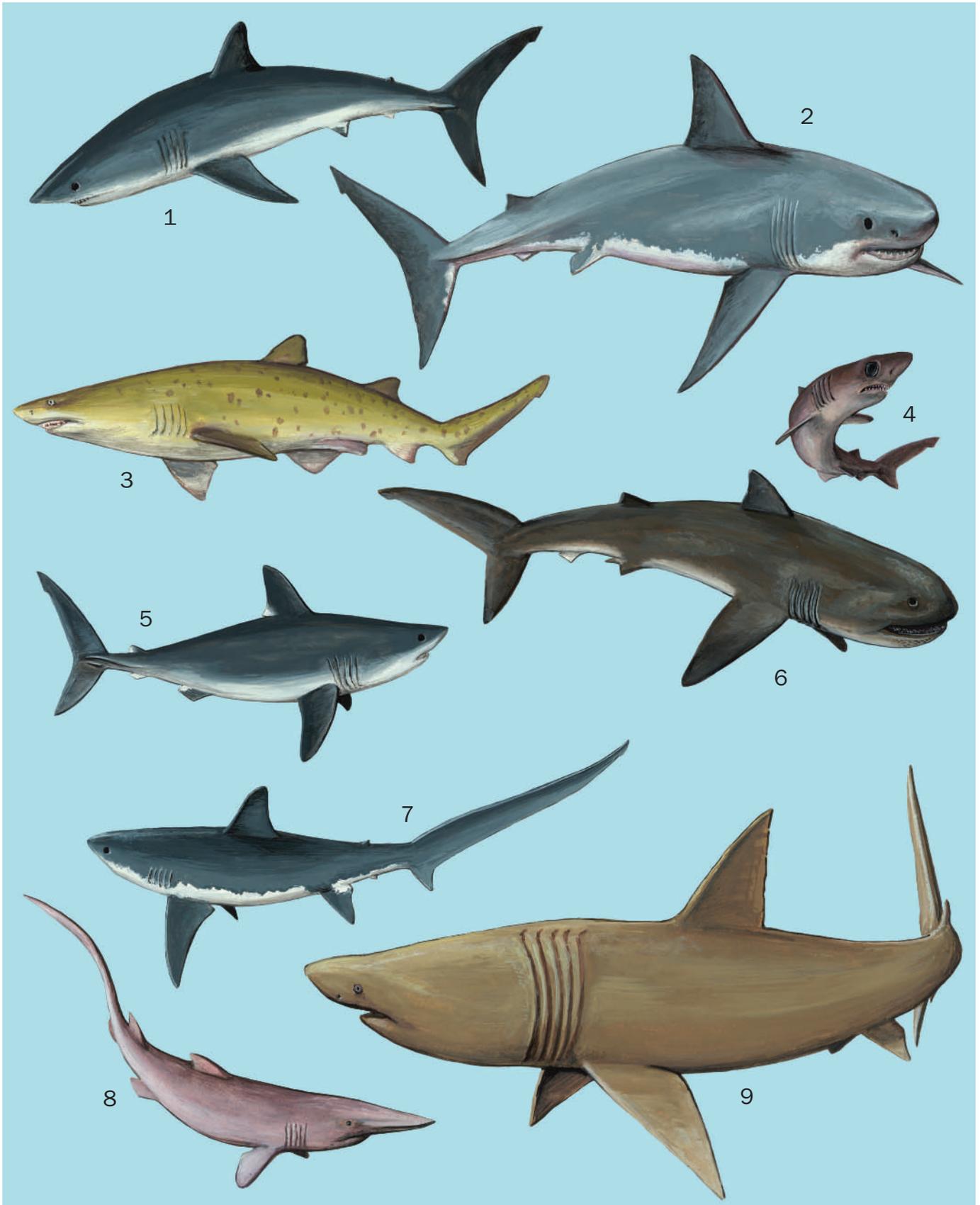
1. Whale shark (*Rhincodon typus*); 2. Zebra shark (*Stegostoma fasciatum*); 3. Tasseled wobbegong (*Eucrossorhinus dasypogon*); 4. Nurse shark (*Ginglymostoma cirratum*). (Illustration by Brian Cressman)



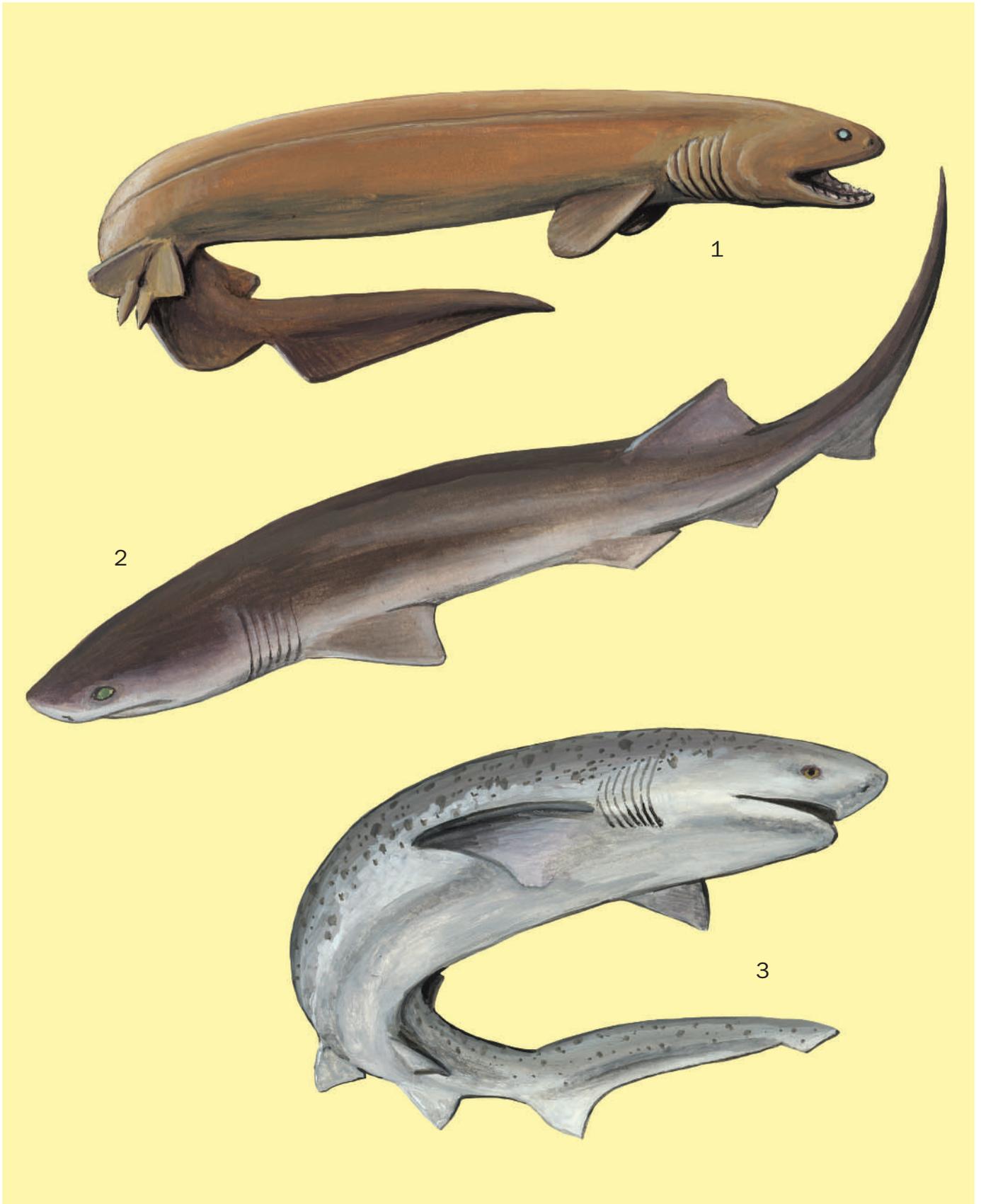
1. Great hammerhead shark (*Sphyrna mokarran*); 2. Lemon shark (*Negaprion brevirostris*); 3. Bonnethead shark (*Sphyrna tiburo*); 4. Ganges shark (*Glyphis gangeticus*); 5. Oceanic whitetip shark (*Carcharhinus longimanus*); 6. Bull shark (*Carcharhinus leucas*); 7. Gray reef shark (*Carcharhinus amblyrhynchos*). (Illustration by Barbara Duperron)



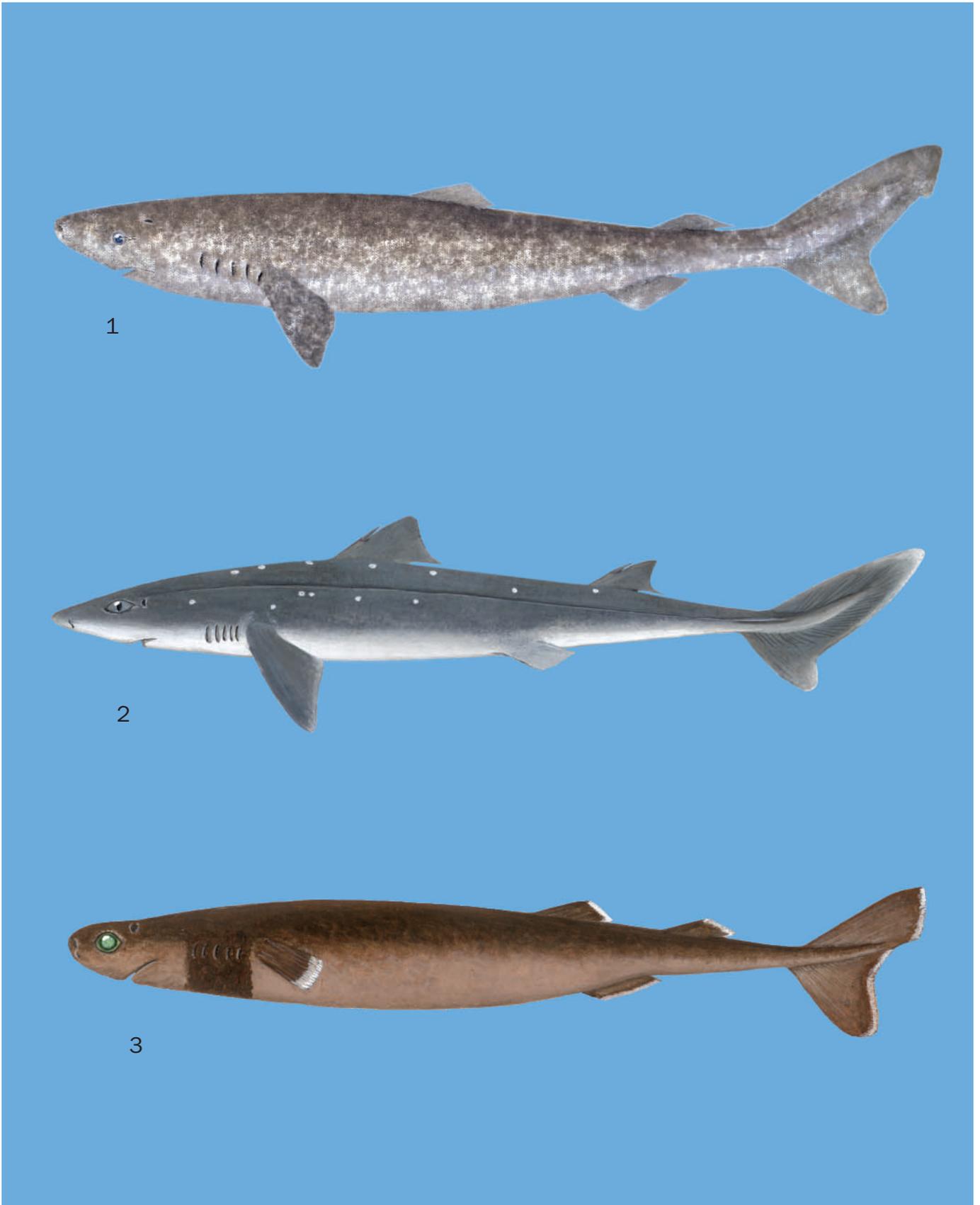
1. Chain catshark (*Scyliorhinus retifer*); 2. Pajama (*Poroderma africanum*); 3. Blue shark (*Prionace glauca*); 4. Leopard shark (*Triakis semifasciata*); 5. Tiger shark (*Galeocerdo cuvier*); 6. Swellshark (*Cephaloscyllium ventriosum*); 7. False catshark (*Pseudotriakis microdon*). (Illustration by Barbara Duperron)



1. Shortfin mako (*Isurus oxyrinchus*); 2. White shark (*Carcharodon carcharias*); 3. Sand tiger shark (*Carcharias taurus*); 4. Crocodile shark (*Pseudocarcharias kamoharai*); 5. Porbeagle (*Lamna nasus*); 6. Megamouth shark (*Megachasma pelagios*); 7. Thresher shark (*Alopias vulpinus*); 8. Goblin shark (*Mitsukurina owstoni*); 9. Basking shark (*Cetorhinus maximus*). (Illustration by Brian Cressman)



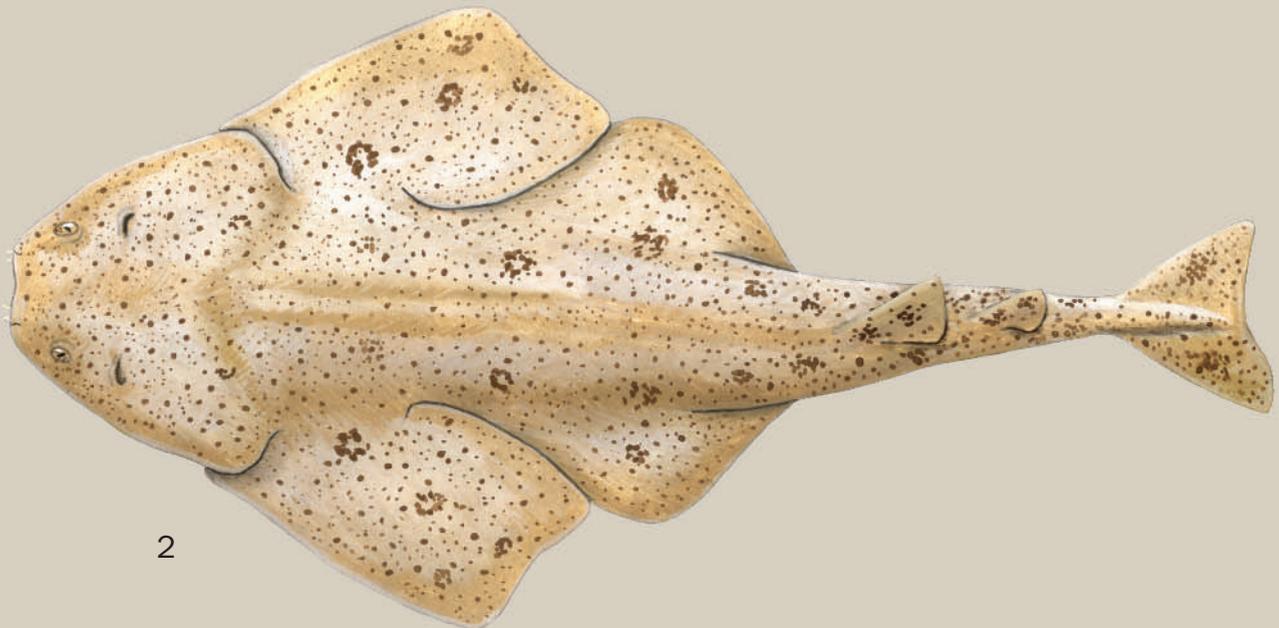
1. Frilled shark (*Chlamydoselachus anguineus*); 2. Bluntnose sixgill shark (*Hexanchus griseus*); 3. Broadnose sevengill shark (*Notorynchus cepedianus*). (Illustration by Brian Cressman)



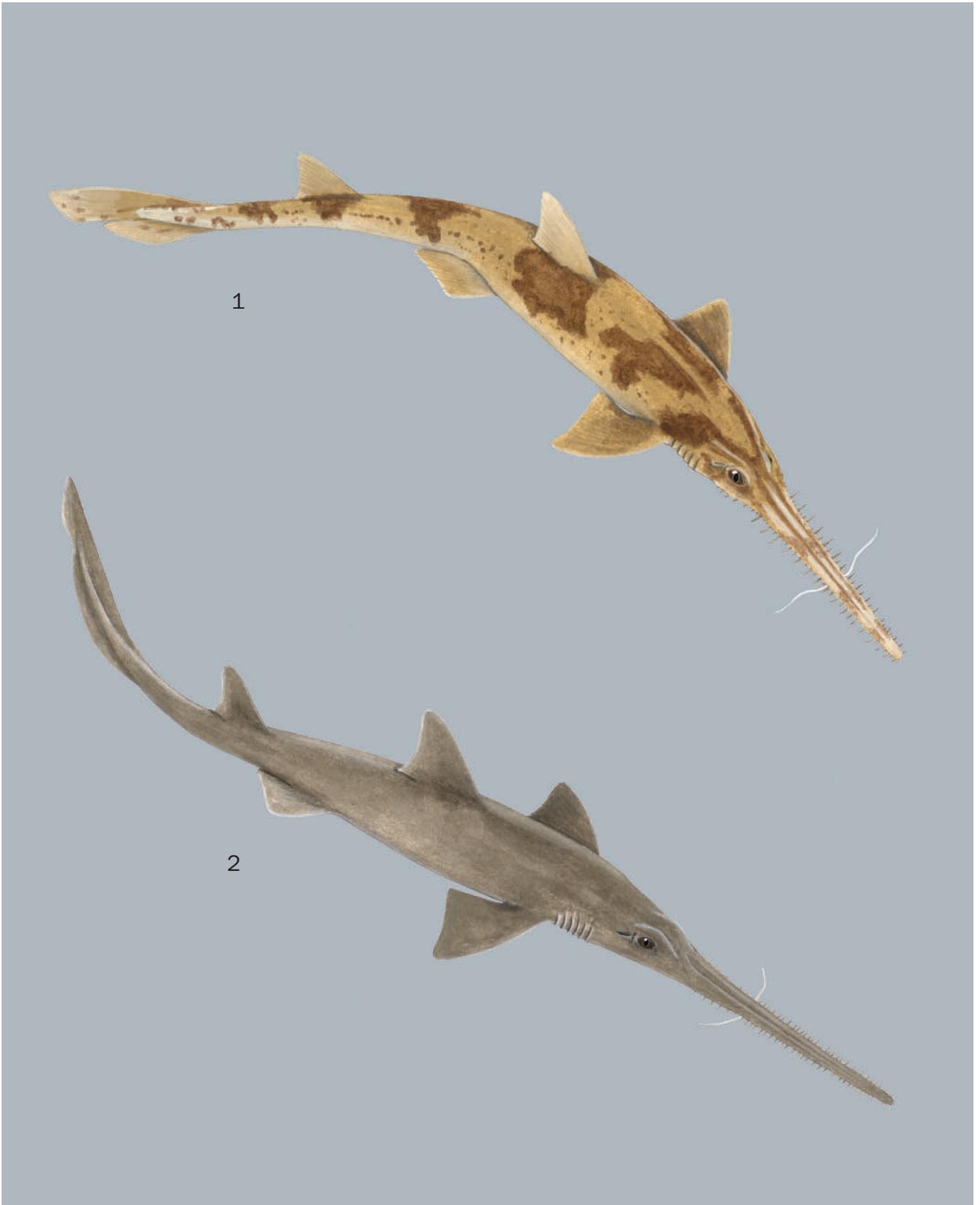
1. Greenland shark (*Somniosus microcephalus*); 2. Piked dogfish (*Squalus acanthias*); 3. Cookie-cutter shark (*Isistius brasiliensis*). (Illustration by Dan Erickson)

# Squatiniiformes

(*Angelsbarks*)



1. Angelshark (*Squatina squatina*); 2. Pacific angelshark (*Squatina californica*). (Illustration by Dan Erickson)



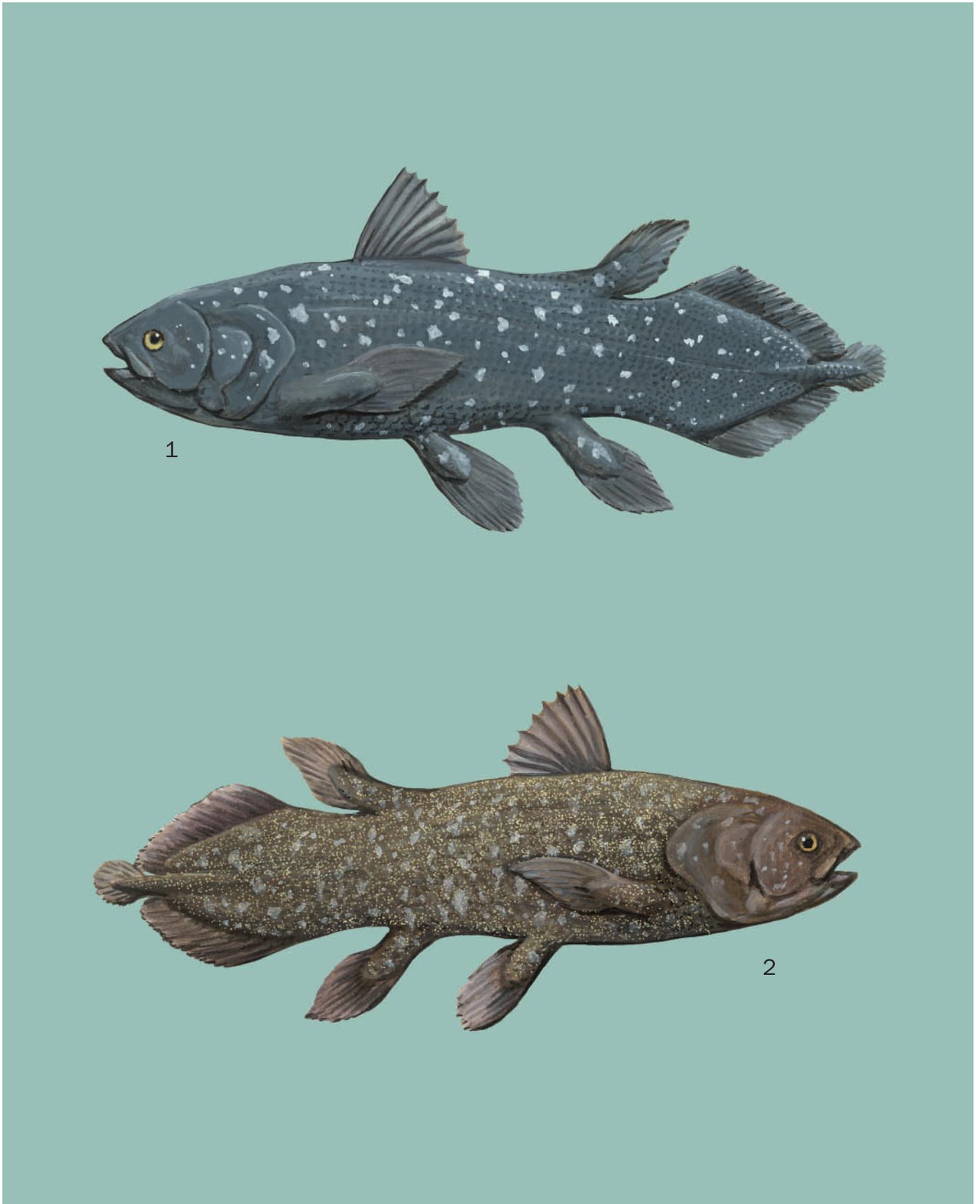
1. Common sawshark (*Pristiophorus cirratus*); 2. Sixgill sawshark (*Pliotrema warreni*). (Illustration by Dan Erickson)



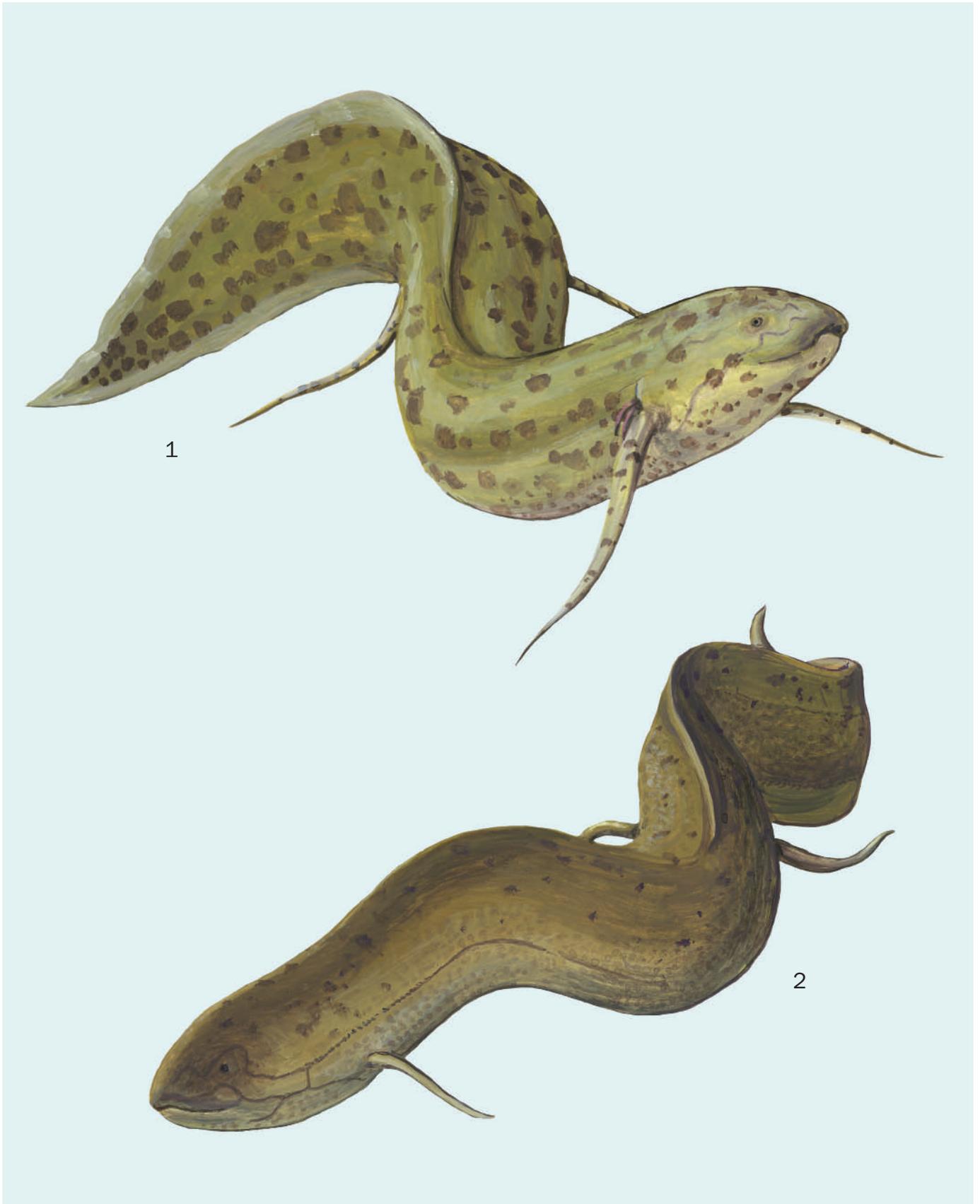
1. Atlantic guitarfish (*Rhinobatos lentiginosus*); 2. Atlantic torpedo (*Torpedo nobiliana*); 3. Rough-tail stingray (*Dasyatis centroura*); 4. Smalltooth sawfish (*Pristis pectinata*); 5. Clearnose skate (*Raja eglanteria*); 6. Freshwater stingray (*Paratrygon aiereba*). (Illustration by Gillian Harris)



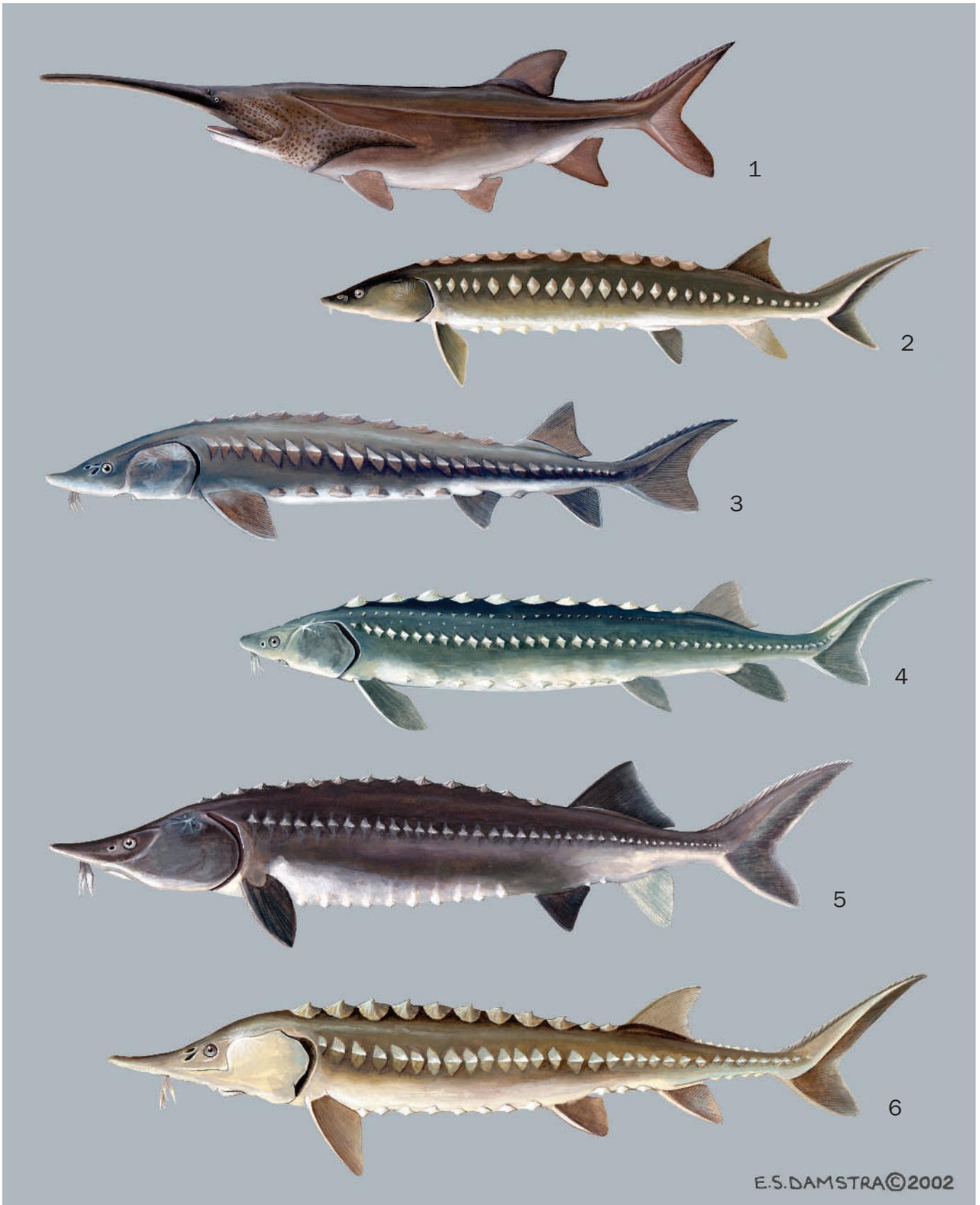
1. Yellow stingray (*Urobatis jamaicensis*); 2. Spotted eagle ray (*Aetobatus narinari*); 3. Spiny butterfly ray (*Gymnura altavela*); 4. Atlantic manta (*Manta birostris*); 5. Lesser electric ray (*Narcine bancrofti*). (Illustration by Gillian Harris)



1. Coelacanth (*Latimeria chalumnae*); 2. Indonesian coelacanth (*Latimeria menadoensis*). (Illustration by Brian Cressman)



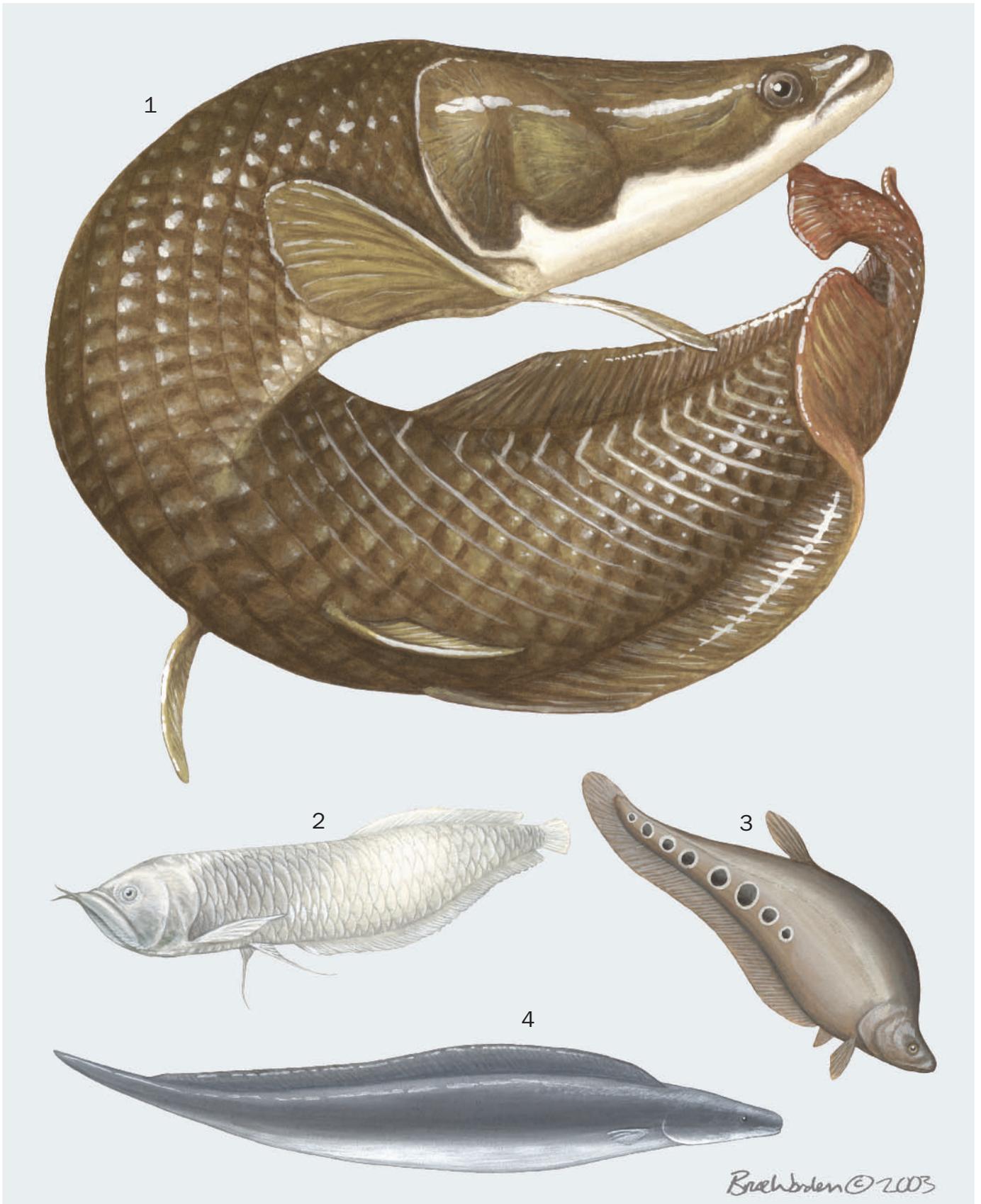
1. African lungfish (*Protopterus annectens*); 2. South American lungfish (*Lepidosiren paradoxa*). (Illustration by Brian Cressman)



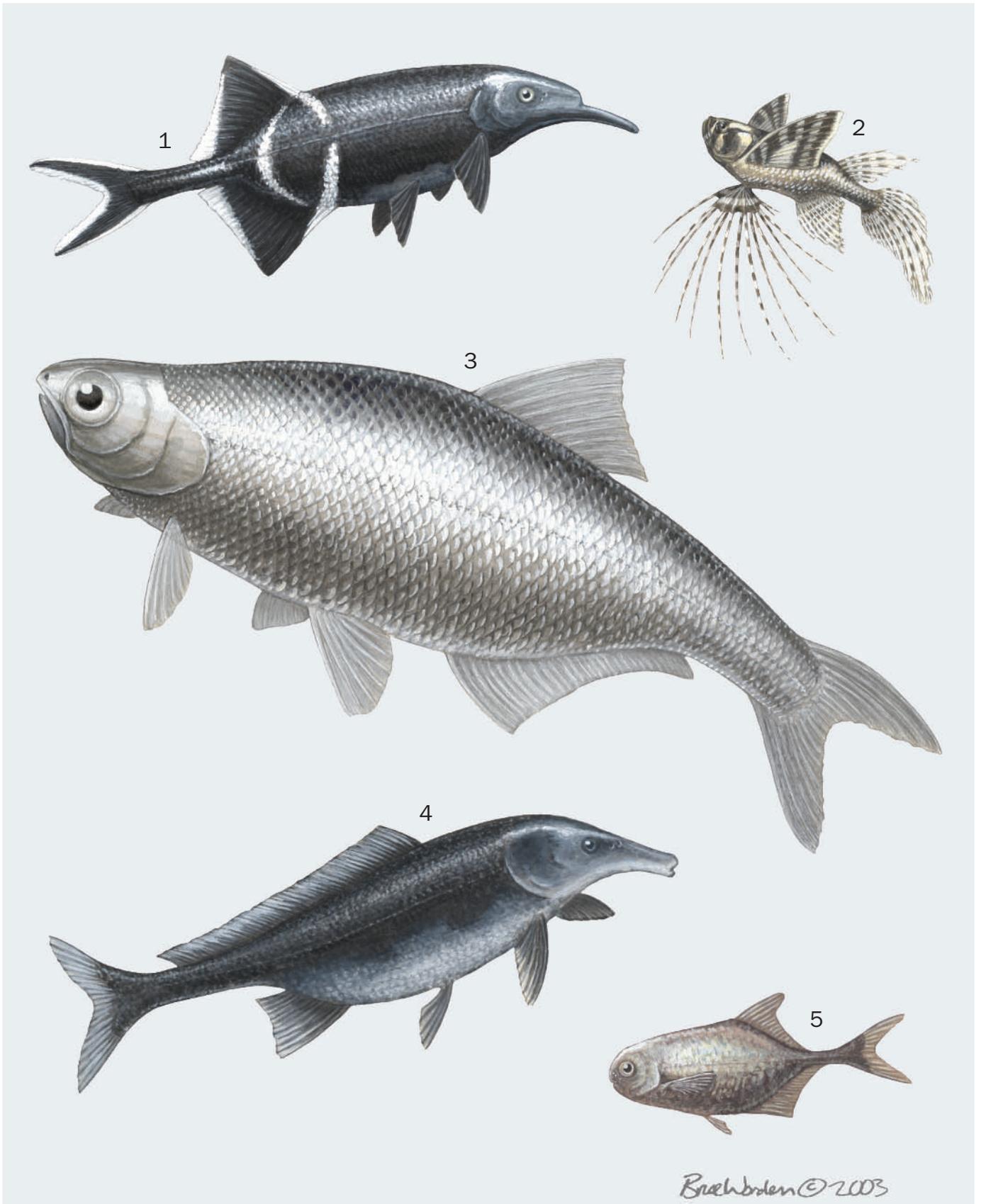
1. American paddlefish (*Polyodon spathula*); 2. Shortnose sturgeon (*Acipenser brevirostrum*); 3. Lake sturgeon (*Acipenser fulvescens*); 4. White sturgeon (*Acipenser transmontanus*); 5. Beluga sturgeon (*Huso huso*); 6. Atlantic sturgeon (*Acipenser oxyrinchus*). (Illustration by Emily Damstra)



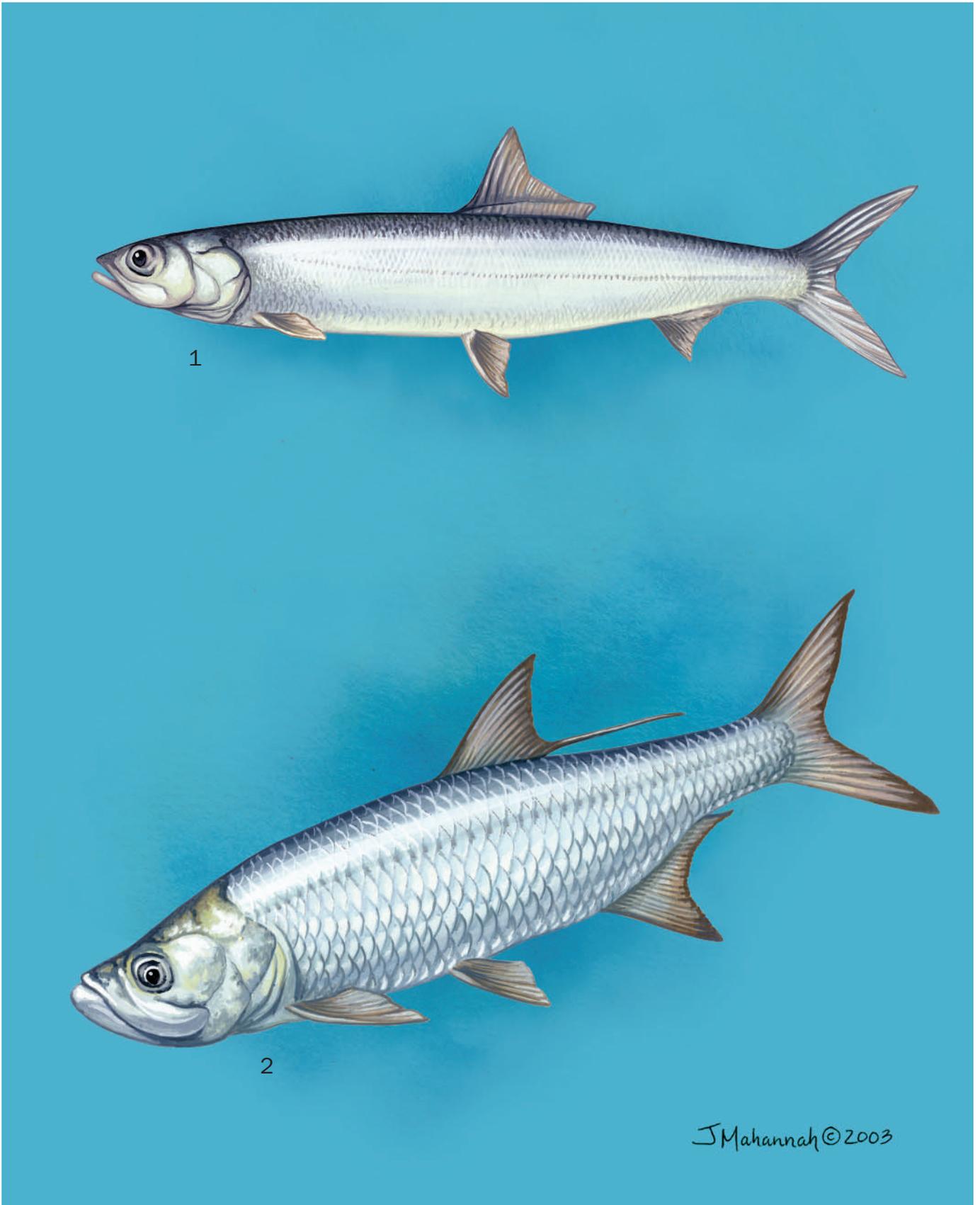
1. Cuban gar (*Atractosteus tristoechus*); 2. Tropical gar (*Atractosteus tropicus*); 3. Longnose gar (*Lepisosteus osseus*); 4. Shortnose gar (*Lepisosteus platostomus*); 5. Spotted gar (*Lepisosteus oculatus*); 6. Florida gar (*Lepisosteus platyrhincus*); 7. Alligator gar (*Atractosteus spatula*). (Illustration by Emily Damstra)



1. Arapaima (*Arapaima gigas*); 2. Arawana (*Osteoglossum bicirrhosum*); 3. Clown knifefish (*Chitala chitala*); 4. Aba-aba (*Gymnarchus niloticus*). (Illustration by Bruce Worden)



1. Elephantnose fish (*Gnathonemus petersii*); 2. Freshwater butterflyfish (*Pantodon buchholzi*); 3. Mooneye (*Hiodon tergisus*); 4. *Mormyrus rume probosciostris*; 5. Elephantfish (*Pollimyrus isidori*). (Illustration by Bruce Worden)

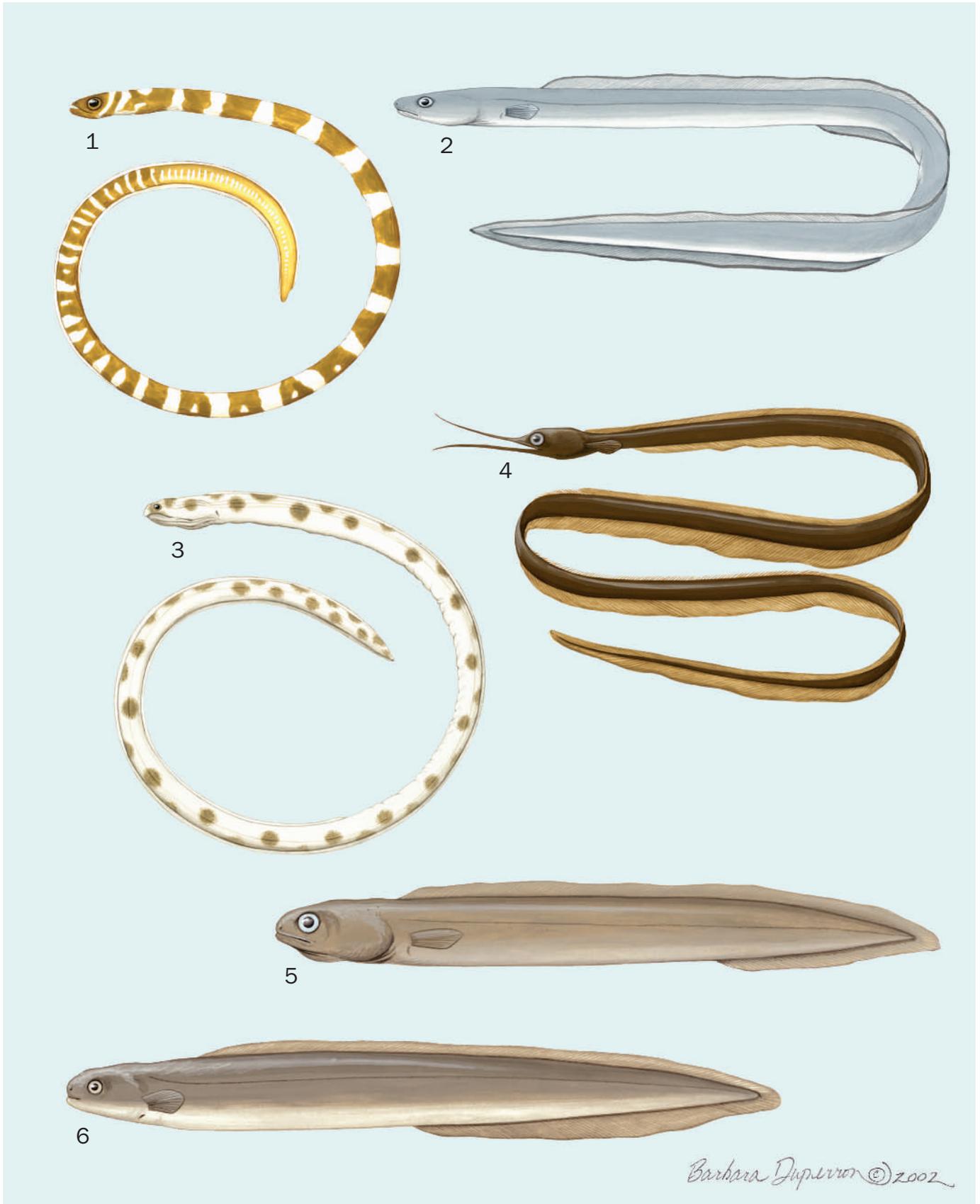


1. Ladyfish (*Elops saurus*); 2. Atlantic tarpon (*Megalops atlanticus*). (Illustration by Jacqueline Mahannah)

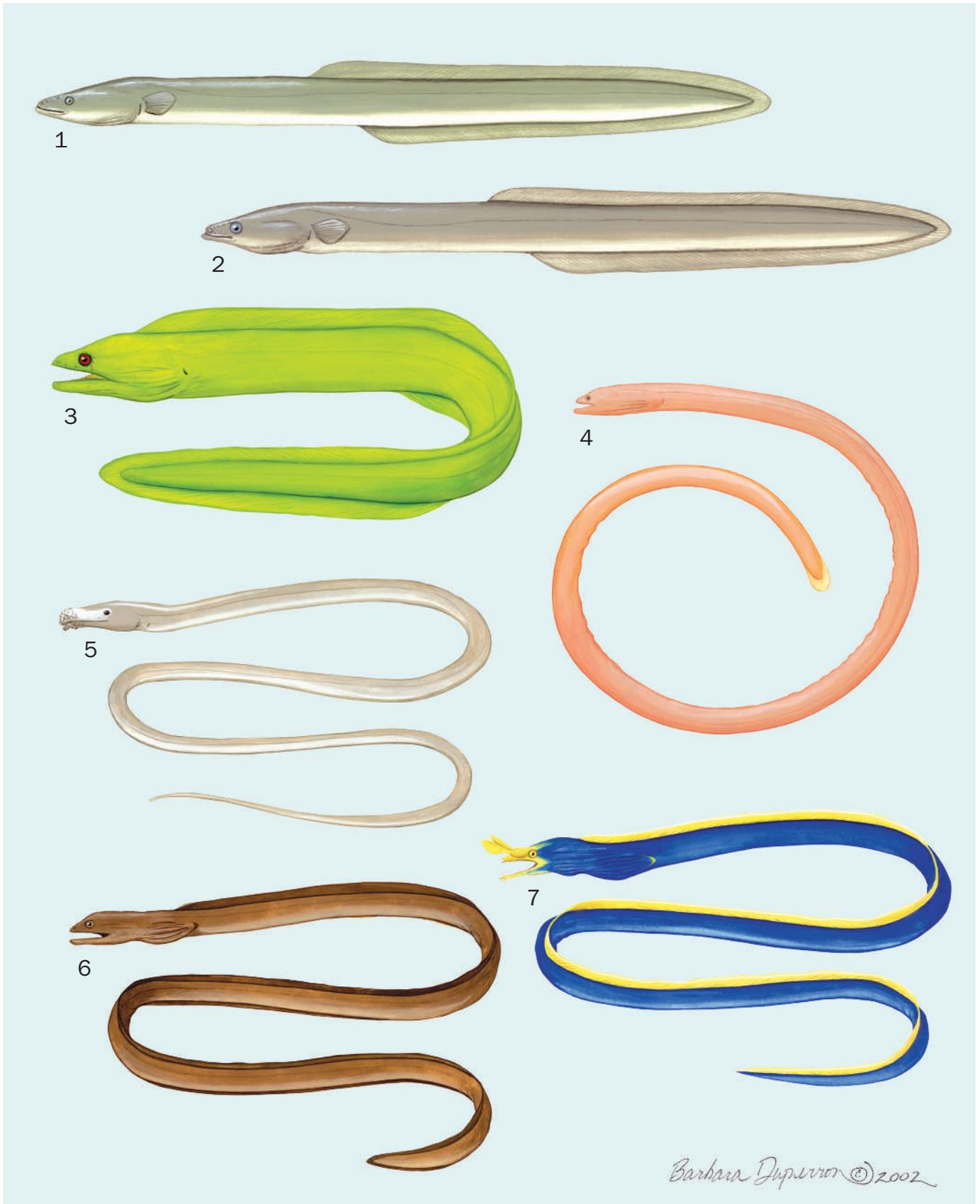


ESD©2003

1. Marine spiny eel (*Polyacanthonotus merretti*); 2. Halosaur (*Halosaurus macrochir*). (Illustration by Emily Damstra)



1. Splendid garden eel (*Gorgasia preclara*); 2. American conger (*Conger oceanicus*); 3. Tiger snake eel (*Myrichthys maculosus*); 4. Slender snipe eel (*Nemichthys scolopaceus*); 5. Froghead eel (*Coloconger raniceps*); 6. Snubnosed eel (*Simenchelys parasitica*). (Illustration by Barbara Duperron)

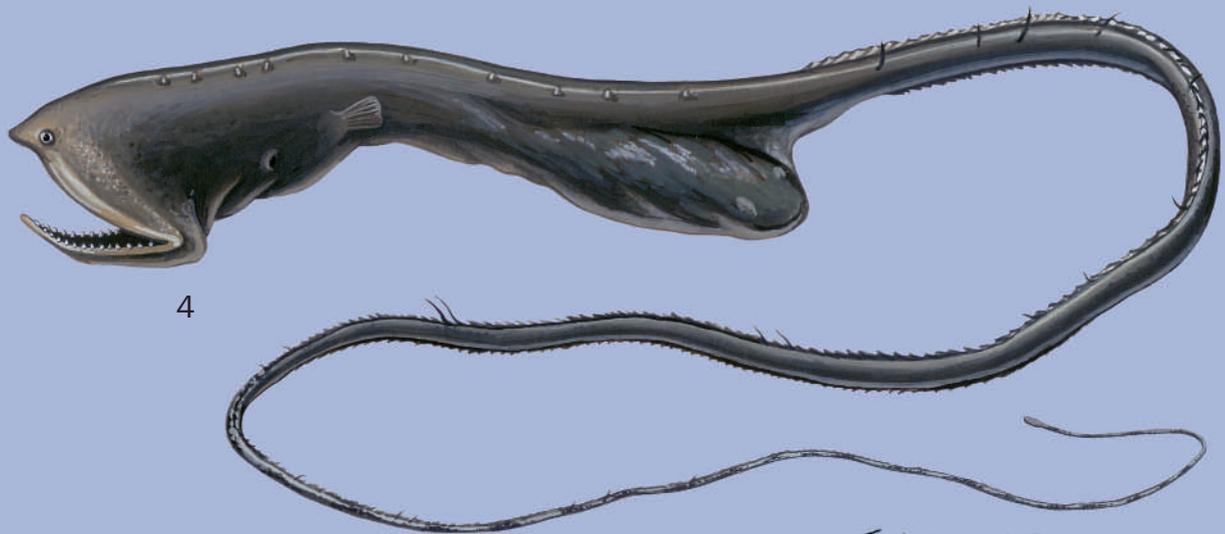
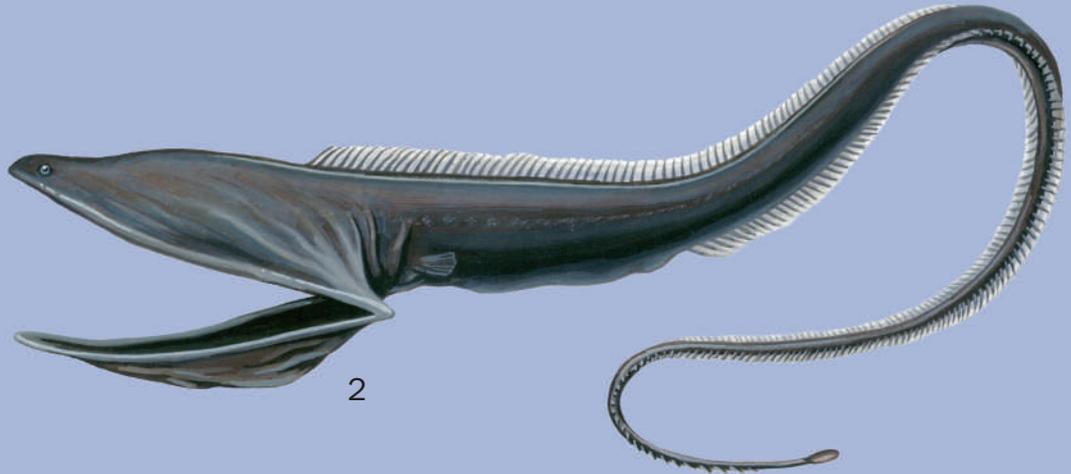


Barbara Duperron © 2002

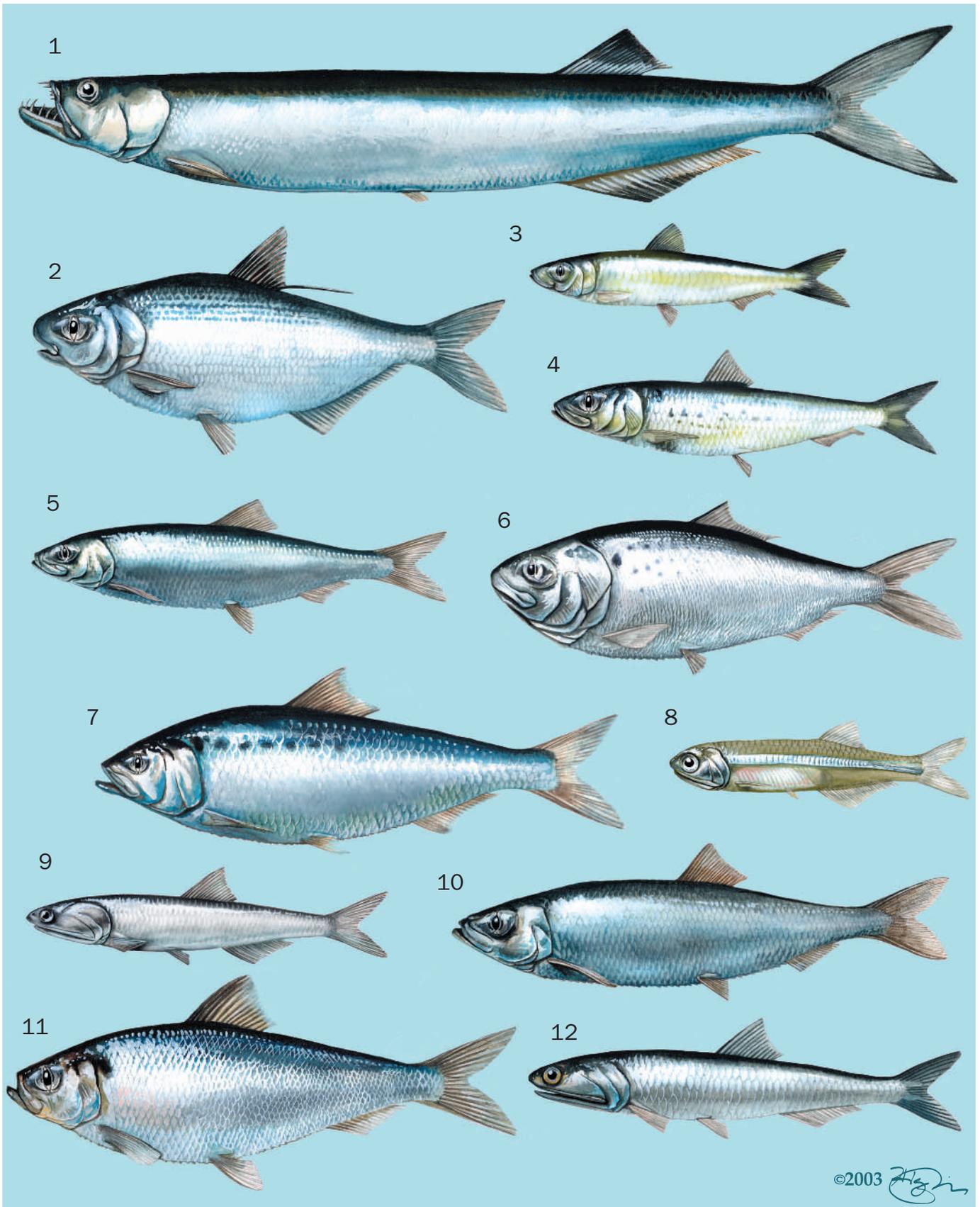
1. European eel (*Anguilla anguilla*); 2. American eel (*Anguilla rostrata*); 3. Green moray (*Gymnothorax funebris*); 4. Rusty spaghetti eel (*Moringua ferruginea*); 5. Pignosed arrowtooth eel (*Dysomma brevirostre*); 6. Slender giant moray (*Strophidon sathete*); 7. Ribbon moray (*Rhinomuraena quaesita*). (Illustration by Barbara Duperron)

# Saccopharyngiformes

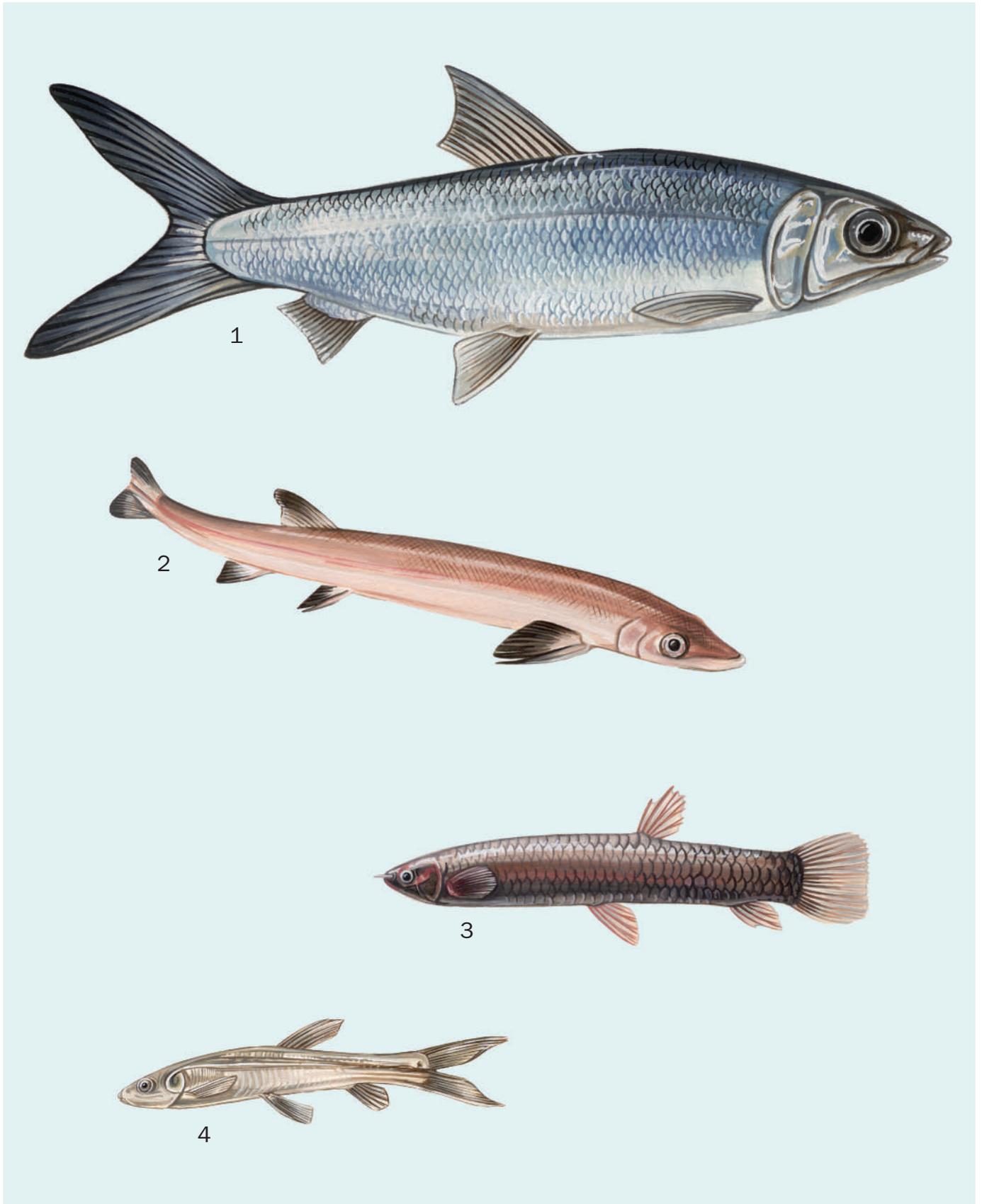
(Swallowers and gulpers)



JMahannah©2003



1. Dorab wolf herring (*Chirocentrus dorab*); 2. Gizzard shad (*Dorosoma cepedianum*); 3. European pilchard (*Sardina pilchardus*); 4. South American pilchard (*Sardinops sagax*); 5. Pacific herring (*Clupea pallasii*); 6. Atlantic menhaden (*Brevoortia tyrannus*); 7. American shad (*Alosa sapidissima*); 8. Bay anchovy (*Anchoa mitchilli*); 9. Northern anchovy (*Engraulis mordax*); 10. Atlantic herring (*Clupea harengus*); 11. Alewife (*Alosa pseudoharengus*); 12. Anchoveta (*Engraulis ringens*). (Illustration by Jonathan Higgins)

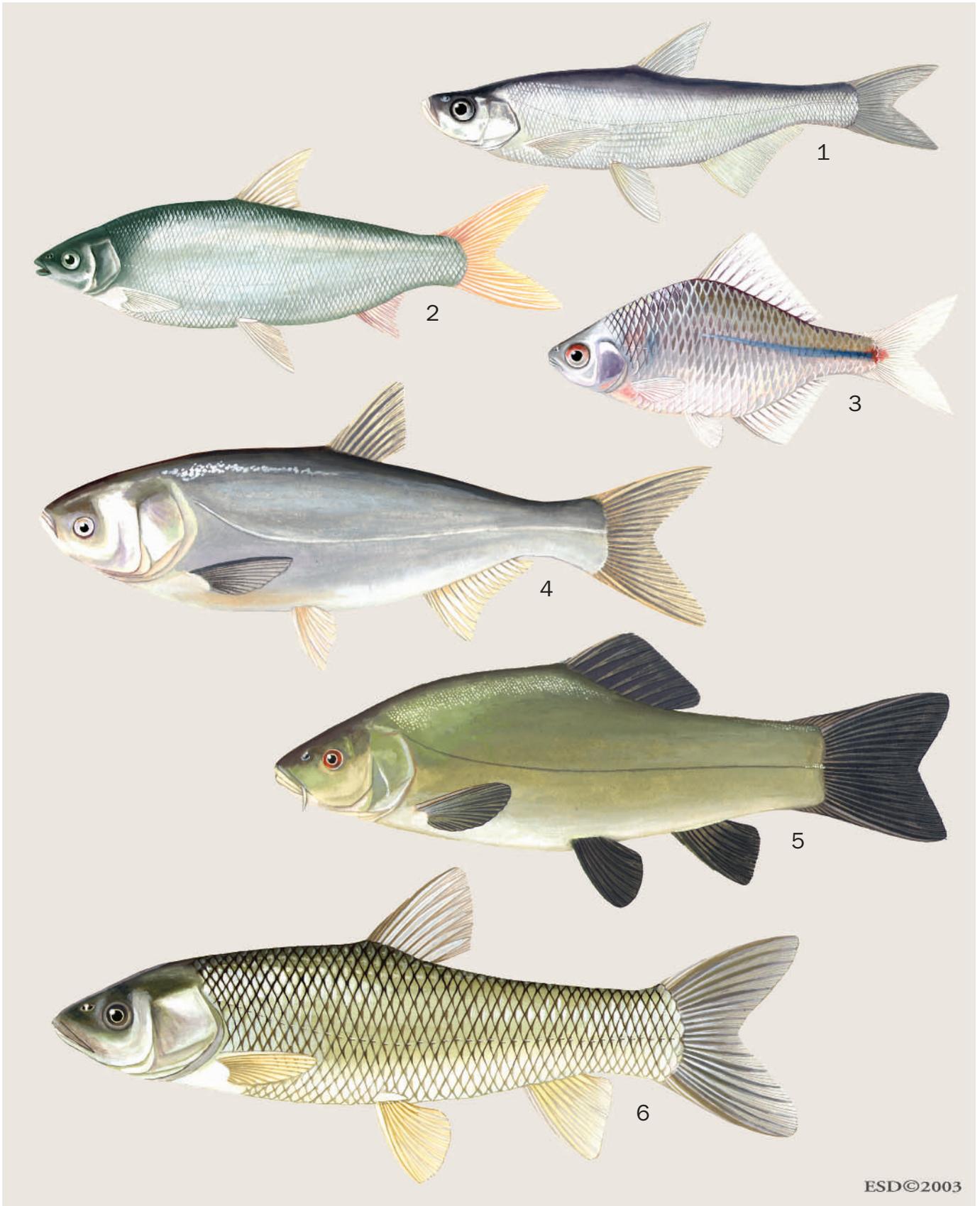


1. Milkfish (*Chanos chanos*); 2. Sandfish (*Gonorynchus gonorynchus*); 3. African mudfish (*Phractolaemus ansorgii*); 4. *Kneria wittei*. (Illustration by Patricia Ferrer)

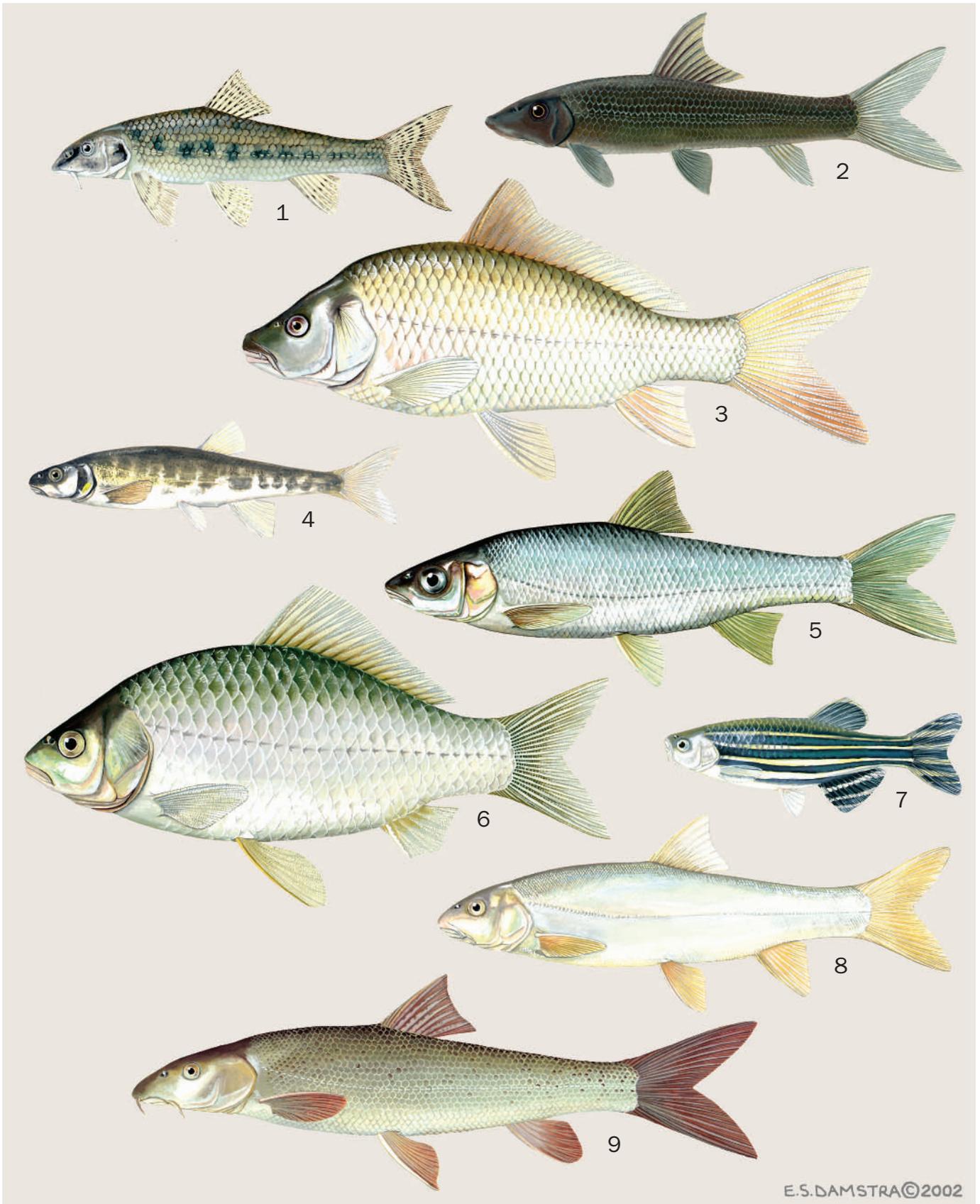


ESD©2003

1. Dagaa (*Rastrineobola argentea*); 2. Stoneroller (*Campostoma anomalum*); 3. Ningu (*Labeo victorinus*); 4. Harlequin (*Rasbora heteromorpha*); 5. Rudd (*Scardinius erythrophthalmus*); 6. Fathead minnow (*Pimephales promelas*); 7. Tiger barb (*Puntius tetrazona tetrazona*); 8. Colorado pikeminnow (*Ptychocheilus lucius*). (Illustration by Emily Damstra)

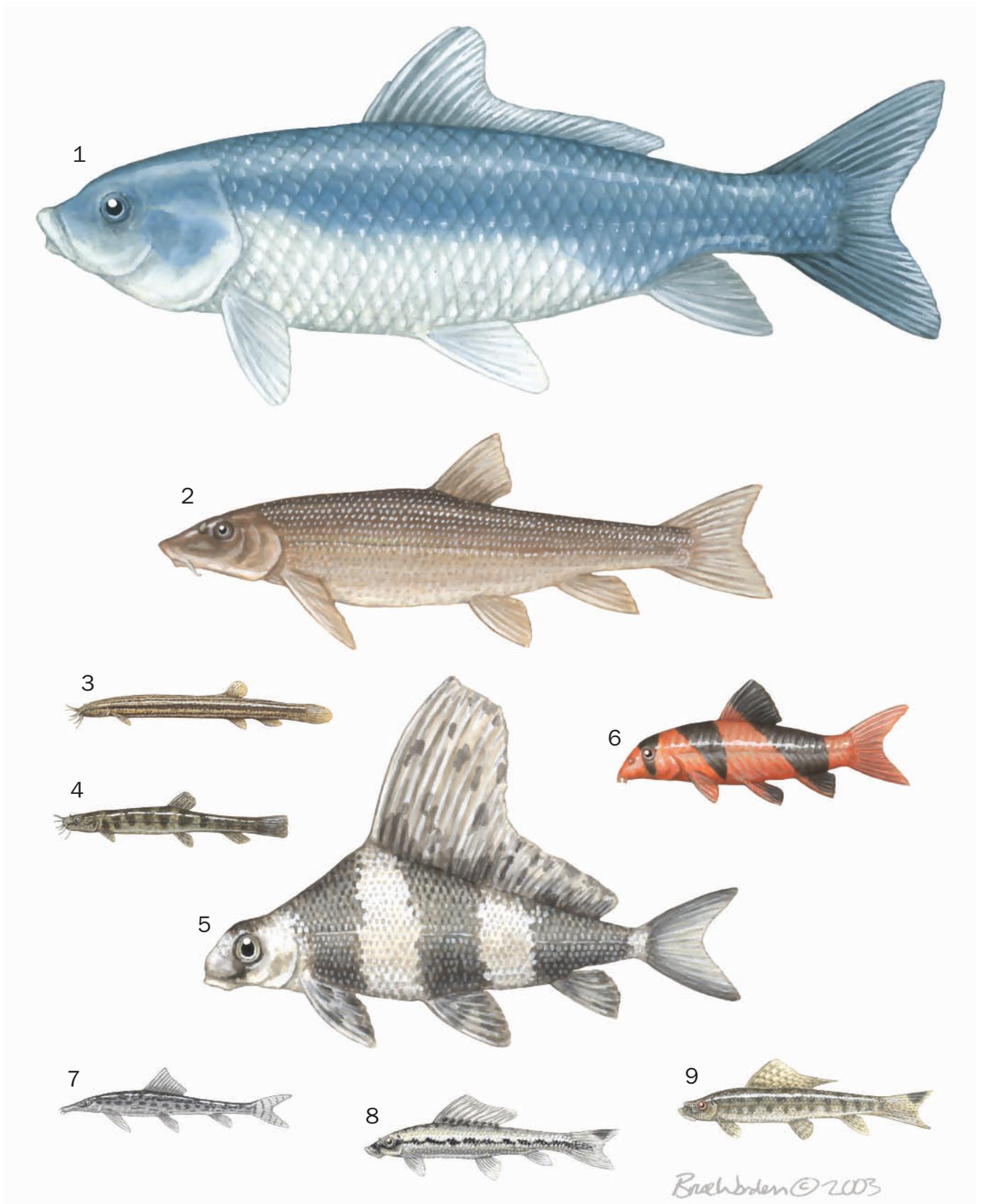


1. Upper mouth (*Culter alburnus*); 2. Smallscale yellowfin (*Xenocypris microlepis*); 3. Rosy bitterling (*Rhodeus ocellatus*); 4. Silver carp (*Hypophthalmichthys molitrix*); 5. Tench (*Tinca tinca*); 6. Grass carp (*Ctenopharyngodon idellus*). (Illustration by Emily Damstra)

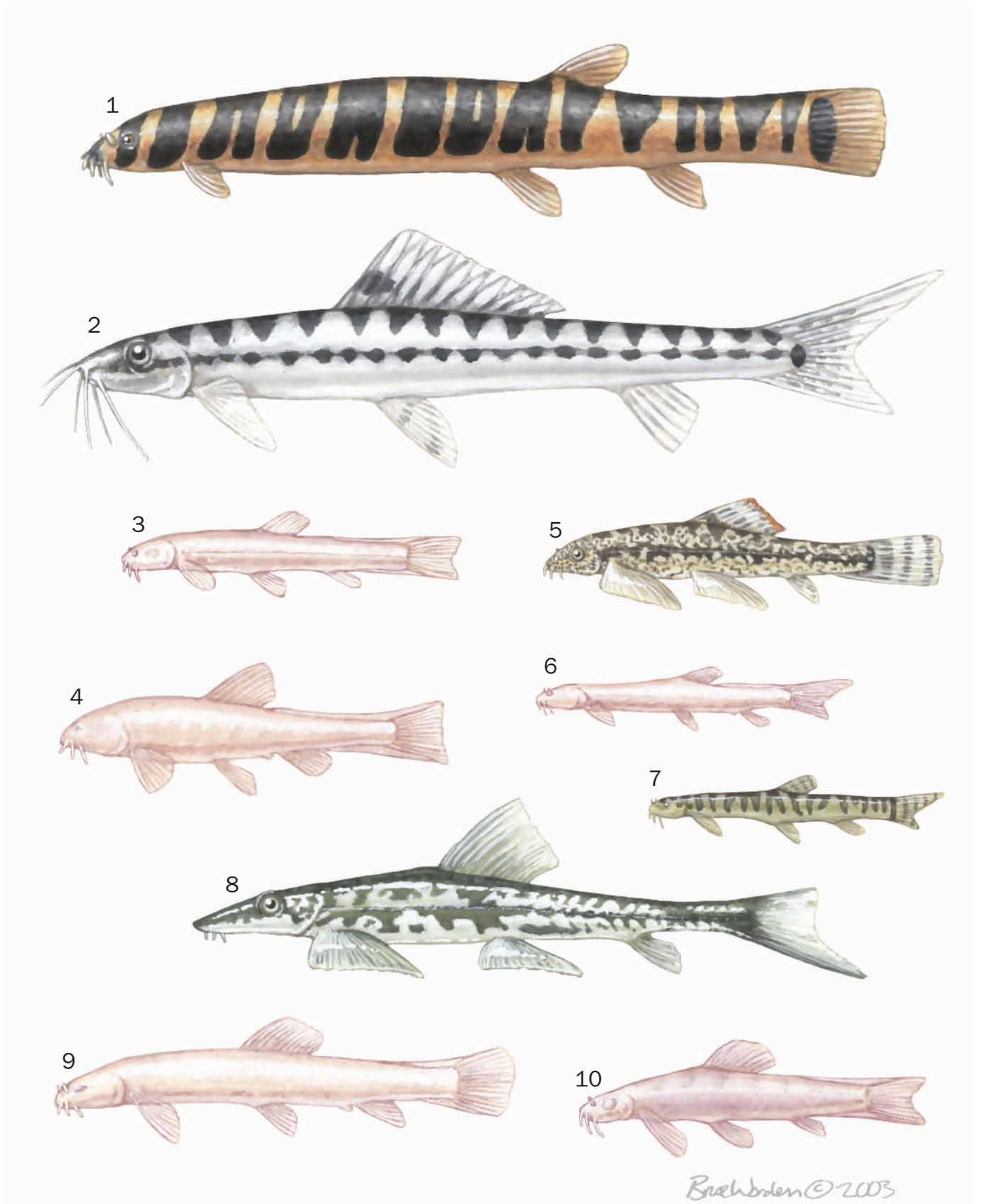


E.S.DAMSTRA©2002

1. Gudgeon (*Gobio gobio*); 2. Black stick (*Garra pingi*); 3. Common carp (*Cyprinus carpio*); 4. Eurasian minnow (*Phoxinus phoxinus*); 5. Common dace (*Leuciscus leuciscus*); 6. Crucian carp (*Carassius auratus*); 7. Zebrafish (*Danio rerio*); 8. *Schizothorax prenanti*; 9. Barbel (*Barbus barbus*). (Illustration by Emily Damstra)



1. Bigmouth buffalo (*Ictiobus cyprinellus*); 2. Longnose sucker (*Catostomus catostomus*); 3. Weatherfish (*Misgurnus fossilis*); 4. Stone loach (*Barbatula barbatula*); 5. Chinese sucker (*Myxocyprinus asiaticus*); 6. Clown loach (*Botia macracanthus*); 7. Horseface loach (*Acanthopsis choiro-rhynchus*); 8. Chinese algae eater (*Gyrinocheilus aymonieri*); 9. Spotted algae eater (*Gyrinocheilus pennocki*). (Illustration by Bruce Worden)

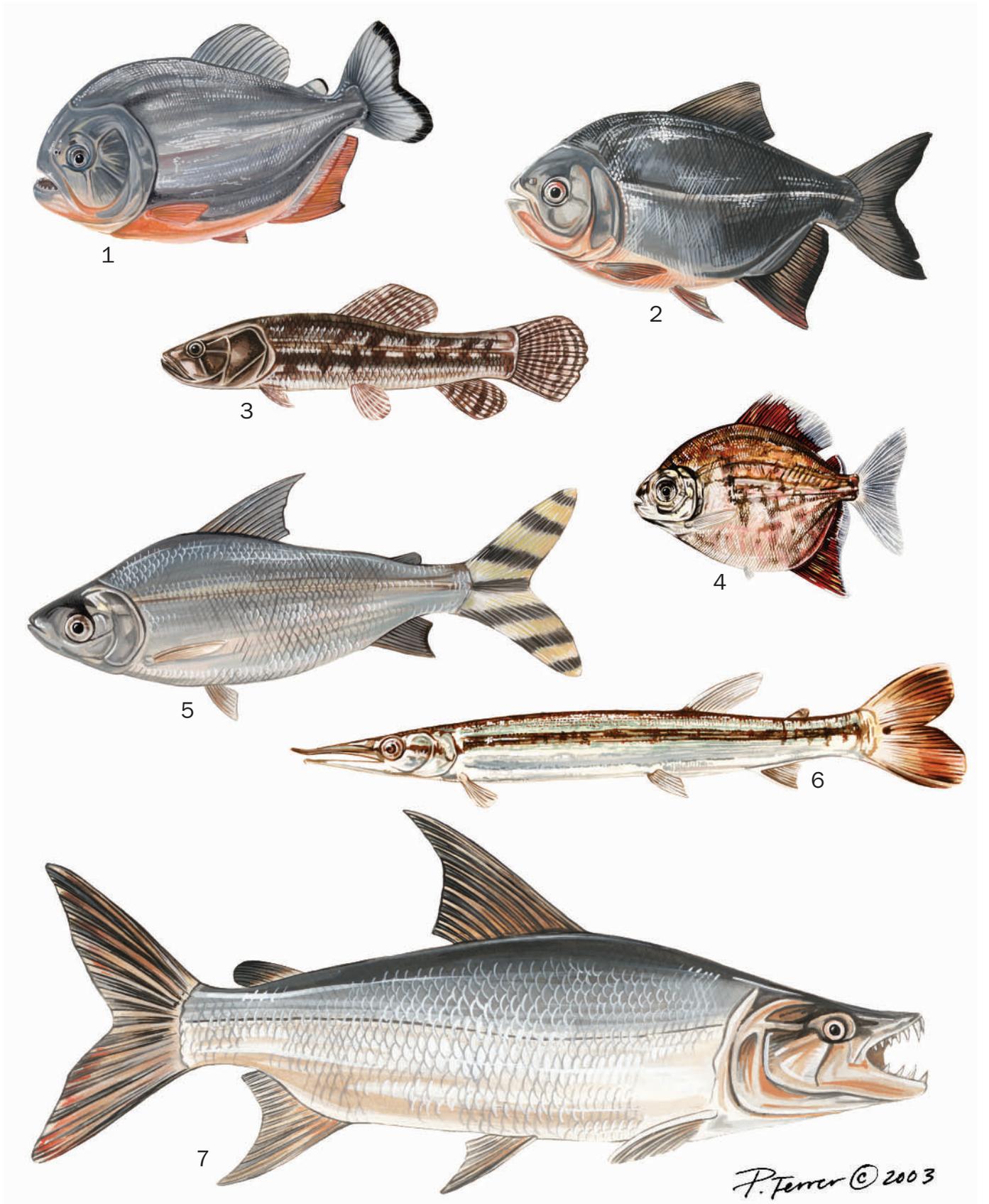


1. Coolie loach (*Pangio kuhlii*); 2. Arrow loach (*Nemacheilus masyae*); 3. Cavetfish of Nam Lang (*Schistura oedipus*); 4. Kughitang blind loach (*Nemacheilus starostini*); 5. Chinese hillstream loach (*Pseudogastromyzon chen*); 6. Blind loach (*Paracobitis smithi*); 7. Hillstream loach (*Nemacheilus evezardi*). 8. Anamia (*Annamia normani*); 9. Blind cave loach of Xiaao (*Protocobitis typhlops*); 10. Siju blind cavefish (*Schistura sijuensis*). (Illustration by Bruce Worden)

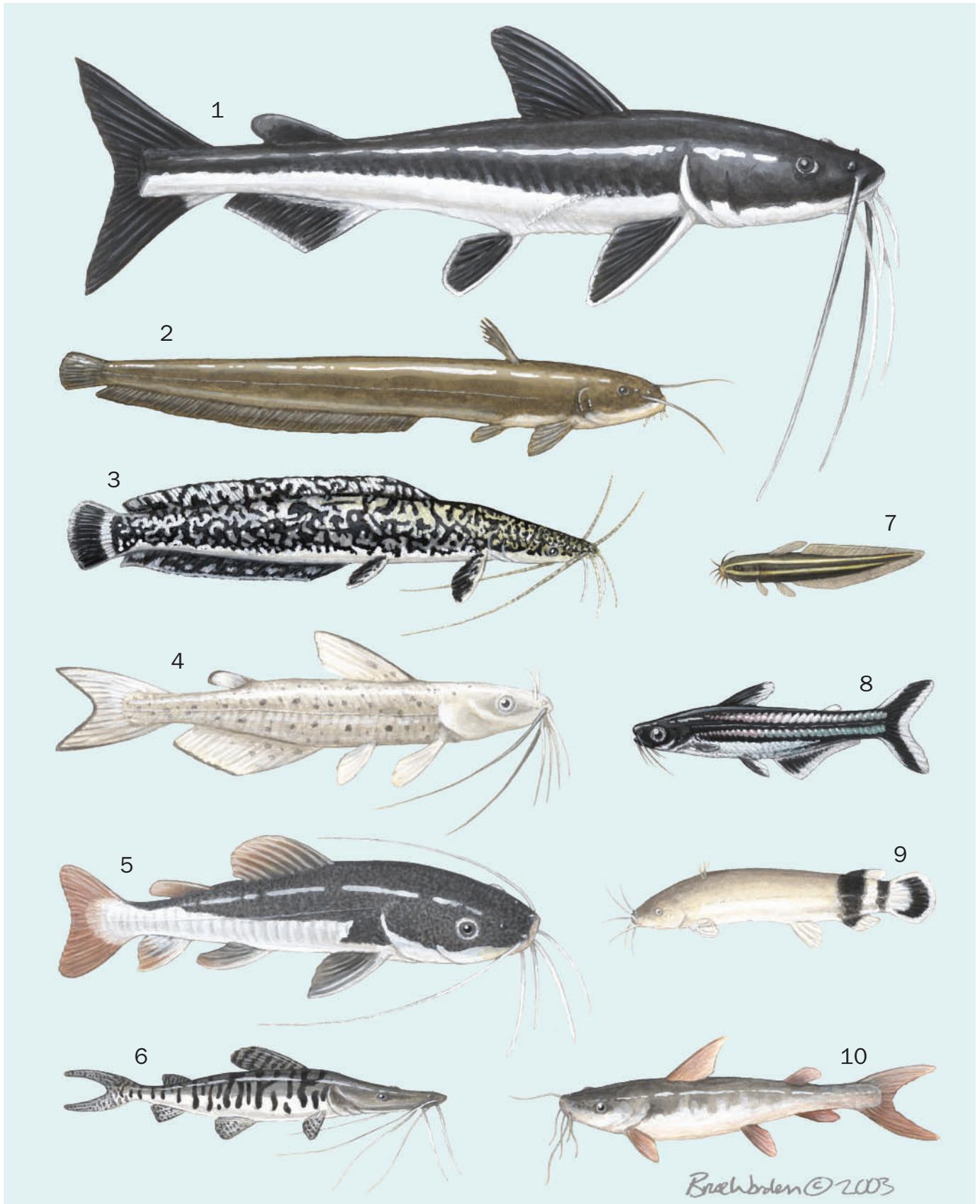


*P. Ferrer © 2003*

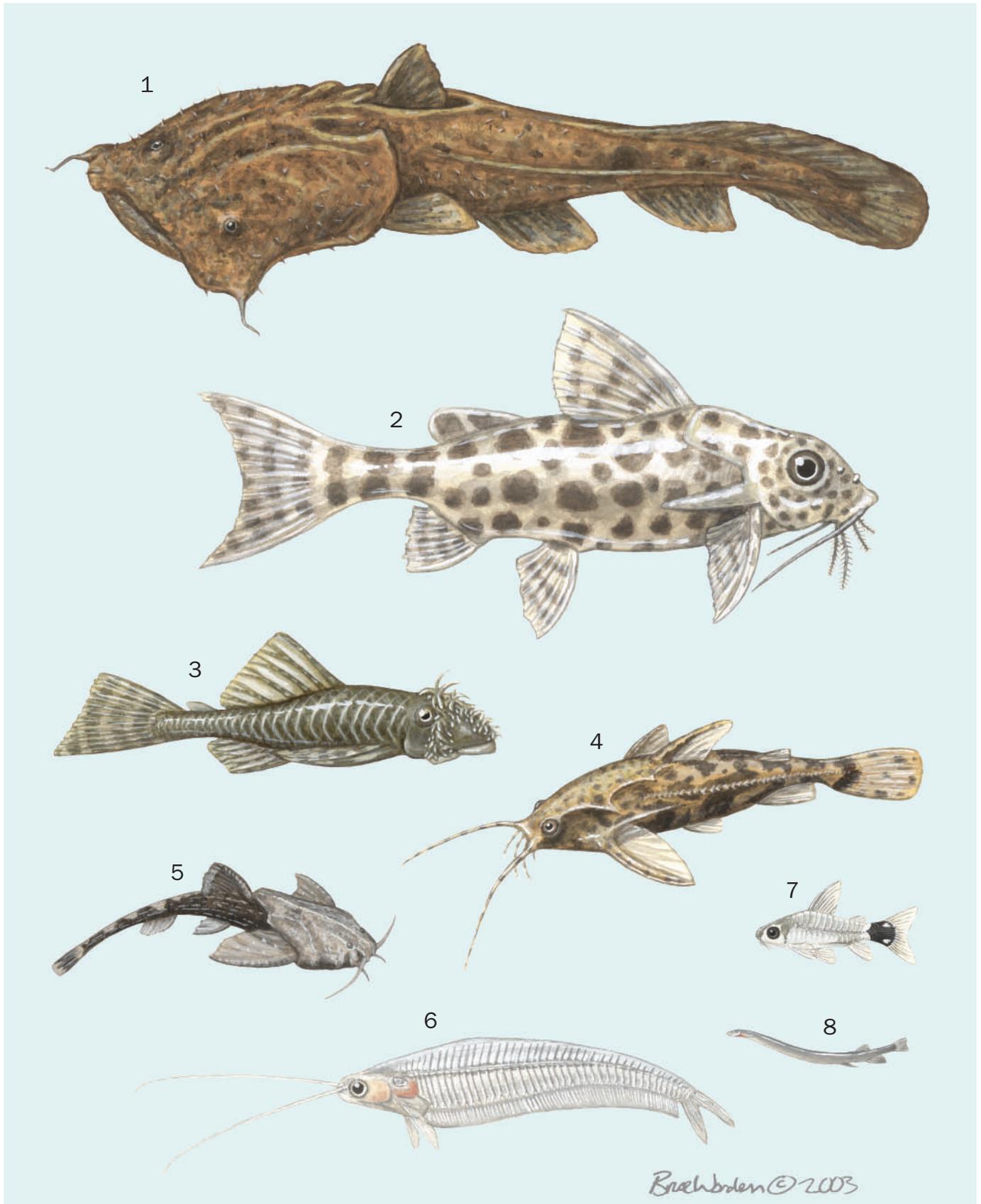
1. Splash tetra (*Copella arnoldi*); 2. False rumynose tetra (*Petitella georgiae*); 3. Bleeding-heart tetra (*Hyphessobrycon erythrostigma*); 4. Cardinal tetra (*Paracheirodon axelrodi*); 5. Blind cavefish (*Astyanax mexicanus jordani*); 6. Striped African darter (*Nannocharax fasciatus*); 7. Striped headstander (*Anostomus anostomus*); 8. River hatchetfish (*Gasteropelecus sternicla*). (Illustration by Patricia Ferrer)



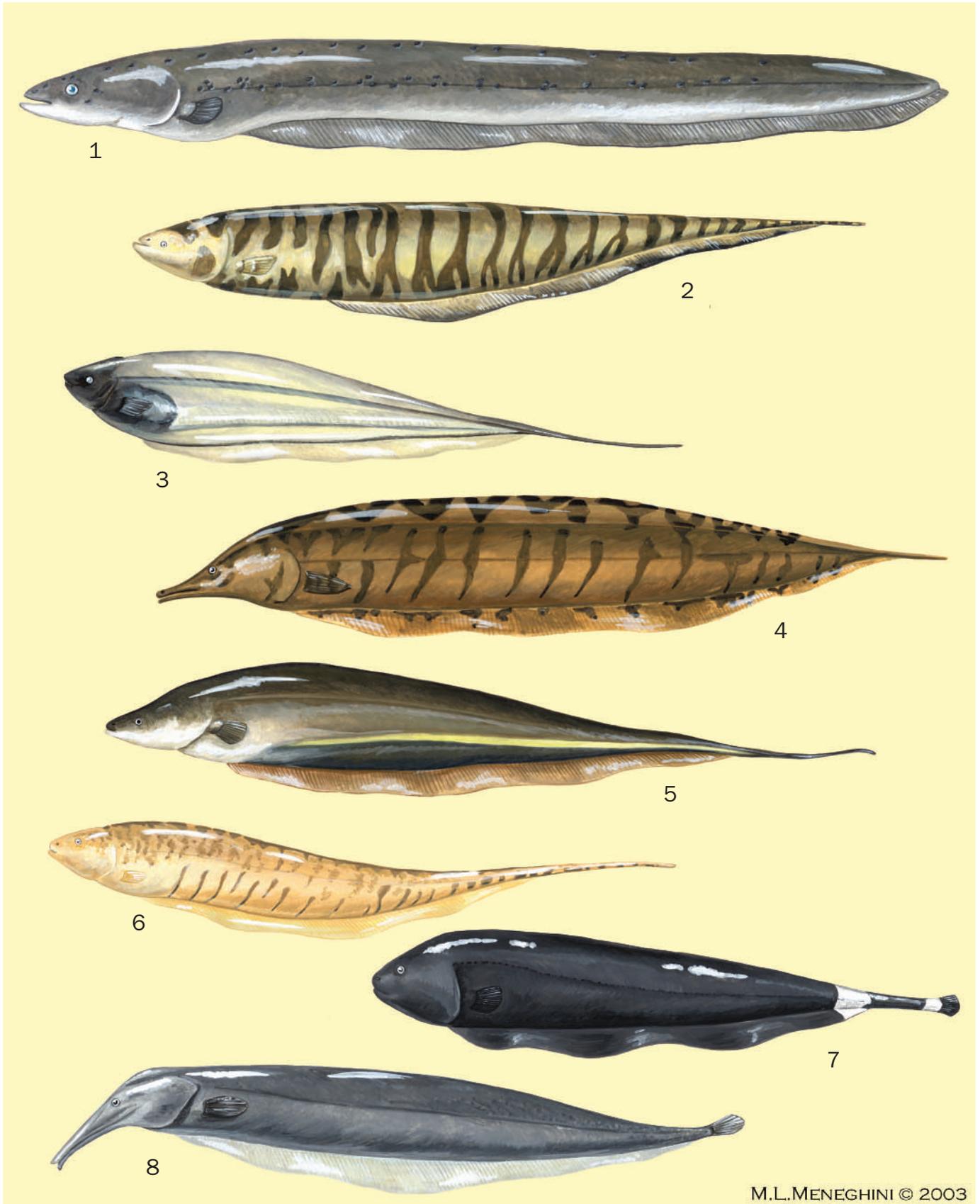
1. Red-bellied piranha (*Pygocentrus nattereri*); 2. Pirapitinga (*Piaractus brachipomus*); 3. Trahira (*Hoplias malabaricus*); 4. Silver dollar (*Myleus pacu*); 5. Flagtail prochilodus (*Semaprochilodus taeniurus*); 6. Golden pike characin (*Boulengerella lucius*); 7. Giant tigerfish (*Hydrocynus goliath*). (Illustration by Patricia Ferrer)



1. Lau-lau (*Brachyplatystoma filamentosum*); 2. European wels (*Silurus glanis*); 3. Sharptooth catfish (*Clarias gariepinus*); 4. Channel catfish (*Ictalurus punctatus*); 5. Redtail catfish (*Phractocephalus hemiliopterus*); 6. Tiger shovelnose catfish (*Pseudoplatystoma fasciatum*); 7. Coral catfish (*Plotosus lineatus*); 8. Iridescent shark-catfish (*Pangasius hypophthalmus*); 9. Electric catfish (*Malapterurus electricus*); 10. New Granada sea catfish (*Ariopsis bonillai*). (Illustration by Bruce Worden)

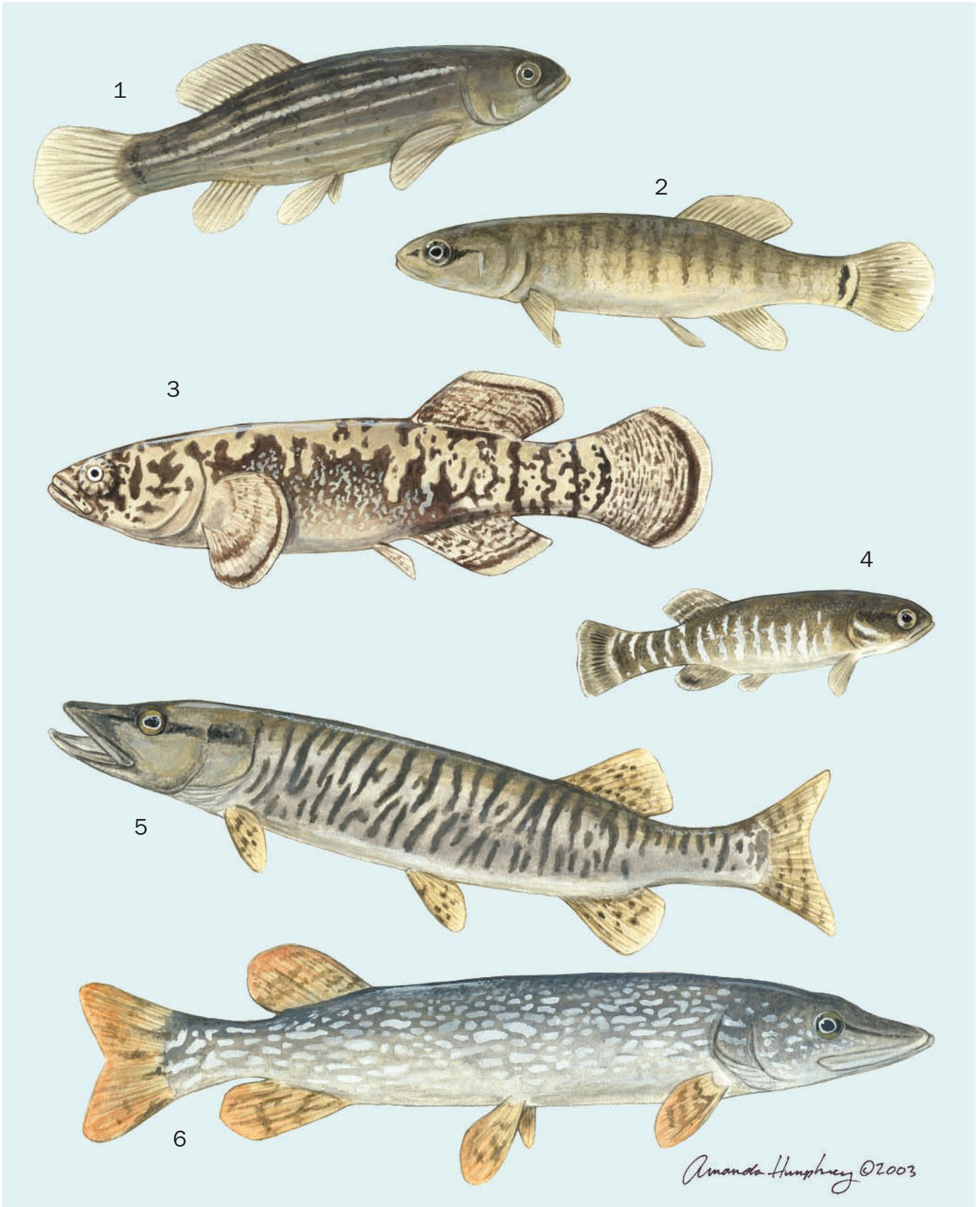


1. Squarehead catfish (*Chaca chaca*); 2. Blotched upsidedown catfish (*Synodontis nigriventris*); 3. Branched bristlenose catfish (*Ancistrus triradiatus*); 4. Blue-eye catfish (*Amblydoras hancockii*); 5. Guitarrita (*Dysichthys coracoideus*); 6. Glass catfish (*Kryptopterus bicirrhus*); 7. Dwarf corydoras (*Corydoras hastatus*); 8. Candiru (*Vandellia cirrhosa*). (Illustration by Bruce Worden)

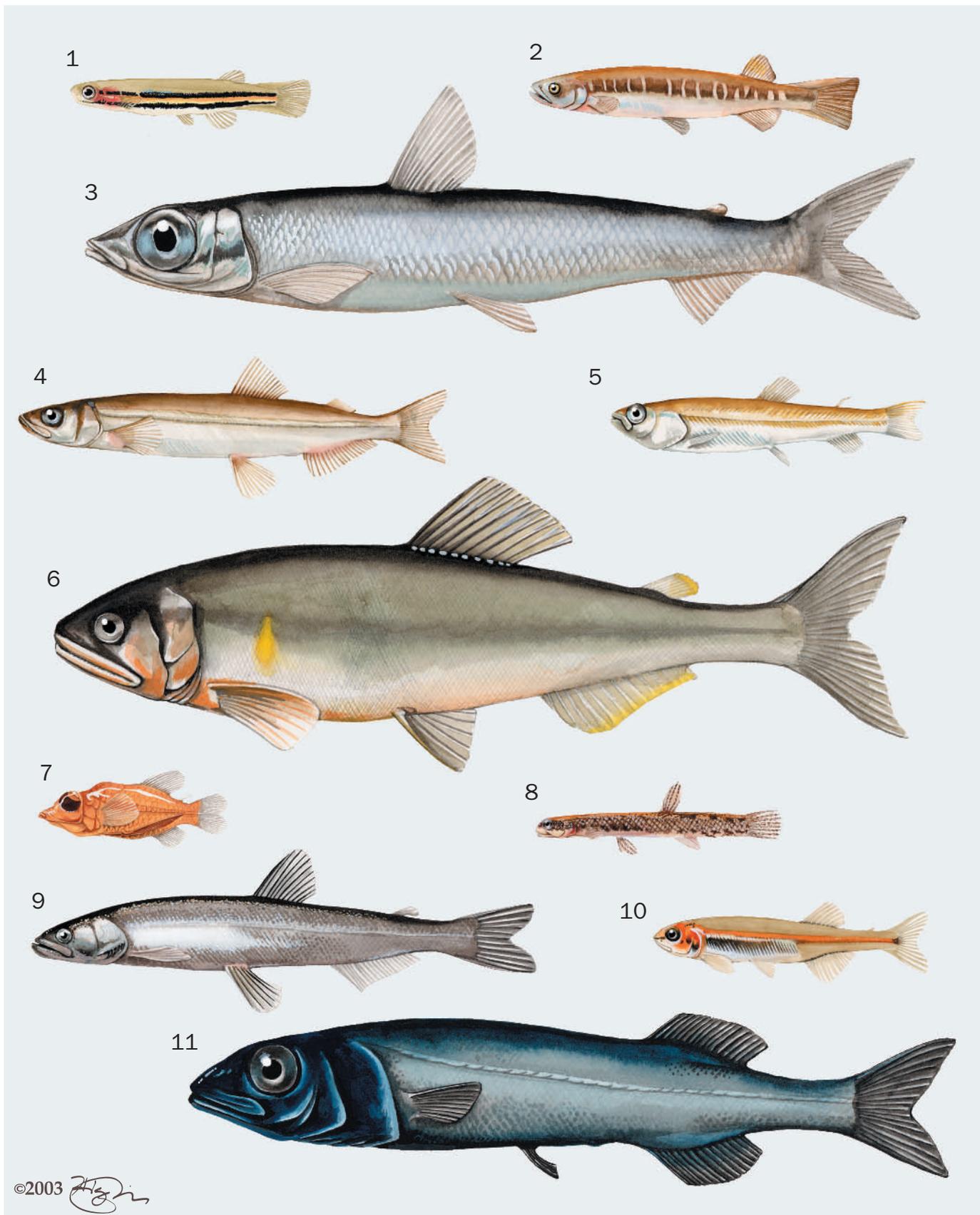


M.L.MENEGHINI © 2003

1. Electric eel (*Electrophorus electricus*); 2. Banded knifefish (*Gymnotus carapo*); 3. Glass knifefish (*Eigenmannia lineata*); 4. Bandfish (*Rhamphichthys rostratus*); 5. Longtail knifefish (*Sternopygus macrurus*); 6. *Brachyhypopomus pinnicaudatus*; 7. Black ghost (*Apteronotus albifrons*); 8. *Sternarchorhynchus curvirostris*. (Illustration by Michelle Meneghini)



1. European mudminnow (*Umbra krameri*); 2. Central mudminnow (*Umbra limi*); 3. Alaska blackfish (*Dallia pectoralis*); 4. Olympic mudminnow (*Novumbra hubbsi*); 5. Muskellunge (*Esox masquinongy*); 6. Northern pike (*Esox lucius*). (Illustration by Amanda Humphrey)



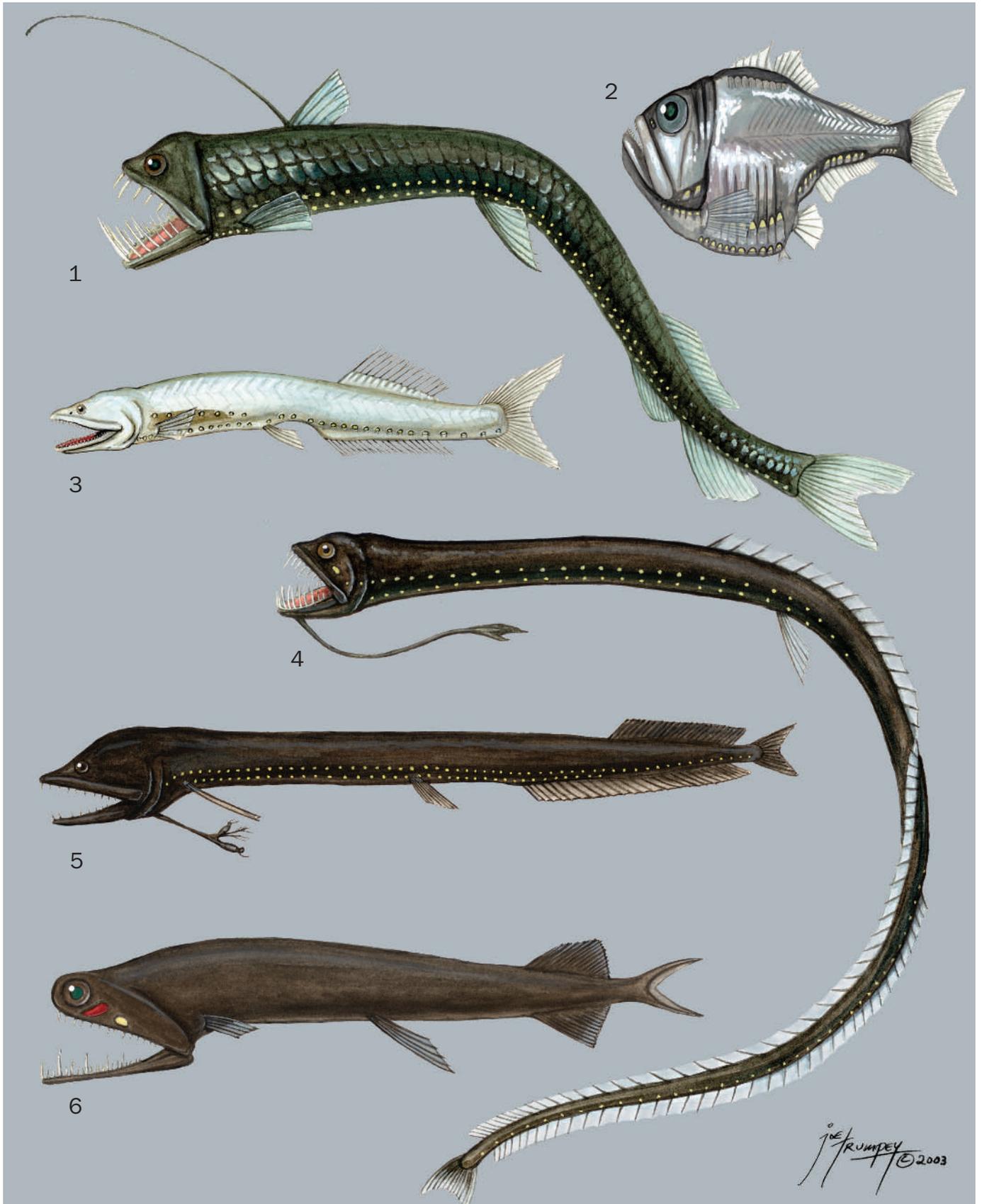
1. Black-stripe minnow (*Galaxiella nigrostriata*); 2. Western minnow (*Galaxias occidentalis*); 3. Greater argentine (*Argentina silus*); 4. Capelin (*Malotus villosus*); 5. California smoothtongue (*Leuroglossus stilbius*); 6. Ayu (*Plecoglossus altivelis*); 7. Barreleye (*Macropinna microstoma*); 8. Salamanderfish (*Lepidogalaxias salamandroides*); 9. Eulachon (*Thaleichthys pacificus*); 10. Australian smelt (*Retropinna semoni*); 11. California slickhead (*Alepocephalus tenebrosus*). (Illustration by Jonathan Higgins)



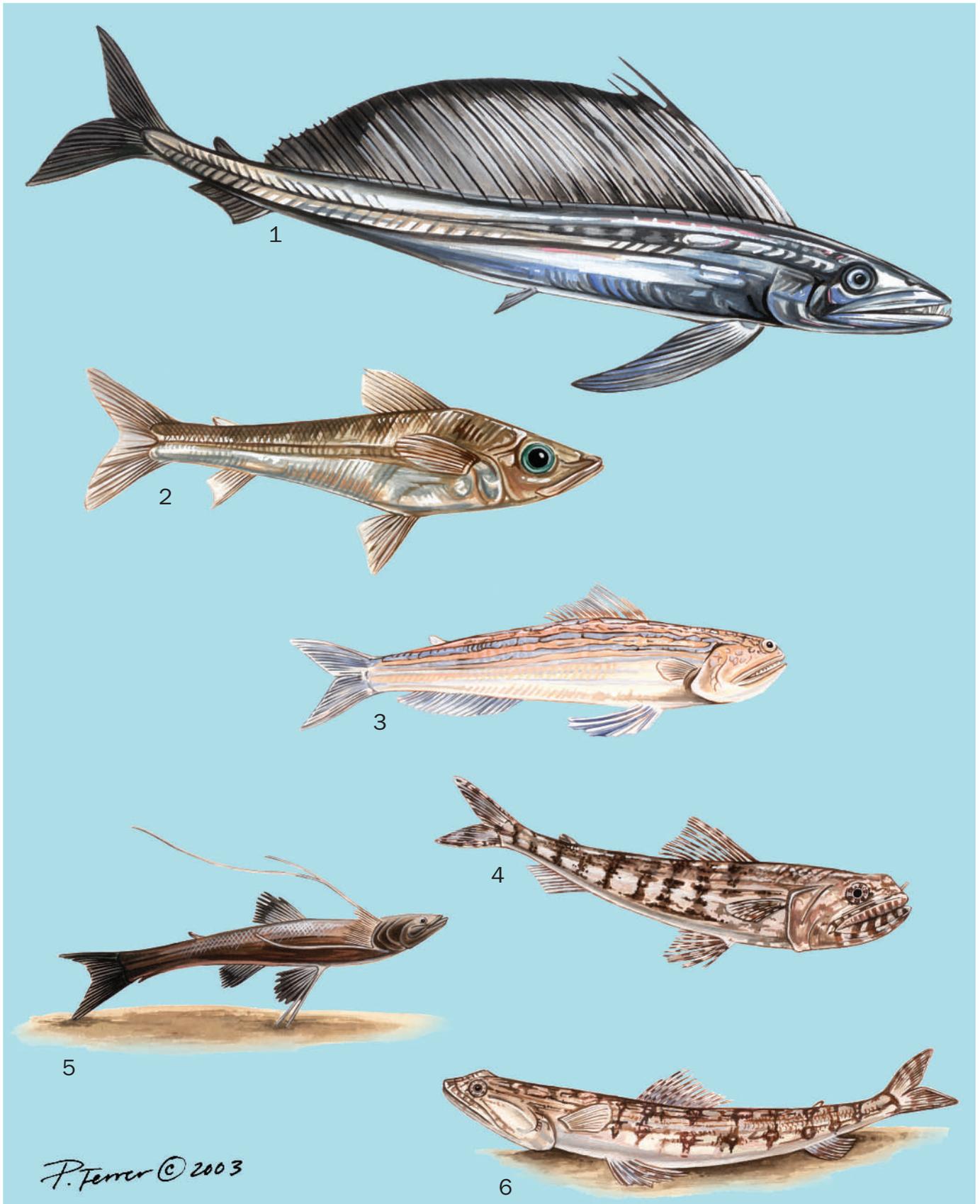
1. Brook trout (*Salvelinus fontinalis*); 2. Brown trout (*Salmo trutta*); 3. Lake trout (*Salvelinus namaycush*); 4. Charr (*Salvelinus alpinus*); 5. Atlantic salmon (*Salmo salar*); 6. Arctic grayling (*Thymallus arcticus arcticus*); 7. Lake whitefish (*Coregonus clupeaformis*). (Illustration by John Megahan)



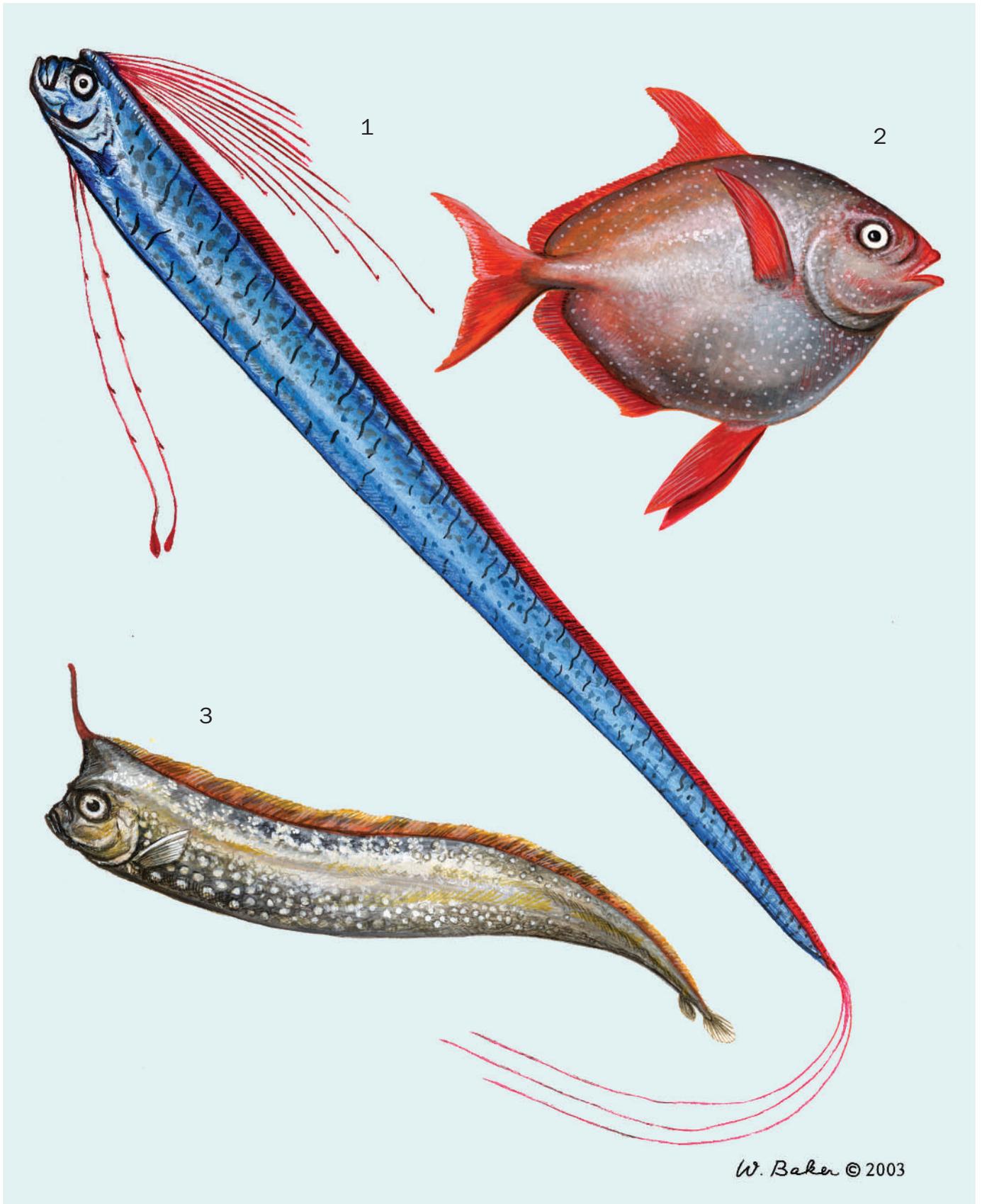
1. Cherry salmon (*Oncorhynchus masou*); 2. Rainbow trout (*Oncorhynchus mykiss*); 3. Golden trout (*Oncorhynchus aguabonita*); 4. Chinook salmon (*Oncorhynchus tshawytscha*); 5. Pink salmon (*Oncorhynchus gorbuscha*); 6. Sockeye salmon (*Oncorhynchus nerka*); 7. Coho salmon (*Oncorhynchus kisutch*). (Illustration by John Megahan)



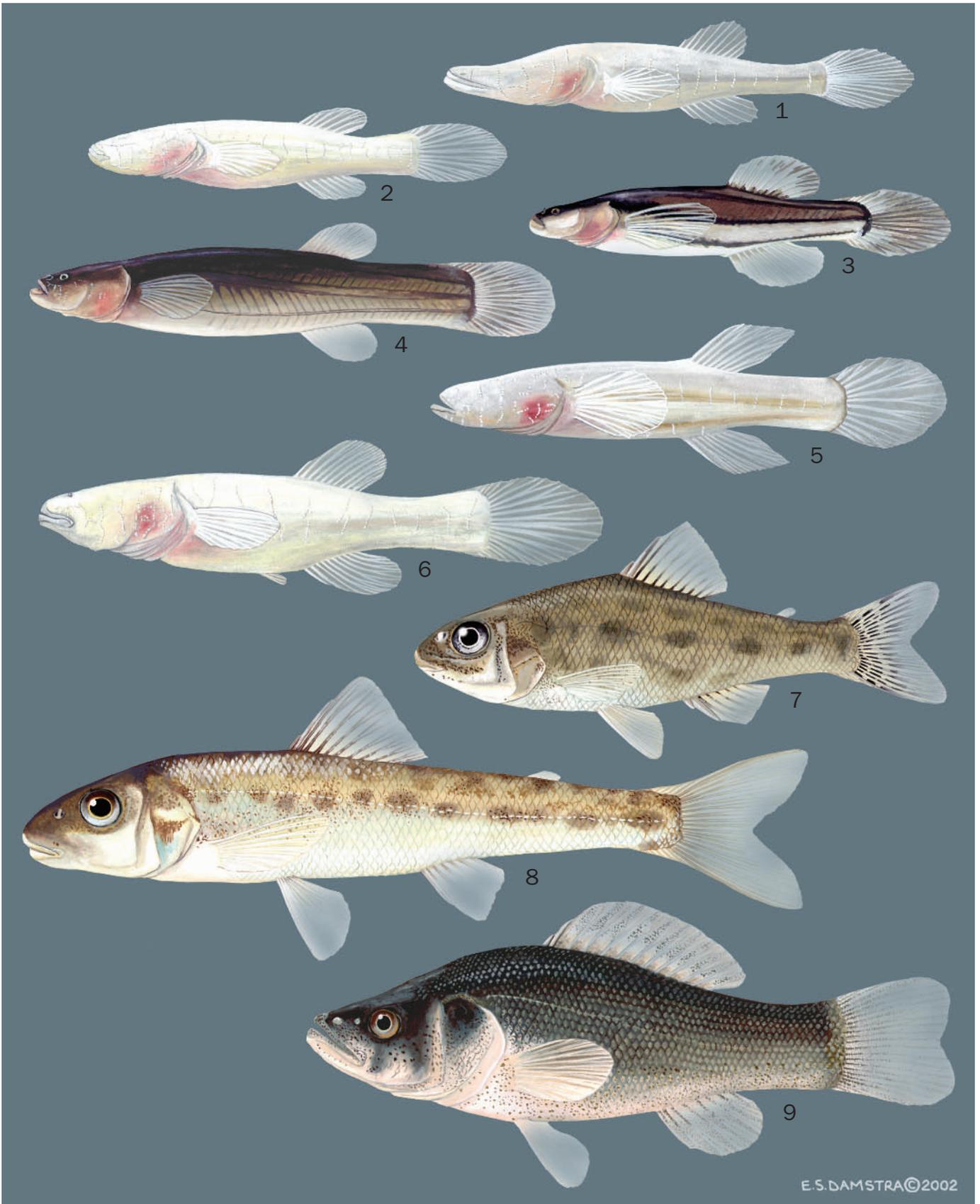
1. Viperfish (*Chauliodus sloani*); 2. Silver hatchetfish (*Argyropelecus aculeatus*); 3. Brauer's bristlemouth (*Cyclothone braueri*); 4. Black dragonfish (*Idiacanthus fasciola*); 5. Scaleless dragonfish (*Eustomias schmidt*); 6. Rat-trap fish (*Malacosteus niger*). (Illustration by Joseph E. Trumpey)



1. Longnose lancetfish (*Alepisaurus ferox*); 2. Greeneye (*Chlorophthalmus acutifrons*); 3. Painted lizardfish (*Trachinocephalus myops*); 4. Slender lizardfish (*Saurida gracilis*); 5. Tripodfish (*Bathypterois quadrifilis*); 6. Clearfin lizardfish (*Synodus dermatogenys*). (Illustration by Patricia Ferrer)



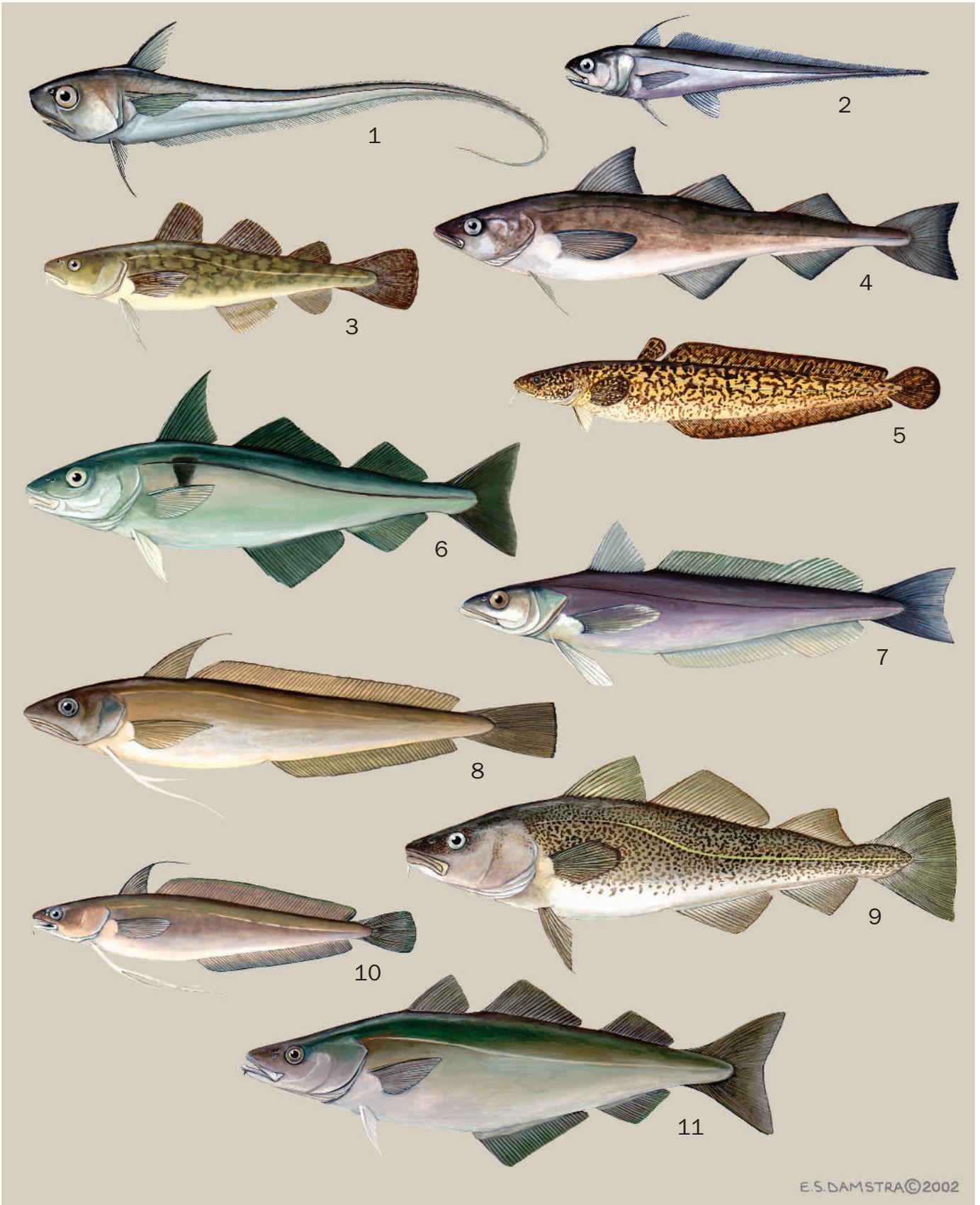
1. Oarfish (*Regalecus glesne*); 2. Opah (*Lampris guttatus*); 3. Crestfish (*Lophotus lacepede*). (Illustration by Wendy Baker)



1. Alabama cavefish (*Speoplatyrhinus poulsoni*); 2. Ozark cavefish (*Amblyopsis rosae*); 3. Swampfish (*Chologaster cornuta*); 4. Spring cavefish (*Forbesichthys agassizii*); 5. Southern cavefish (*Typhlichthys subterraneus*); 6. Northern cavefish (*Amblyopsis spelaea*); 7. Sand roller (*Percopsis transmontana*); 8. Troutperch (*Percopsis omiscomaycus*); 9. Pirate perch (*Aphredoderus sayanus*). (Illustration by Emily Damstra)

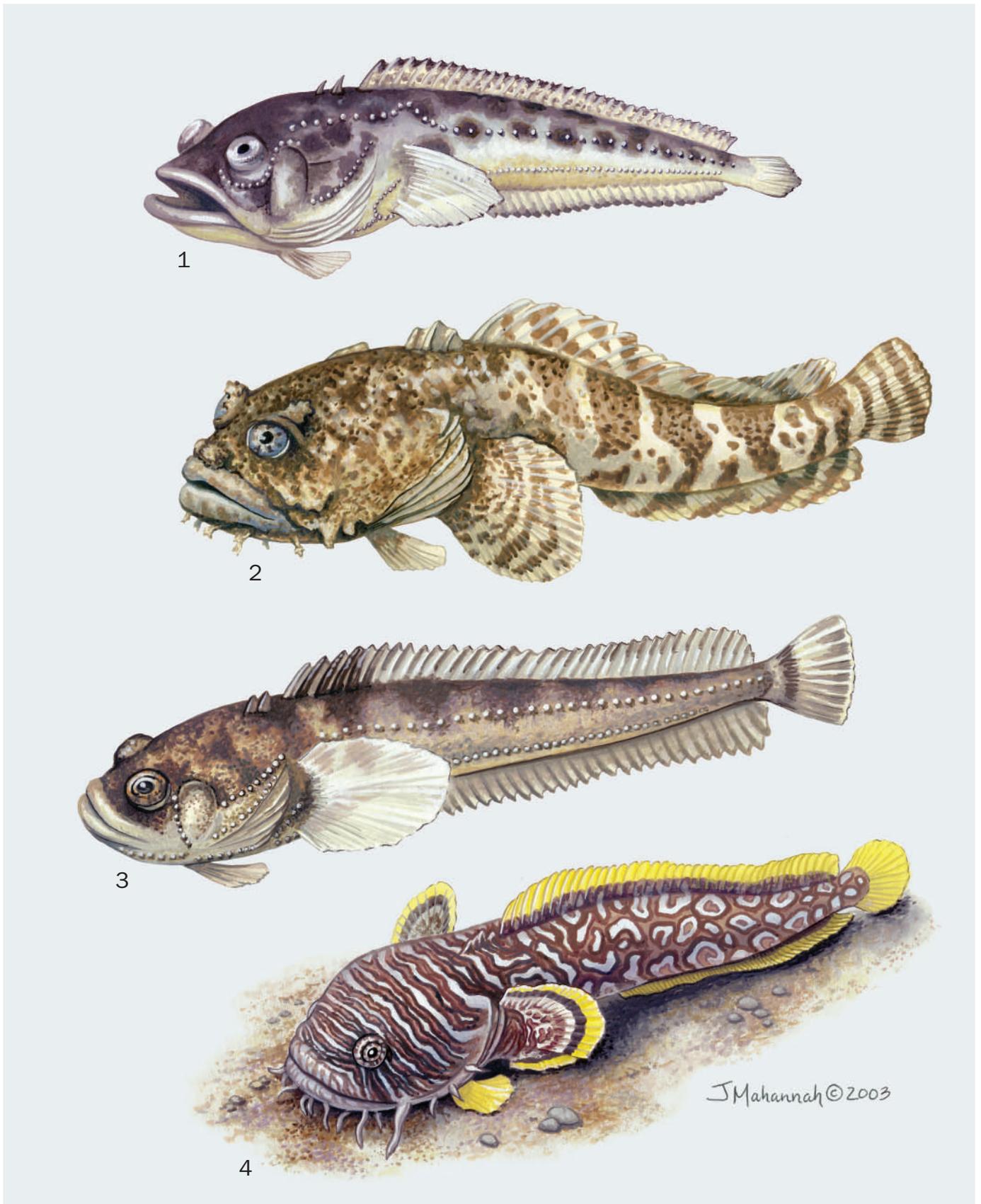


1. Key brotula (*Ogilbia cayorum*); 2. Pearlfish (*Carapus bermudensis*); 3. Band cusk-eel (*Ophidion holbrooki*). (Illustration by Patricia Ferrer)



E.S.DAMSTRA©2002

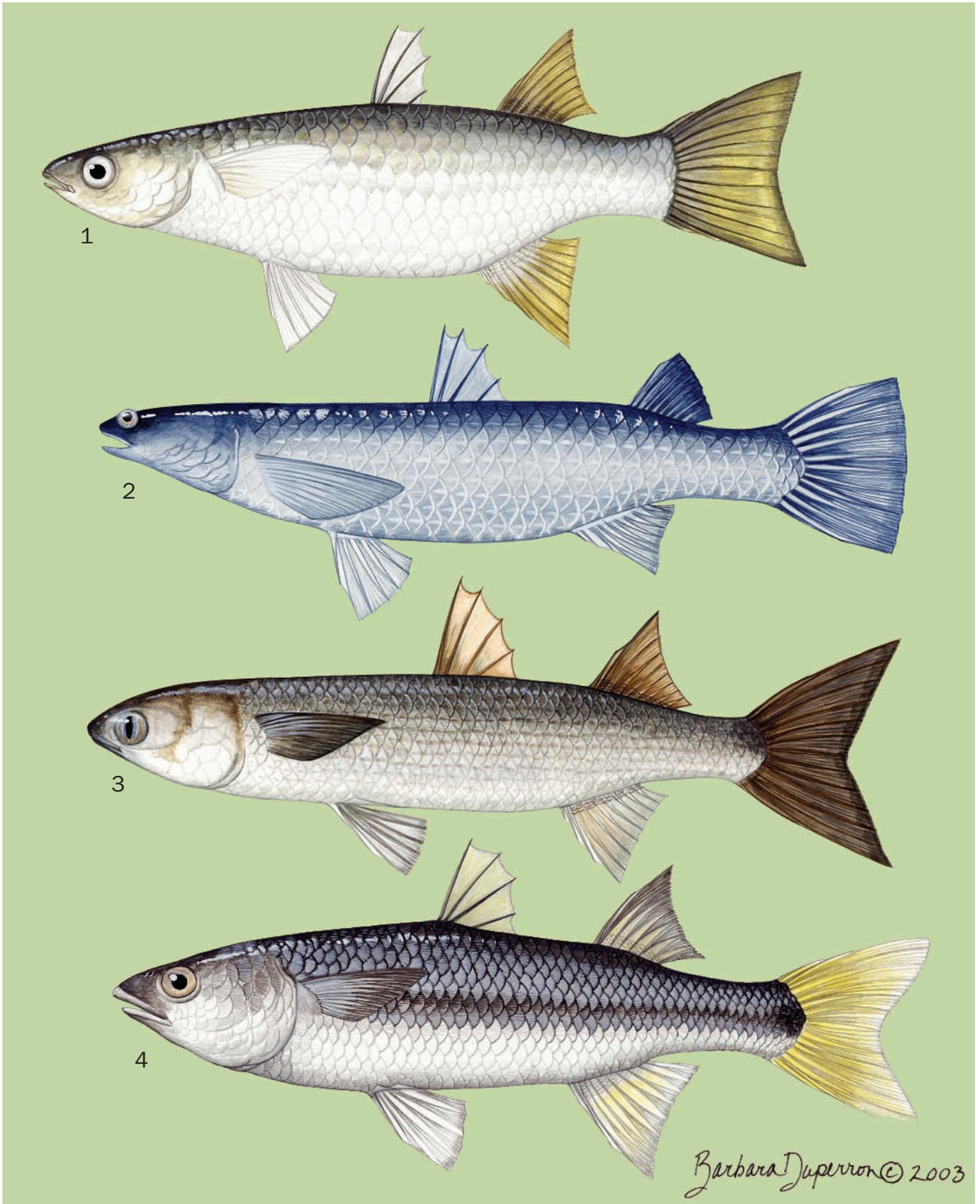
1. Roundnose grenadier (*Coryphaenoides rupestris*); 2. Luminous hake (*Steindachneria argentea*); 3. Atlantic tomcod (*Microgadus tomcod*); 4. Alaska pollock (*Theragra chalcogramma*); 5. Burbot (*Lota lota*); 6. Haddock (*Melanogrammus aeglefinus*); 7. Silver hake (*Merluccius bilinearis*); 8. White hake (*Urophycis tenuis*); 9. Atlantic cod (*Gadus morhua*); 10. Red hake (*Urophycis chuss*); 11. Pollock (*Pollachius virens*). (Illustration by Emily Damstra)



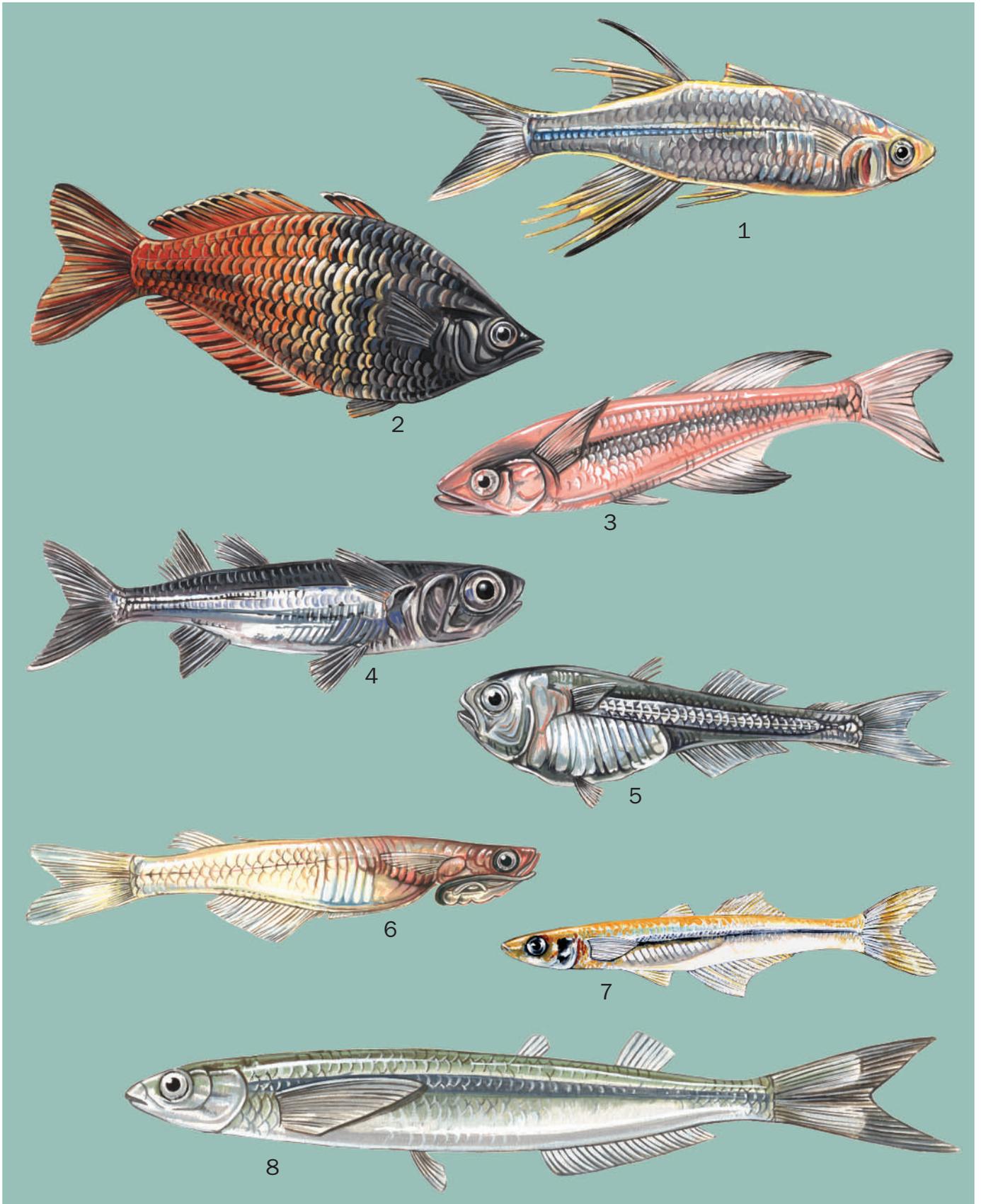
1. Atlantic midshipman (*Porichthys plectrodon*); 2. Oyster toadfish (*Opsanus tau*); 3. Plainfin midshipman (*Porichthys notatus*); 4. Splendid coral toadfish (*Sanopus splendidus*). (Illustration by Jacqueline Mahannah)



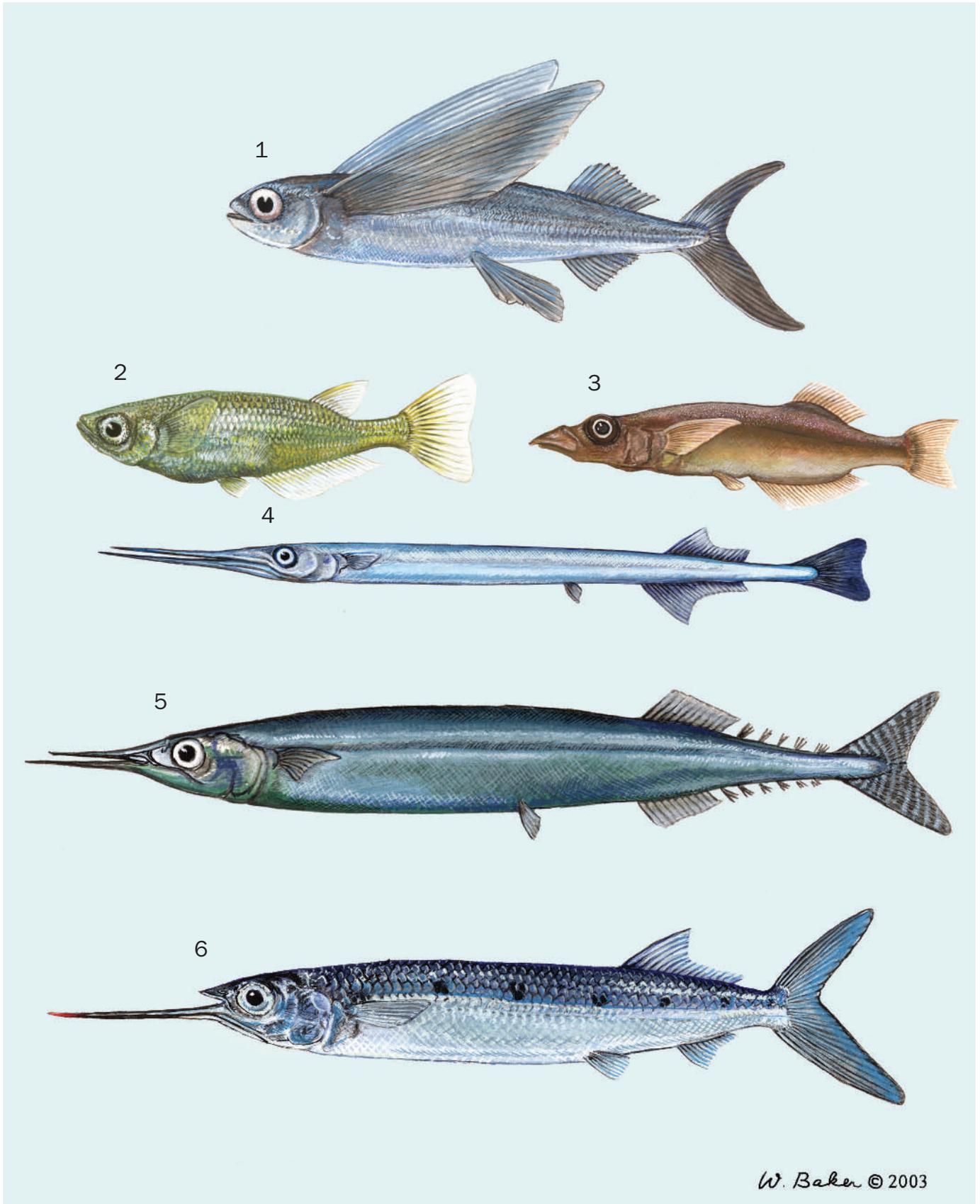
1. Male seadevil (*Cryptopsaras couesii*); 2. Sargassumfish (*Histrio histrio*); 3. Big-eye frogfish (*Antennarius radiosus*); 4. Longnose batfish (*Ogcocephalus corniger*); 5. Monkfish (*Lophius americanus*). (Illustration by Joseph E. Trumpey)



1. Large-scale mullet (*Liza grandisquamis*); 2. Shark mullet (*Rhinomugil nasutus*); 3. Flathead mullet (*Mugil cephalus*); 4. Mountain mullet (*Agonostomus monticola*). (Illustration by Barbara Duperron)



1. Celebes rainbowfish (*Marosatherina ladigesii*); 2. Boeseman's rainbowfish (*Melanotaenia boesemani*); 3. *Rheocles derhami*; 4. Eendracht land silverside (*Atherinomorus endrachtensis*); 5. Flower of the wave (*Iso rhotophilus*); 6. *Neostethus bicornis*; 7. Inland silverside (*Menidia beryllina*); 8. California grunion (*Leuresthes tenuis*). (Illustration by Patricia Ferrer and Michelle Meneghini)

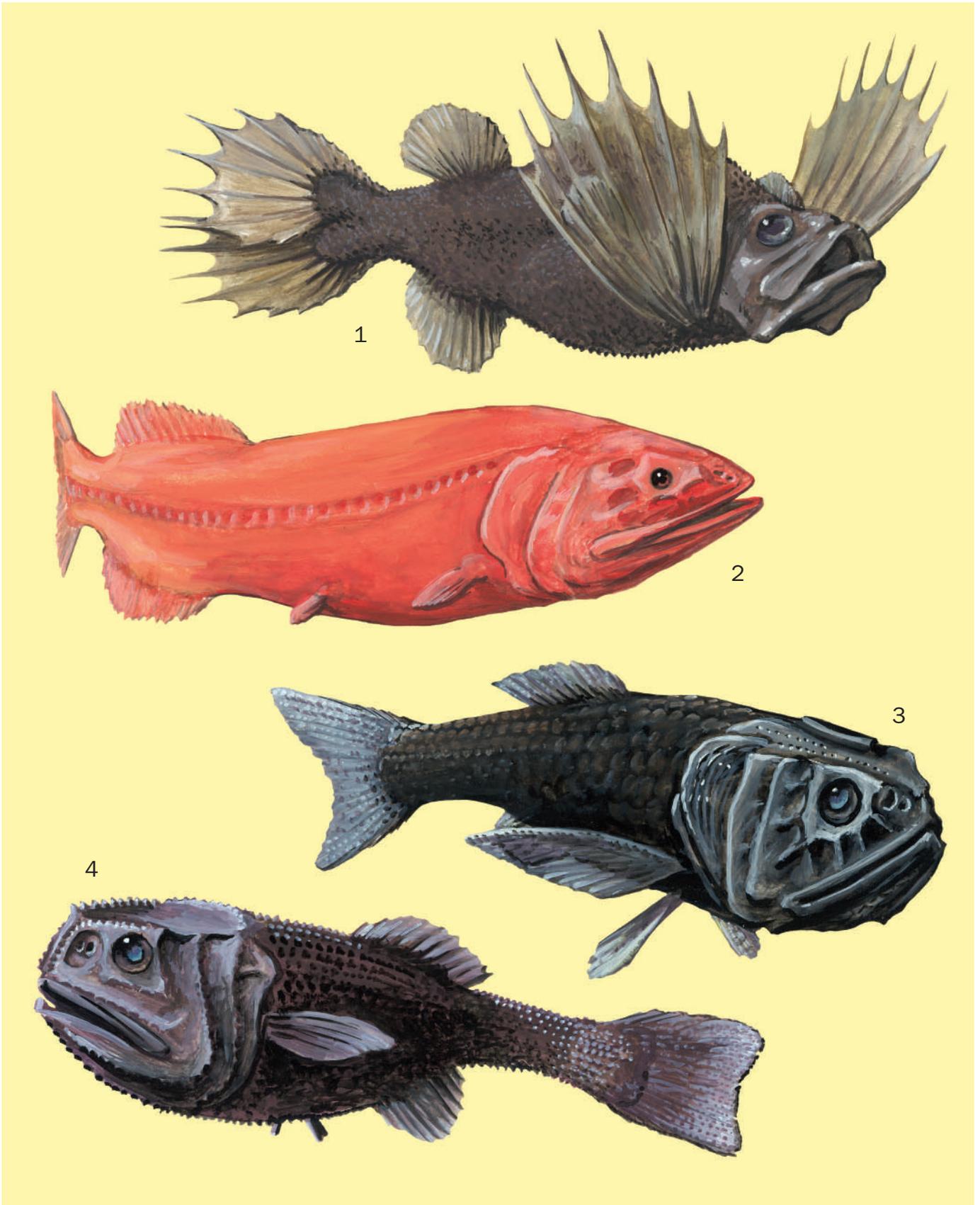


1. California flyingfish (*Cheilopogon pinnatibarbatus californicus*); 2. Japanese rice fish (*Oryzias latipes*); 3. Duckbilled bunting (*Adrianichthys kruyti*); 4. Californian needlefish (*Strongylura exilis*); 5. Atlantic saury (*Scomberesox saurus saurus*); 6. Blackbarred halfbeak (*Hemiramphus far*). (Illustration by Wendy Baker)

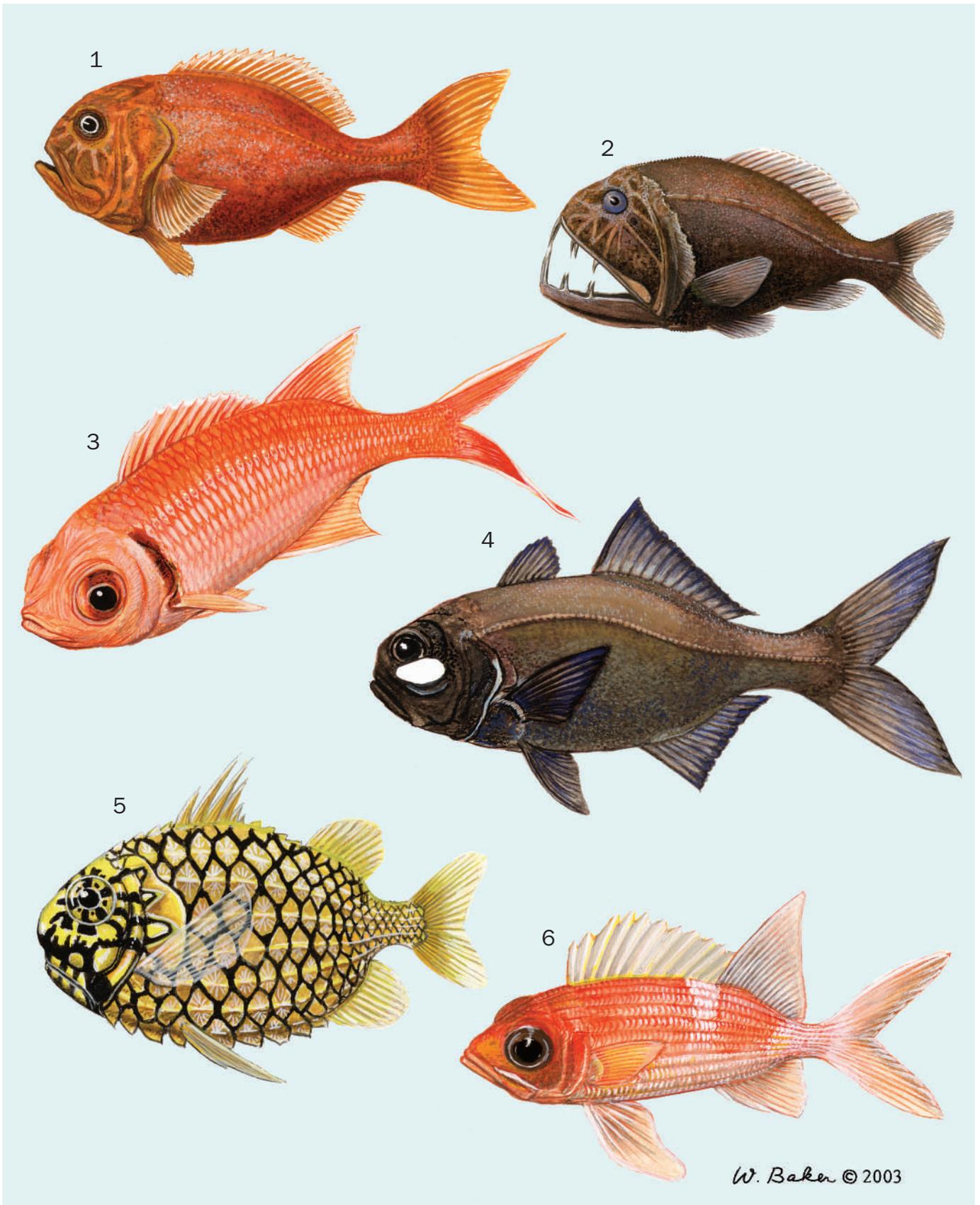


ESD©2003

1. Largescale foureyes (*Anableps anableps*); 2. Redtail splitfin (*Xenotoca eiseni*); 3. Ascotan Mountain killifish (*Orestias ascotanensis*); 4. Northern mummichog (*Fundulus heteroclitus macrolepidotus*); 5. Blackfin pearl killifish (*Austrolebias nigripinnis*); 6. Mangrove rivulus (*Rivulus marmoratus*); 7. Tanganyika pearl lampeye (*Lamprichthys tanganicanus*); 8. Devils Hole pupfish (*Cyprinodon diabolis*); 9. Chocolate lyretail (*Aphyosemion australe*); 10. Green swordtail (*Xiphophorus hellerii* ssp. *hellerii*). (Illustration by Emily Damstra)



1. Hairyfish (*Mirapinna esau*); 2. Red whalefish (*Barbourisia rufa*); 3. Longjaw bigscale (*Scopeloberyx robustus*); 4. Pricklefish (*Stephanoberyx monae*). (Illustration by Brian Cressman)



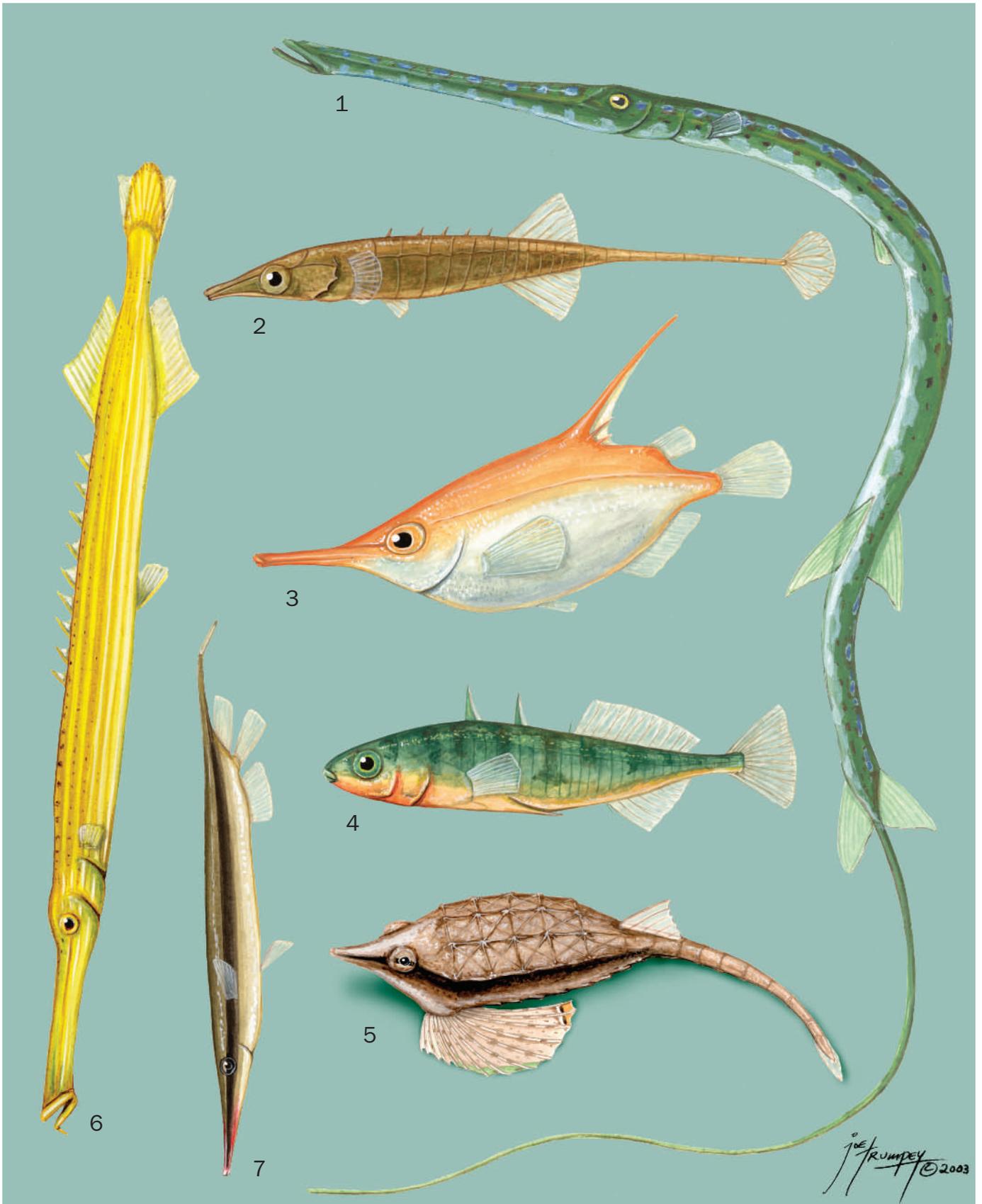
1. Orange roughy (*Hoplostethus atlanticus*); 2. Common fangtooth (*Anoplogaster cornuta*); 3. Blackbar soldierfish (*Myripristis jacobus*); 4. Splitfin flashlightfish (*Anomalops katoptron*); 5. Pinecone fish (*Monocentris japonica*); 6. Squirrelfish (*Holocentrus ascensionis*). (Illustration by Wendy Baker)



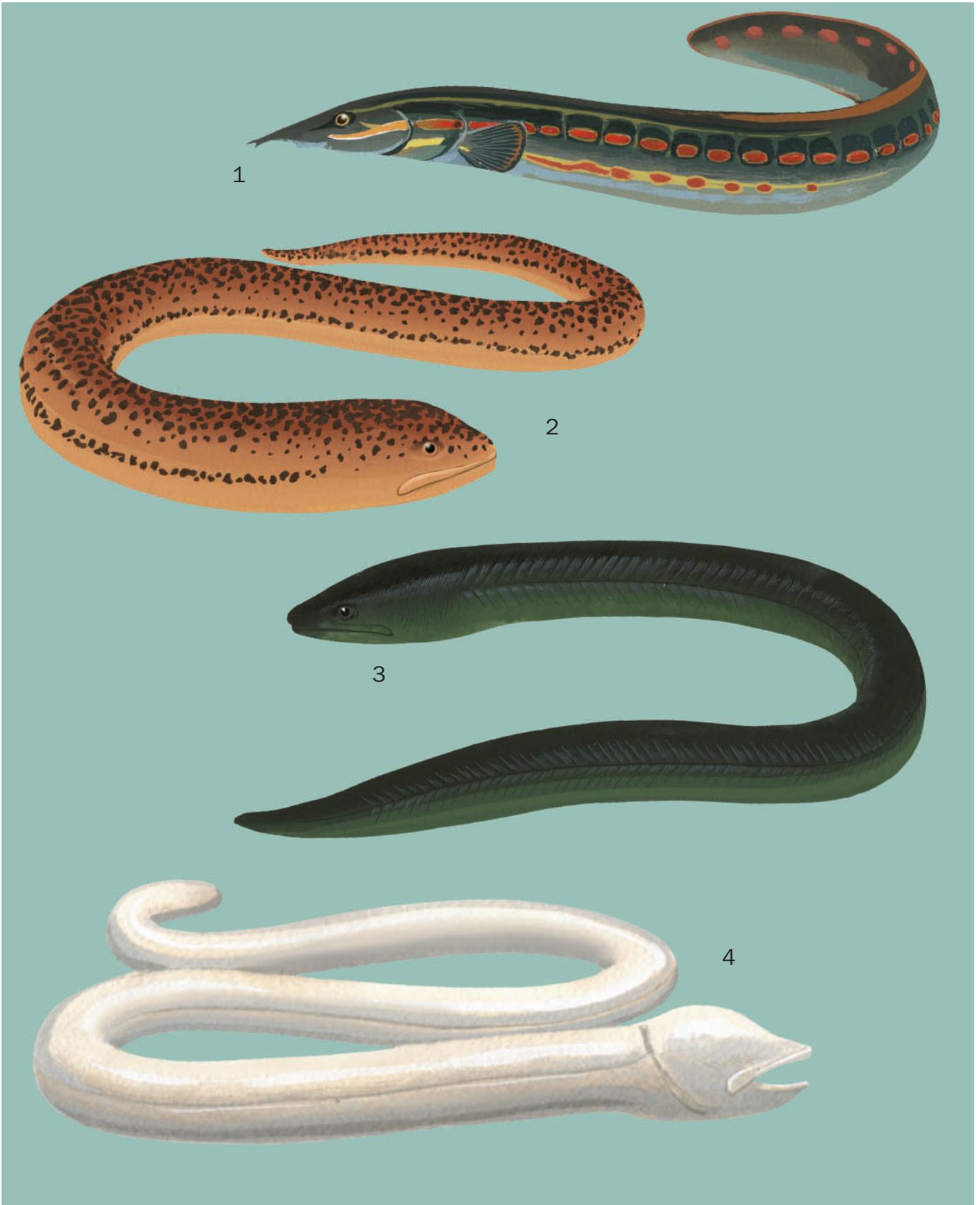
1. Buckler dory (*Zenopsis conchifer*); 2. John dory (*Zeus faber*); 3. Red boarfish (*Antigonia rubescens*); 4. Thorny tinseltfish (*Grammicolepis brachiusculus*); 5. Tinseltfish (*Xenolepidichthys dalgleishi*). (Illustration by John Megahan)



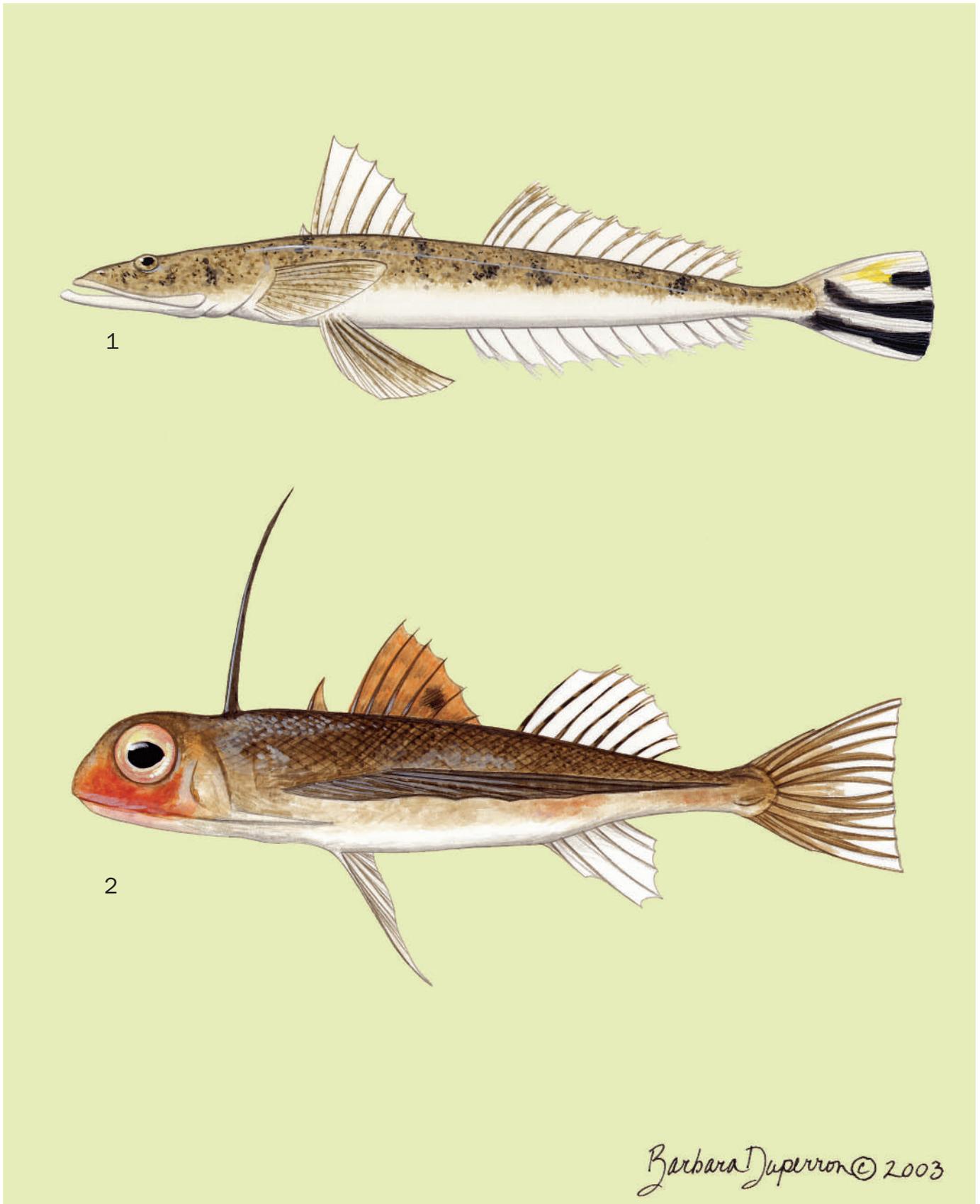
1. Ringed pipefish (*Doryrhamphus dactylophorus*); 2. Leafy seadragon (*Phycodurus eques*); 3. Weedy seadragon (*Phyllopteryx teaniolatus*); 4. Female lined seahorse (*Hippocampus erectus*); 5. Ornate ghost pipefish (*Solenostomus paradoxus*). (Illustration by Joseph E. Trumpey)



1. Blue-spotted cornetfish (*Fistularia tabacaria*); 2. Armored stickleback (*Indostomus paradoxus*); 3. Longspine snipefish (*Macroramphosus scolopax*); 4. Threespine stickleback (*Gasterosteus aculeatus*); 5. Sculptured seamoth (*Pegasus lancifer*); 6. West Atlantic trumpetfish (*Aulostomus maculatus*); 7. Common shrimpfish (*Aeoliscus strigatus*). (Illustration by Joseph E. Trumpey)



1. Fire eel (*Mastacembelus erythrotaenia*); 2. Swamp eel (*Monopterus albus*); 3. Marbled swamp eel (*Synbranchus marmoratus*); 4. Blind cave eel (*Ophisternon candidum*). (Illustration by John Megahan)



Barbara Duperron © 2003

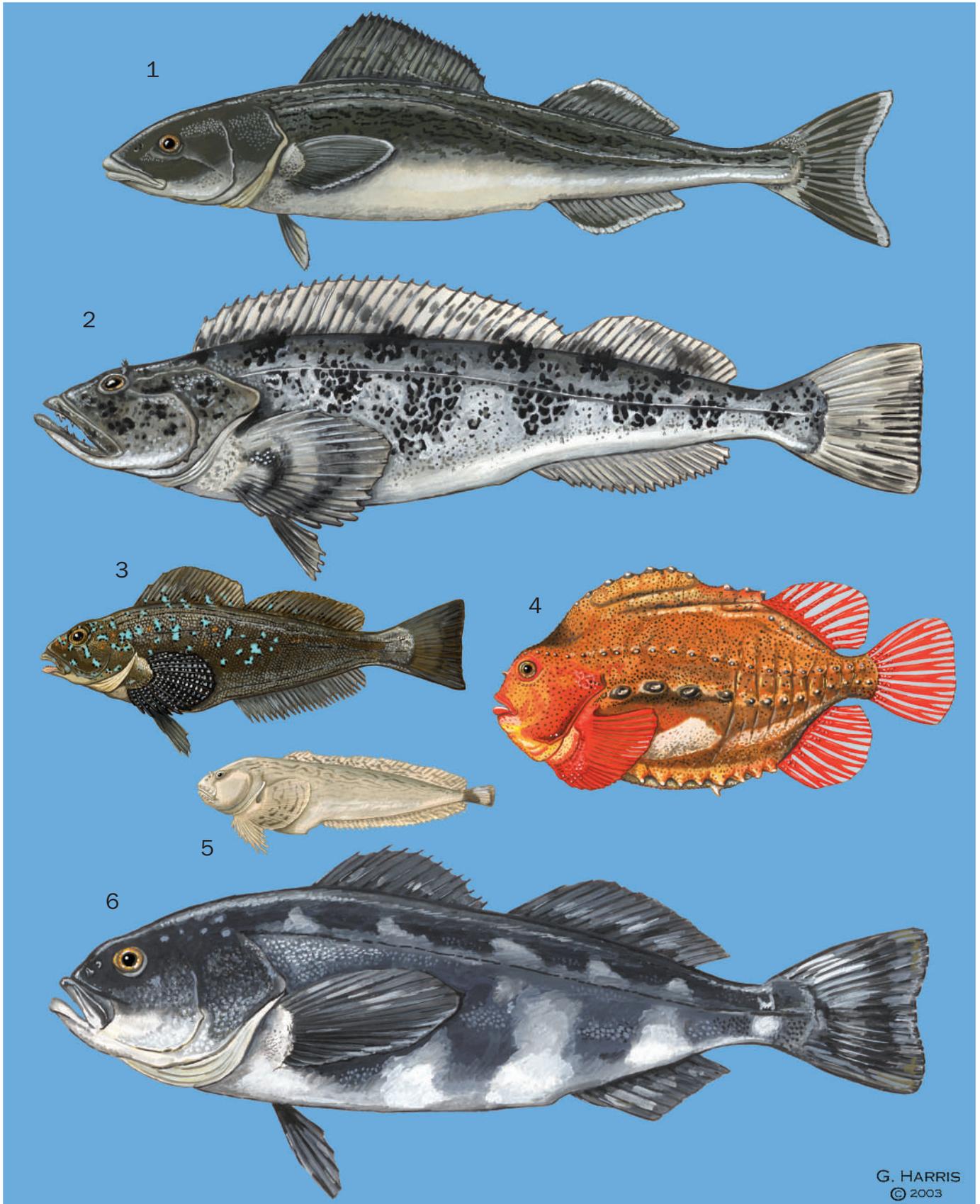
1. Indian flathead (*Platycephalus indicus*); 2. Oriental helmet gurnard (*Dactyloptena orientalis*). (Illustration by Barbara Duperron)



1. Bearded ghou ( *Inimicus didactylus* ); 2. Ocellated waspfish ( *Apistus carinatus* ); 3. Crested scorpionfish ( *Ptarmus jubatus* ); 4. Striped sea robin ( *Prionotus evolans* ); 5. Deepwater scorpionfish ( *Setarches guentheri* ); 6. South American pigfish ( *Congiopodus peruvianus* ); 7. Reef stonefish ( *Synanceia verrucosa* ); 8. Cockatoo waspfish ( *Ablabys taenianotus* ). (Illustration by Jonathan Higgins)

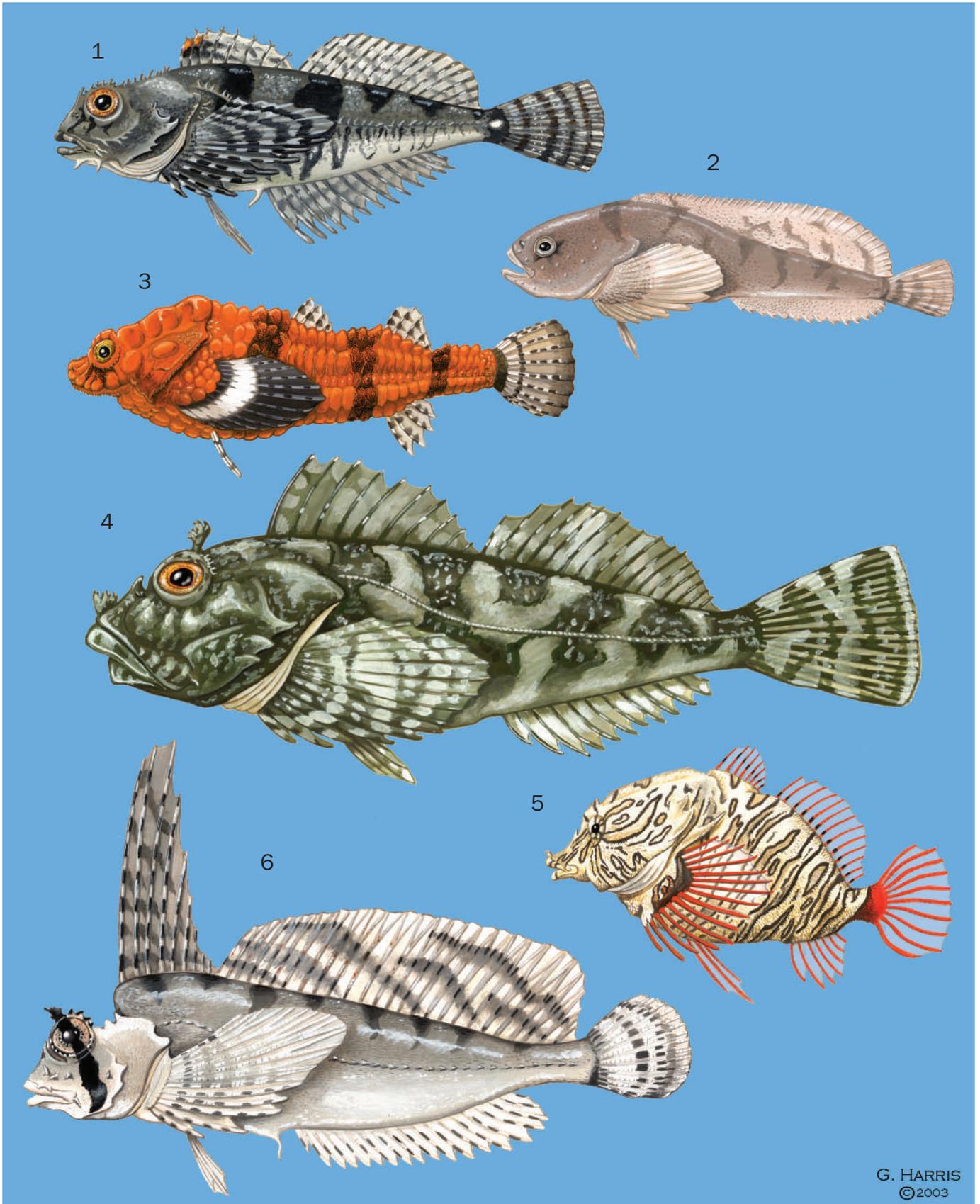


1. Belalang (*Gargariscus prinocephalus*); 2. Red lionfish (*Pterois volitans*); 3. California scorpionfish (*Scorpaena guttata*); 4. Red indianfish (*Pataecus fronto*); 5. Merlet's scorpionfish (*Rhinopias aphanes*); 6. Bocaccio (*Sebastes paucispinis*); 7. Red gurnard (*Chelidonichthys spinosus*); 8. Spotted coral croucher (*Caracanthus maculatus*). (Illustration by Jonathan Higgins)



G. HARRIS  
© 2003

1. Sablefish (*Anoplopoma fimbria*); 2. Lingcod (*Ophiodon elongatus*); 3. Breeding male kelp greenling (*Hexagrammos decagrammus*); 4. Breeding male lumpfish (*Cyclopterus lumpus*); 5. Slipskin snailfish (*Liparis fucensis*); 6. Skilfish (*Erilepis zonifer*). (Illustration by Gillian Harris)



G. HARRIS  
©2003

1. Tidepool sculpin (*Oligocottus maculosus*); 2. Soft sculpin (*Psychrolutes sigalutes*); 3. Rockhead (*Bothragonus swani*); 4. Cabezon (*Scorpaenichthys marmoratus*); 5. Grunt sculpin (*Rhamphocottus richardsoni*); 6. Sailfin sculpin (*Nautichthys oculofasciatus*). (Illustration by Gillian Harris)

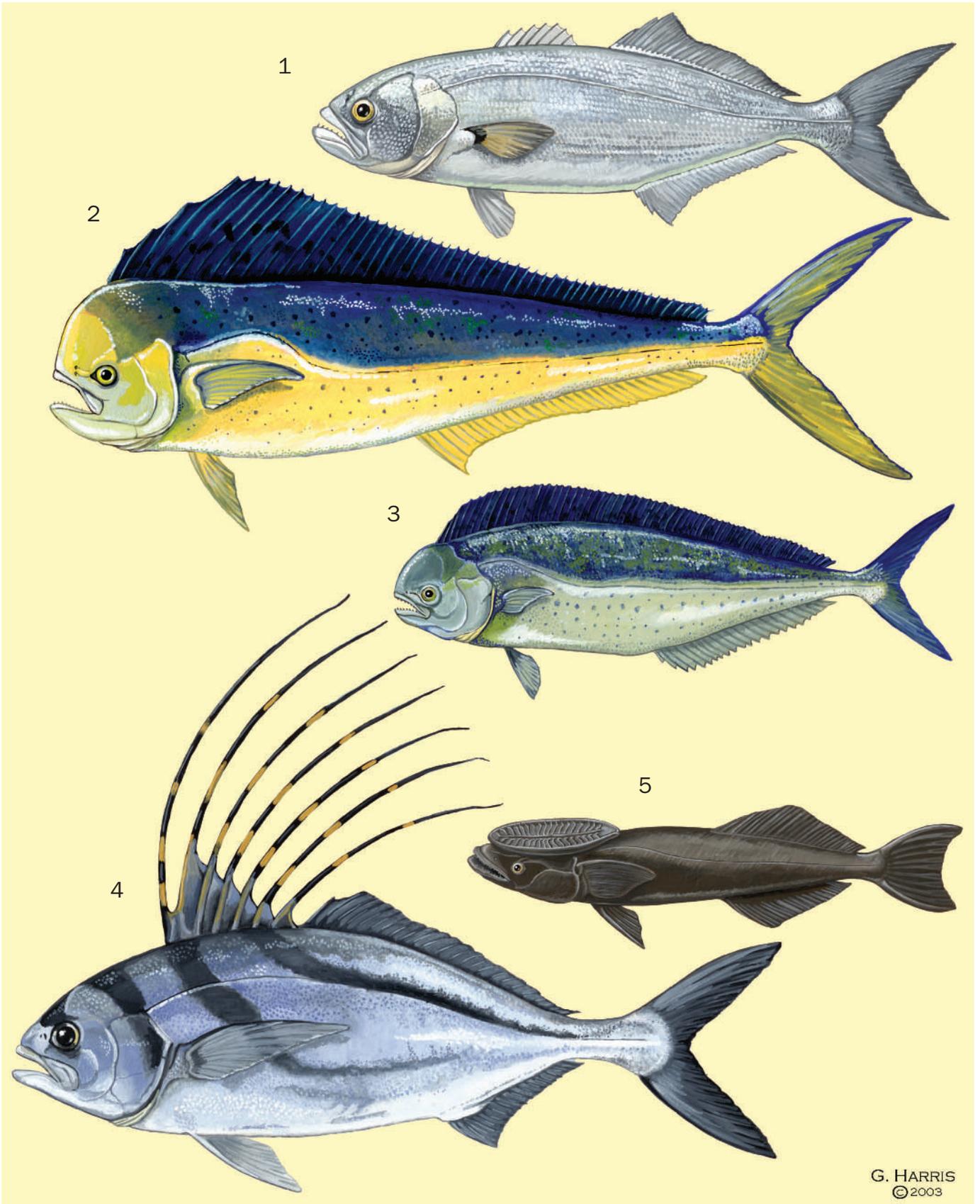


ESD©2003

1. Logperch (*Percina caprodes*); 2. Breeding male rainbow darter (*Etheostoma caeruleum*); 3. Ruffe (*Gymnocephalus cernuus*); 4. Blue-spotted sunfish (*Enneacanthus gloriosus*); 5. Rock bass (*Ambloplites rupestris*); 6. Female black crappie (*Pomoxis nigromaculatus*). (Illustration by Emily Damstra)

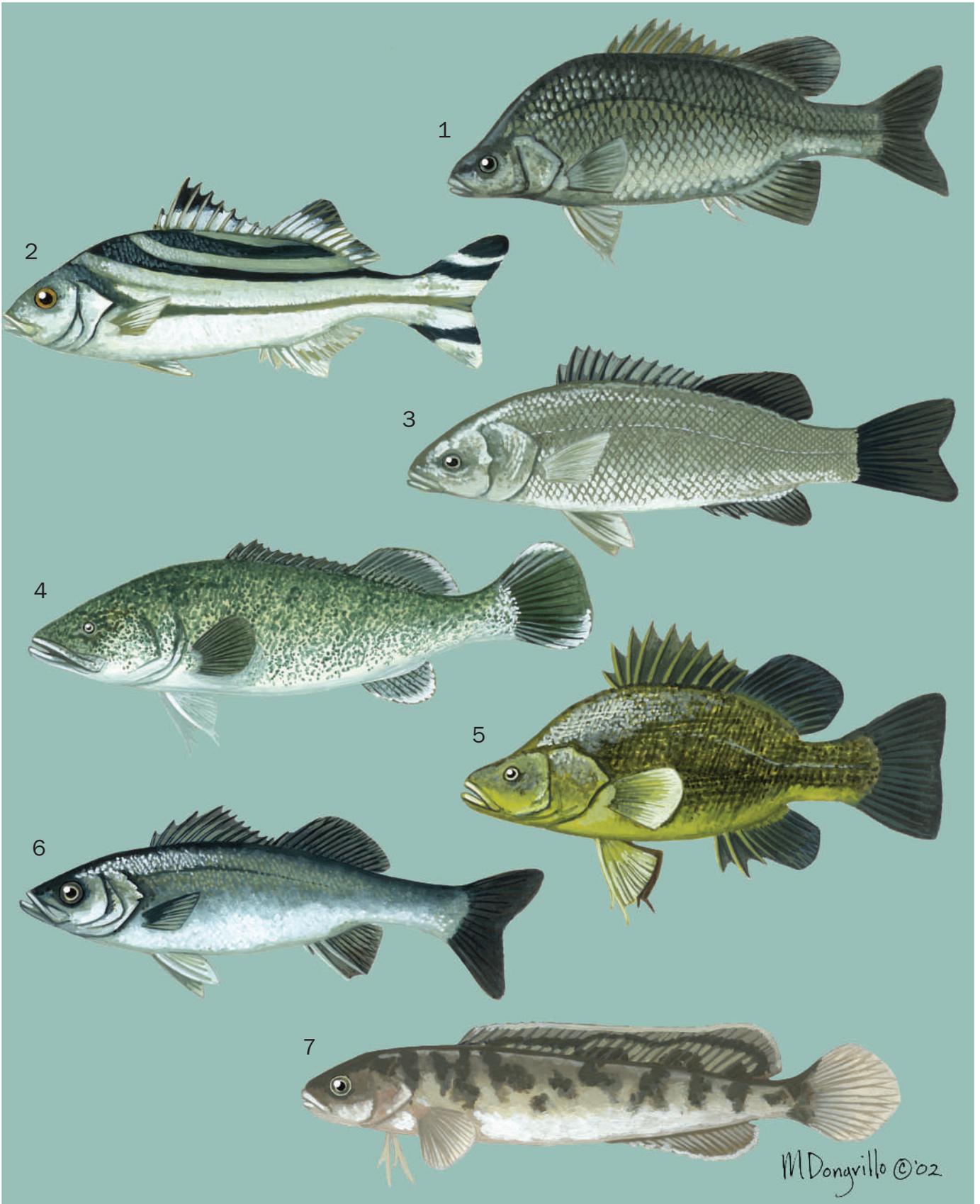


1. Banded pygmy sunfish (*Elassoma zonatum*); 2. Male yellow perch (*Perca flavescens*); 3. Walleye (*Stizostedion vitreum*); 4. Largemouth bass (*Micropterus salmoides*); 5. Male longear sunfish (*Lepomis megalotis*); 6. Bluegill (*Lepomis macrochirus*); 7. Striped sea bass (*Morone saxatilis*). (Illustration by Emily Damstra)

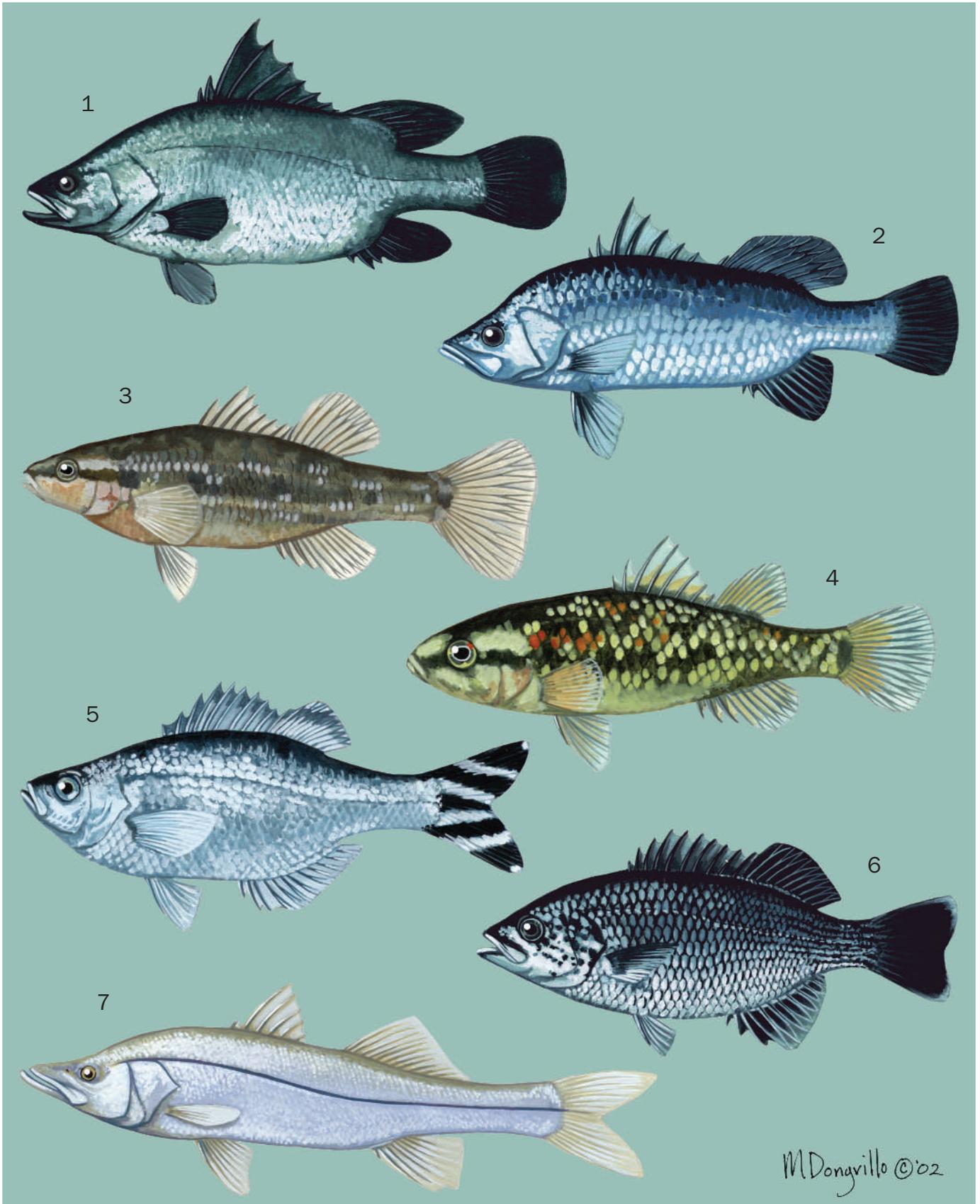


G. HARRIS  
© 2003

1. Bluefish (*Pomatomus saltatrix*); 2. Common dolphinfish (*Coryphaena hippurus*); 3. Pompano dolphinfish (*Coryphaena equiselis*); 4. Roosterfish (*Nematistius pectoralis*); 5. Common remora (*Remora remora*). (Illustration by Gillian Harris)



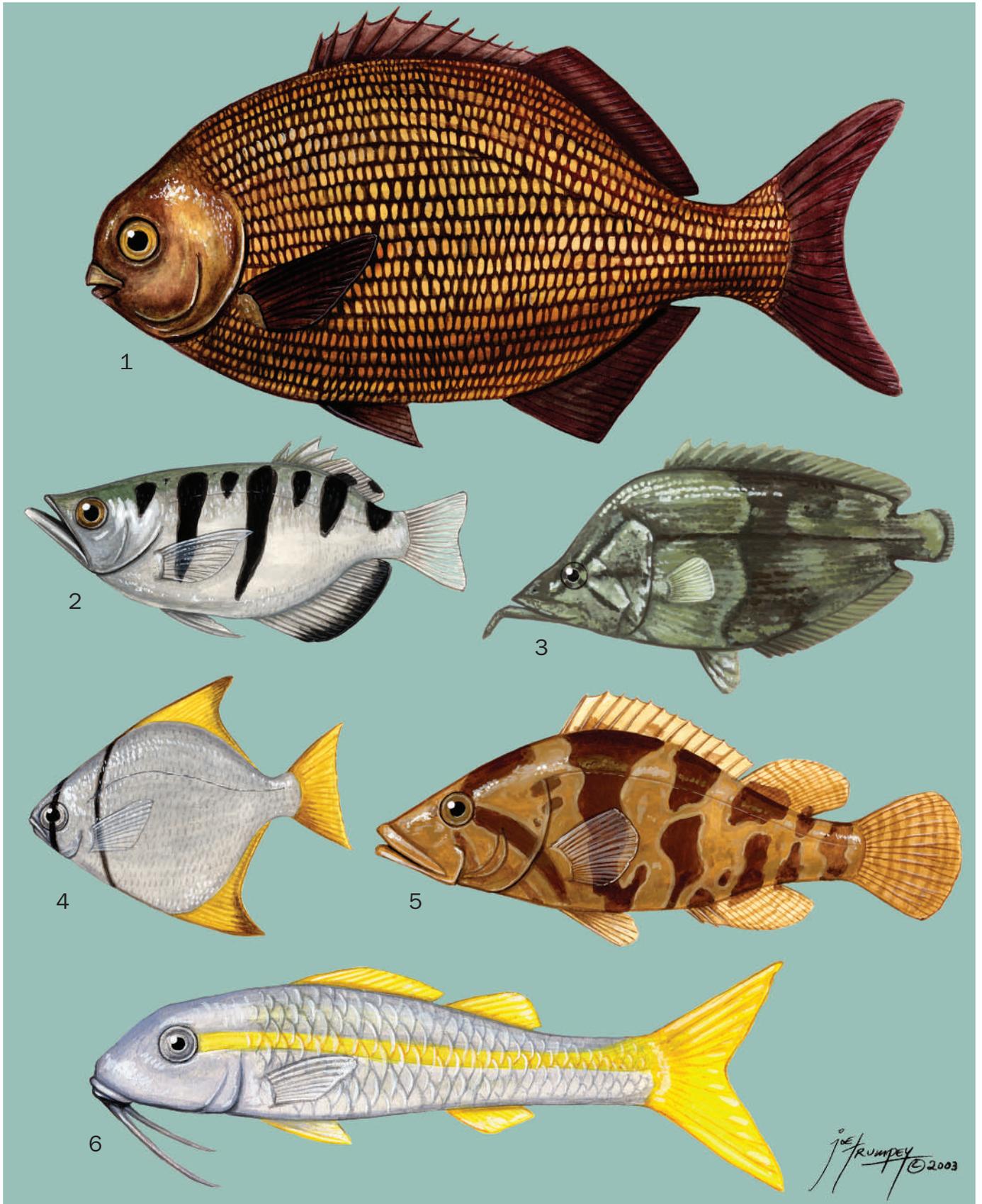
1. Mountain perch (*Macquaria australasica*); 2. Target perch (*Terapon jarbua*); 3. Sooty grunter (*Hephaestus fuliginosus*); 4. Murray cod (*Maccullochella peelii*); 5. Golden perch (*Macquaria ambigua*); 6. Japanese perch (*Lateolabrax japonicus*); 7. River blackfish (*Gadopsis marmoratus*). (Illustration by Marguette Dongvillo)



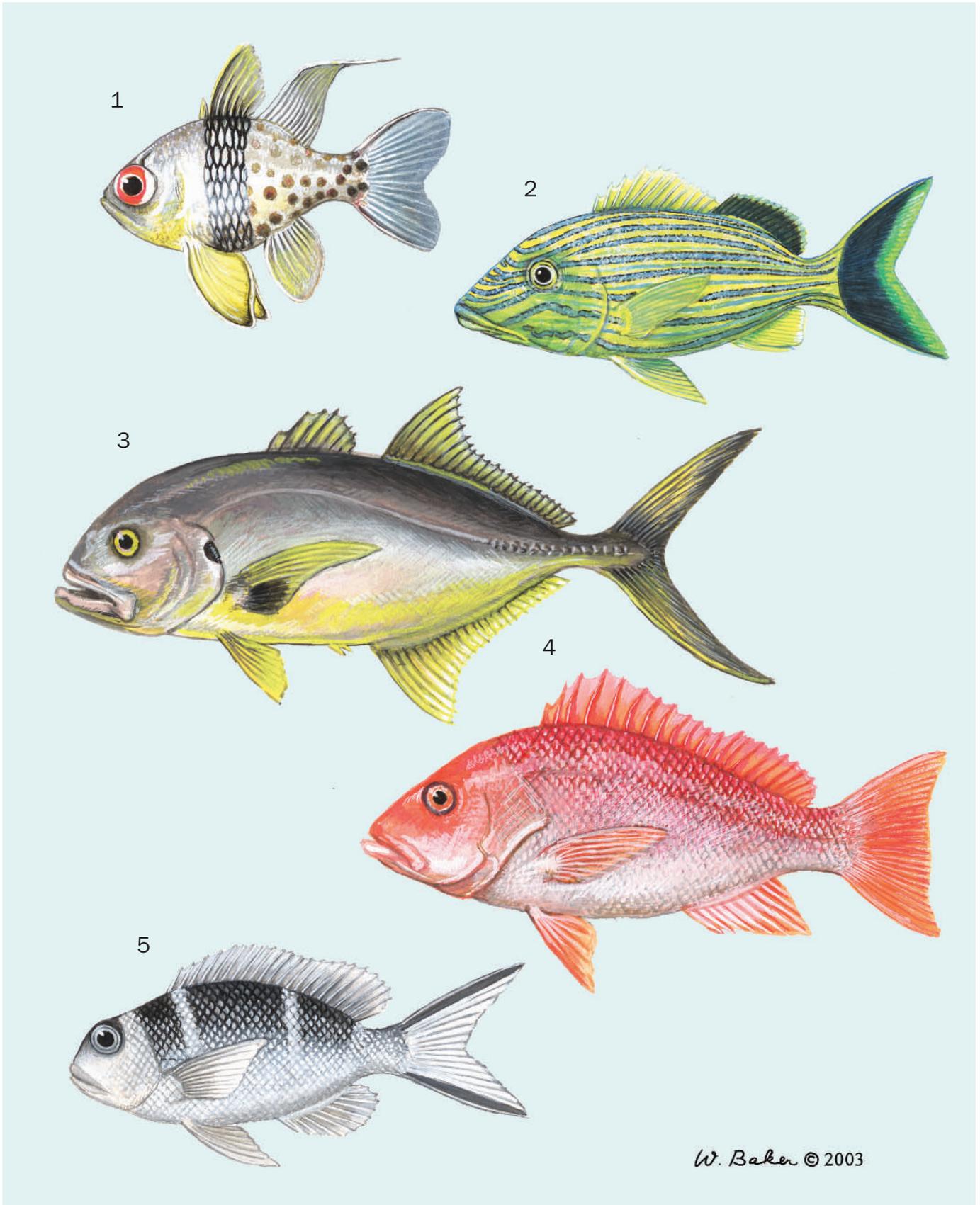
1. Nile perch (*Lates niloticus*); 2. Barramundi (*Lates calcarifer*); 3. Western pygmy perch (*Edelia vittata*); 4. Southern pygmy perch (*Nannoperca australis*); 5. Flagtail kuhlia (*Kuhlia mugil*); 6. Jungle perch (*Kuhlia rupestris*); 7. Common snook (*Centropomus undecimalis*). (Illustration by Marguette Dongvillo)



1. Pebbled butterflyfish (*Chaetodon multicinctus*); 2. Adult emperor angelfish (*Pomacanthus imperator*); 3. Juvenile emperor angelfish; 4. Hawaiian morwong (*Cheilodactylus vittatus*); 5. Longnose hawkfish (*Oxycirrhites typus*); 6. Striped boarfish (*Evisias acutirostris*). (Illustration by Joseph E. Trumpey)



1. Cortez chub (*Kyphosus elegans*); 2. Banded archerfish (*Toxotes jaculatrix*); 3. Amazon leaffish (*Monocirrhus polyacanthus*); 4. Mono (*Monodactylus argenteus*); 5. Gangetic leaffish (*Nandus nandus*); 6. Yellow goatfish (*Mulloidichthys martinicus*). (Illustration by Joseph E. Trumpey)



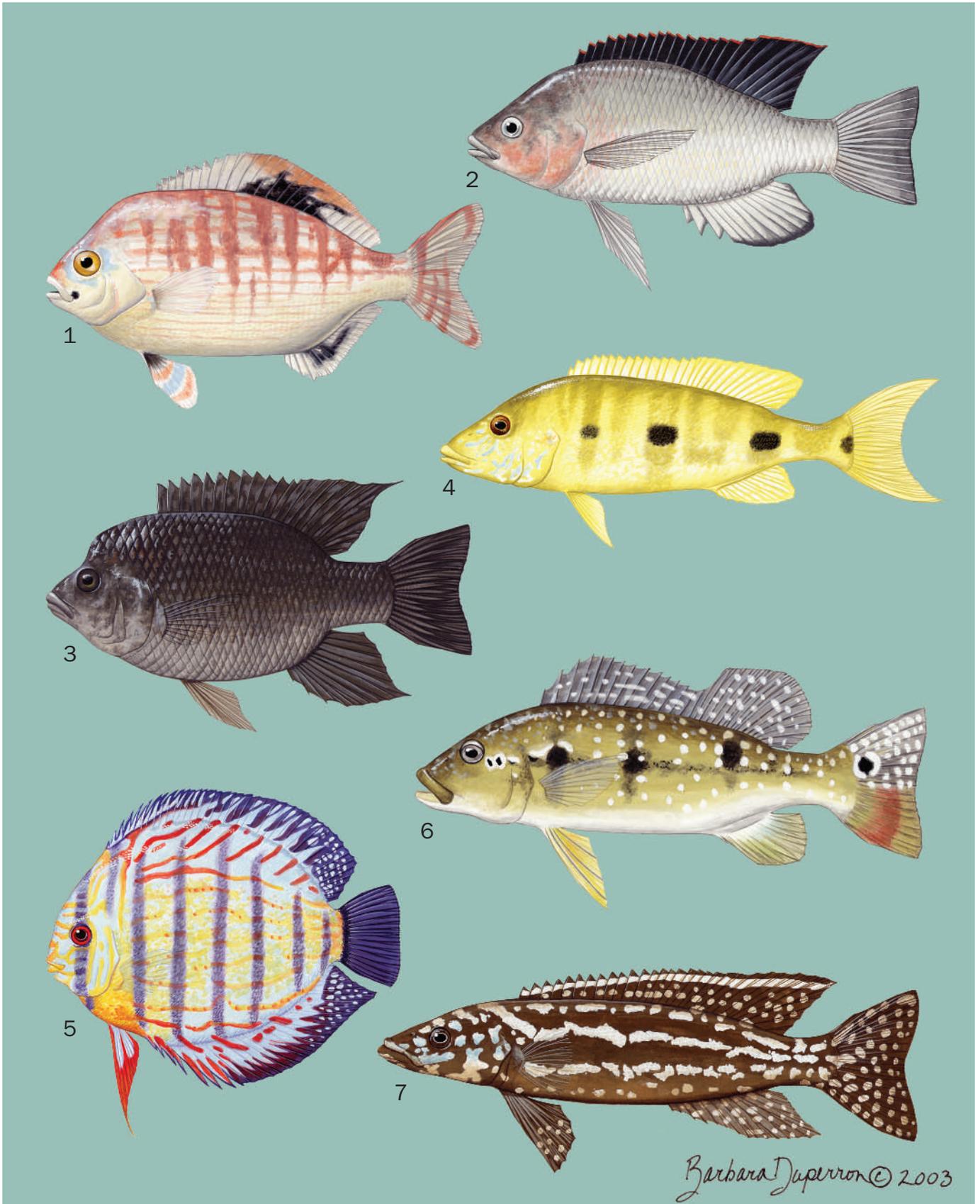
1. Pajama cardinalfish (*Sphaeramia nematoptera*); 2. Bluestriped grunt (*Haemulon sciurus*); 3. Crevalle jack (*Caranx hippos*); 4. Northern red snapper (*Lutjanus campechanus*); 5. Humpnose big-eye bream (*Monotaxis grandoculis*). (Illustration by Wendy Baker)



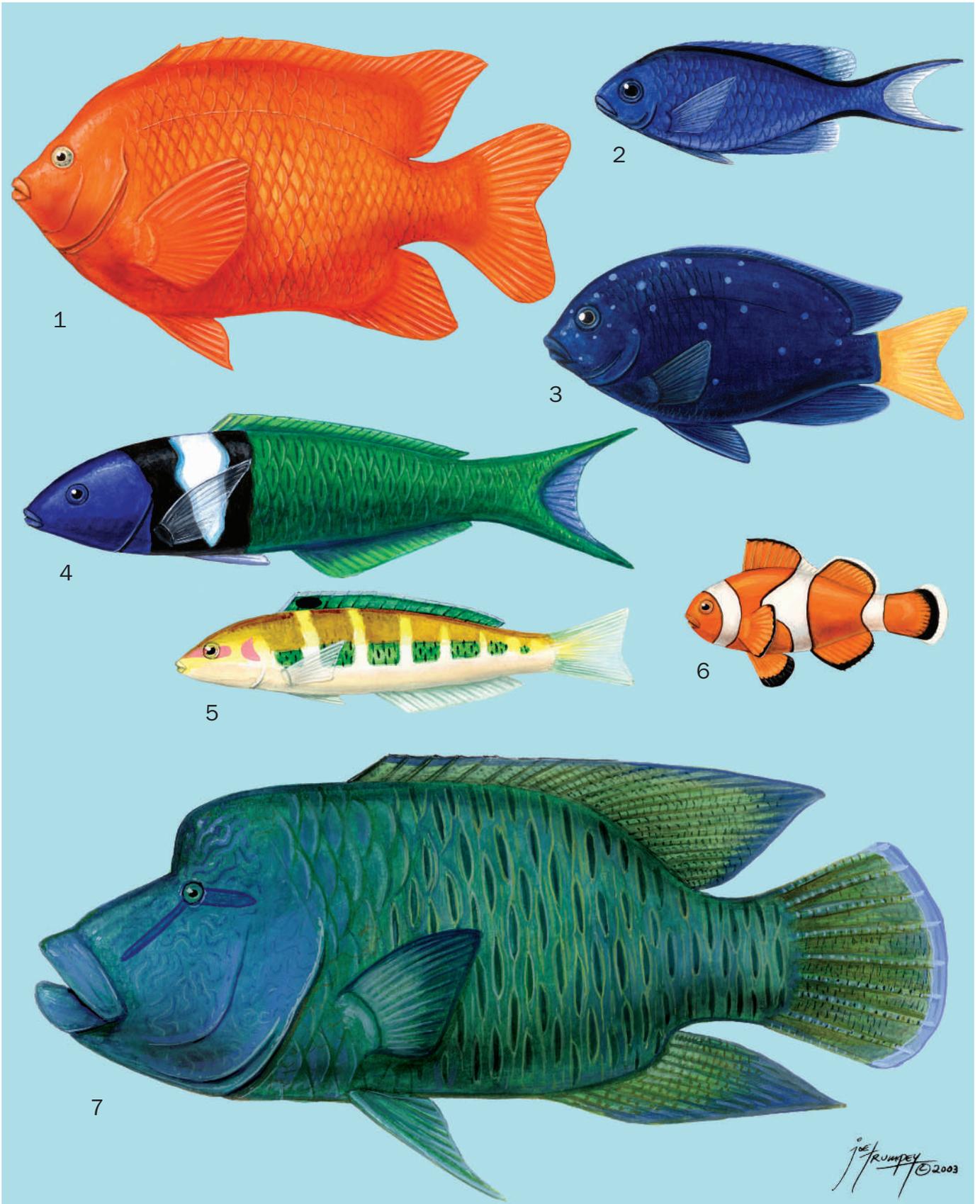
1. Blacksaddled coral grouper "tiger morph" (*Plectropomus laevis*); 2. Sixline soapfish (*Grammistes sexlineatus*); 3. Goggle eye (*Priacanthus hamrur*); 4. Red drum (*Sciaenops ocellatus*); 5. Nassau grouper (*Epinephelus striatus*). (Illustration by Emily Damstra)



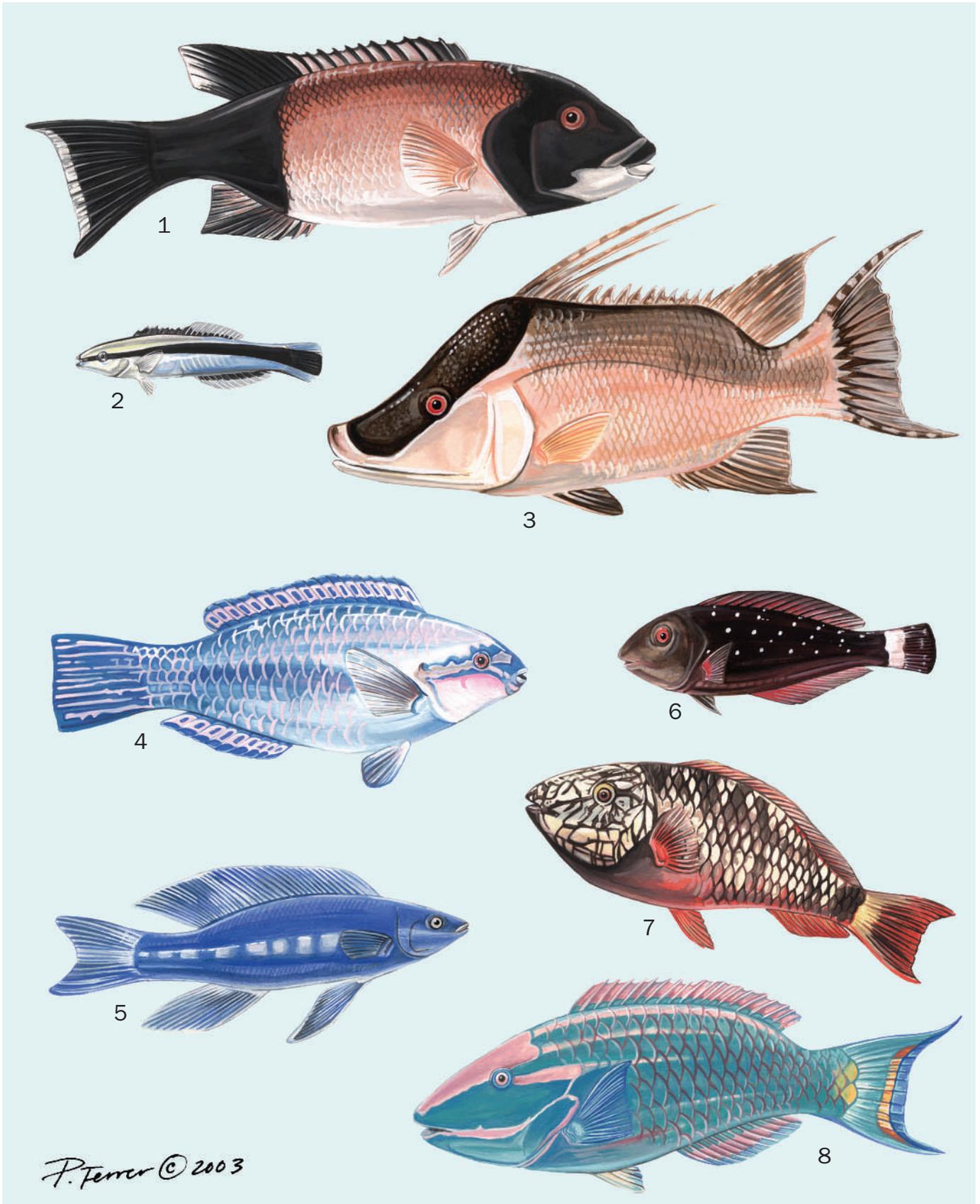
1. Worm cichlid (*Teleogramma gracile*); 2. *Paralabidochromis chilotes*; 3. Trout cichlid (*Champsocichromis caeruleus*); 4. Millet (*Crenicichla alta*); 5. Agassiz's dwarf cichlid (*Apistogramma agassizii*); 6. Freshwater angelfish (*Pterophyllum scalare*); 7. Blunthead cichlid (*Tropheus moorii*). (Illustration by Barbara Duperron)



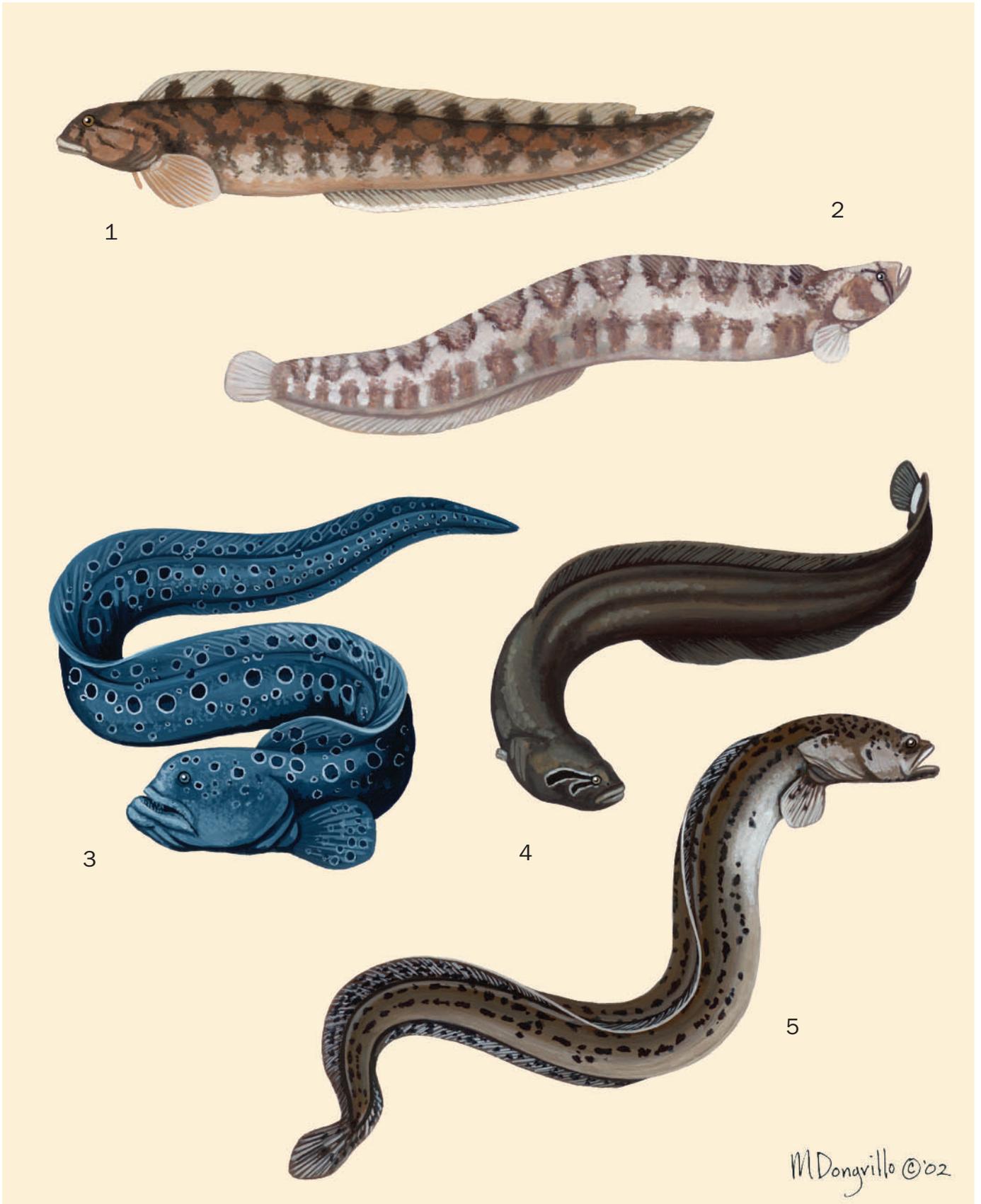
1. Rainbow seaperch (*Hypsurus caryi*); 2. Ngege (*Oreochromis esculentus*); 3. Trondo mainty (*Ptychochromoides betsileanus*); 4. Giant cichlid (*Boulengerochromis microlepis*); 5. Blue discus (*Symphysodon aequifasciata*); 6. Speckled pavon (*Cichla temensis*); 7. *Lepidiolamprologus kendalli*. (Illustration by Barbara Duperron)



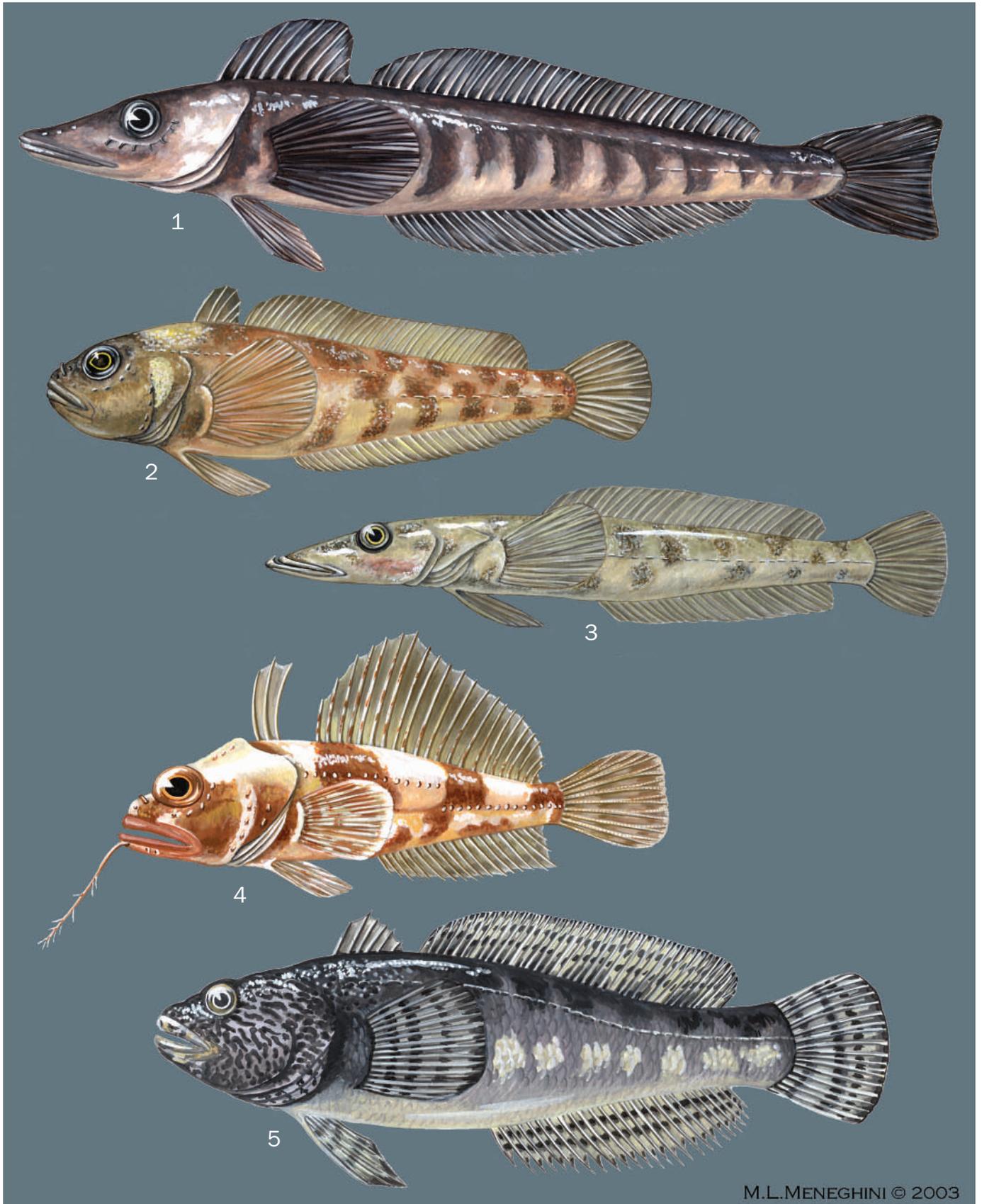
1. Garibaldi damselfish (*Hypsypops rubicundus*); 2. Blue chromis (*Chromis cyanea*); 3. Yellowtail damselfish (*Microspathodon chrysurus*) intermediate stage; 4. Bluehead adult (*Thalassoma bifasciatum*); 5. Bluehead (*Thalassoma bifasciatum*) intermediate stage; 6. Clown anemonefish (*Amphiprion ocellaris*); 7. Humphead wrasse (*Cheilinus undulatus*). (Illustration by Joseph E. Trumpey)



1. California sheephead (*Semicossyphus pulcher*); 2. Bluestreak cleaner wrasse (*Labroides dimidiatus*); 3. Hogfish (*Lachnolaimus maximus*); 4. Striped parrotfish (*Scarus iseri*); 5. Butterfish (*Odax pullus*); 6. Juvenile stoplight parrotfish (*Sparisoma viride*); 7. Initial phase of the stoplight parrotfish; 8. Terminal phase of the stoplight parrotfish. (Illustration by Patricia Ferrer)

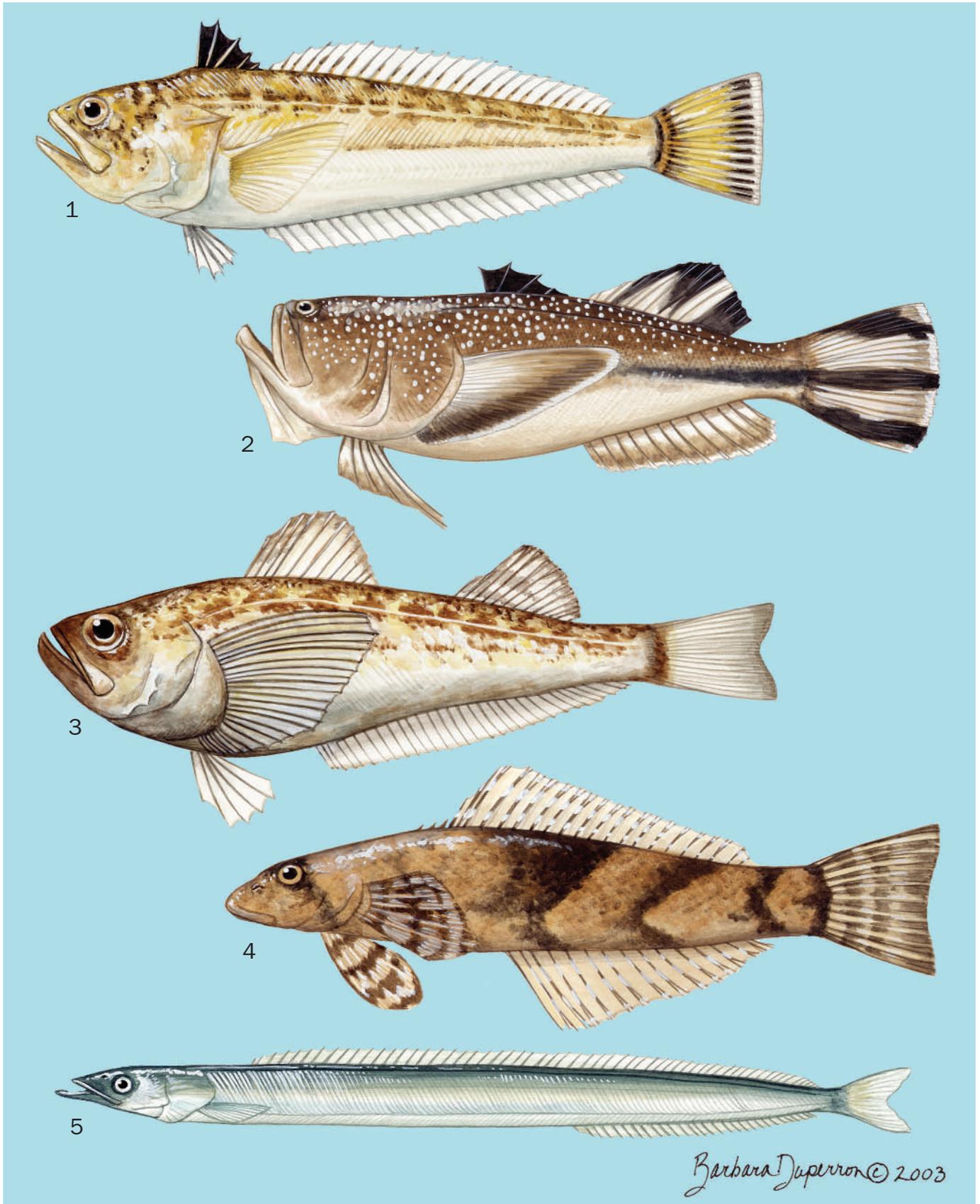


1. Ocean pout (*Zoarces americanus*); 2. Saddleback gunnel (*Pholis ornata*); 3. Wolf-eel (*Anarrhichthys ocellatus*); 4. Black prickleback (*Xiphister atropurpureus*); 5. Wrymouth (*Cryptacanthodes maculatus*). (Illustration by Marguette Dongvillo)

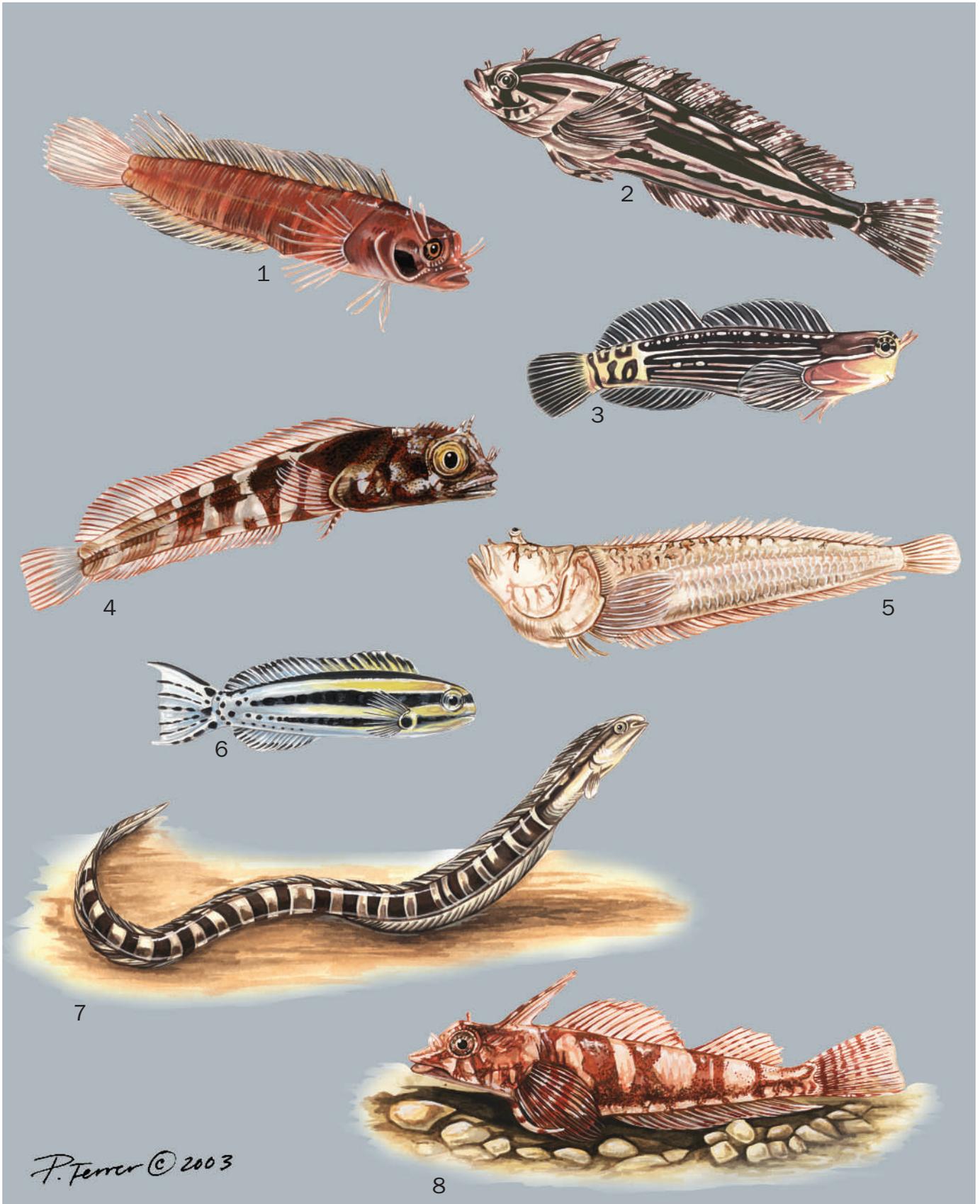


M.L.MENEGHINI © 2003

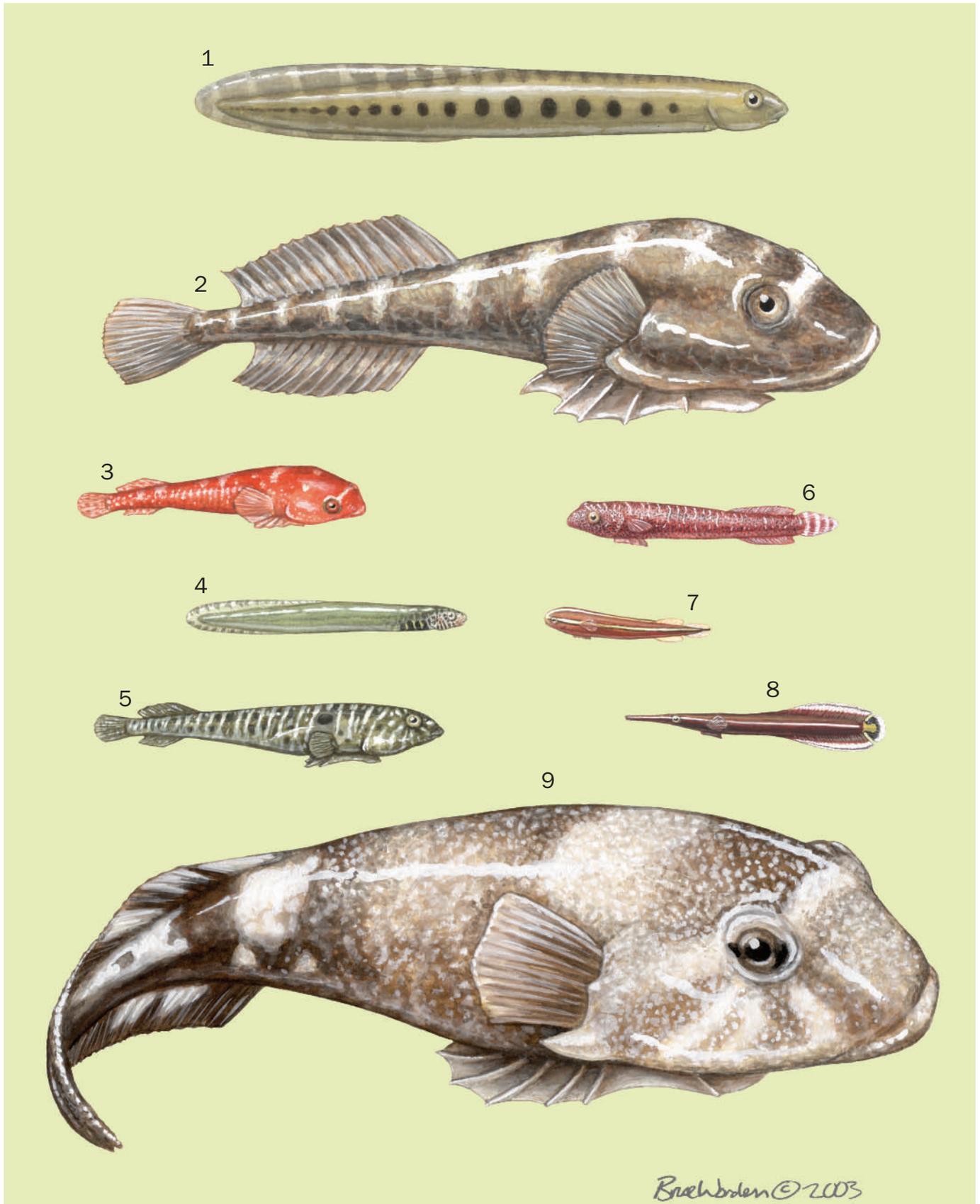
1. Mackerel icefish (*Champsocephalus gunnari*); 2. Emerald notothen (*Trematomus bernacchii*); 3. Naked dragonfish (*Gymnodraco acuticeps*); 4. Sailfin plunderfish (*Histiodraco velifer*); 5. Maori chief (*Notothenia angustata*). (Illustration by Michelle Meneghini)



1. Lesser weever (*Echiichthys vipera*); 2. Northern stargazer (*Astroscopus guttatus*); 3. Sailfin sandfish (*Arctoscopus japonicus*); 4. Torrentfish (*Cheimarrichthys fosteri*); 5. Inshore sand lance (*Ammodytes americanus*). (Illustration by Barbara Duperron)



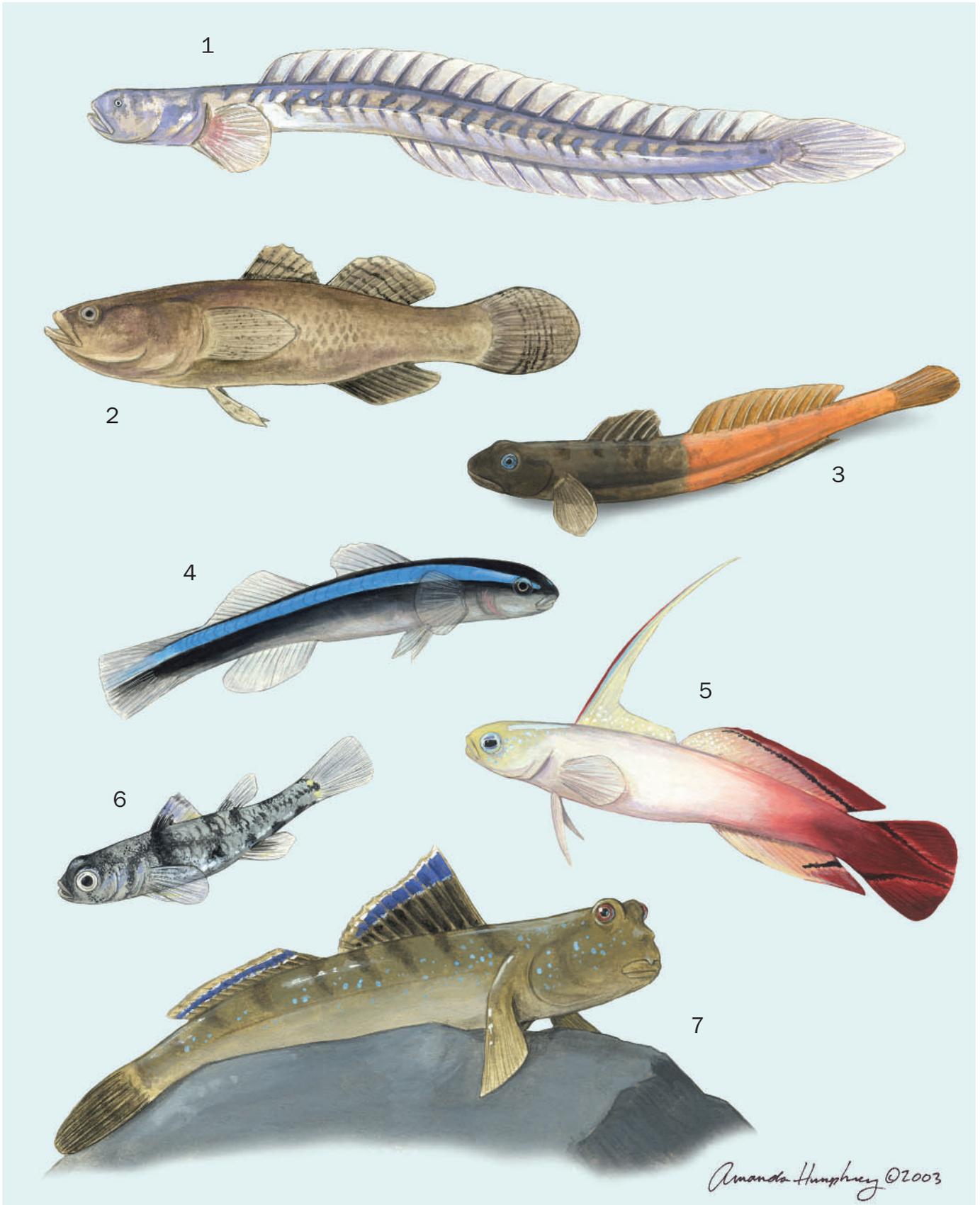
1. Blackcheek blenny (*Starksia lepicoelia*); 2. Rosy weedfish (*Heteroclinus roseus*); 3. White-lined comb-tooth blenny (*Ecsenius pictus*); 4. Secretary blenny (*Acanthemblemaria maria*); 5. Sand stargazer (*Dactyloscopus tridigitatus*); 6. Striped poison-fang blenny (*Meiacanthus grammistes*); 7. Hairtail blenny (*Xiphasia setifer*); 8. Miracle triplefin (*Enneapterygius mirabilis*). (Illustration by Patricia Ferrer)



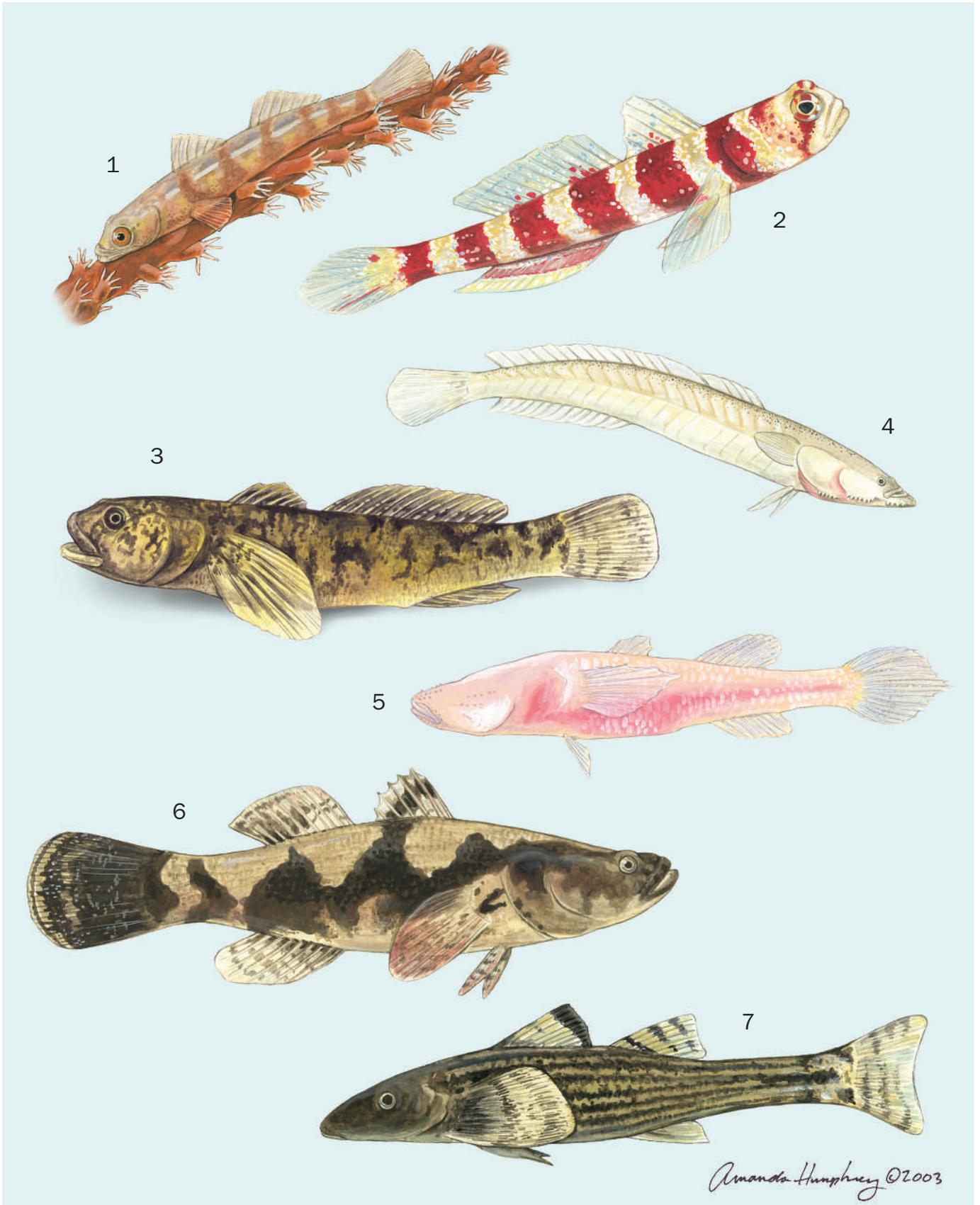
1. Common shore-eel (*Alabes dorsalis*); 2. Northern clingfish (*Gobiesox maeandricus*); 3. Two-spotted clingfish (*Diplecogaster bimaculata bimaculata*); 4. Pygmy shore-eel (*Alabes parvulus*); 5. Sonora clingfish (*Tomicodon humeralis*); 6. Eastern cleaner-clingfish (*Cochleoiceps orientalis*); 7. Crinoid clingfish (*Discotrema crinophila*); 8. Urchin clingfish (*Diademichthys lineatus*); 9. Rocksucker (*Chorisochismus dentex*). (Illustration by Bruce Worden)



1. Draconett (*Centrodraco insolitus*); 2. Draconetta (*Draconetta xenica*); 3. Richardson's dragonet (*Repomucenus richardsonii*); 4. Mandarinfish (*Synchiropus splendidus*); 5. Lancer dragonet (*Paradiplogrammus bairdi*). (Illustration by Marguette Dongvillo)



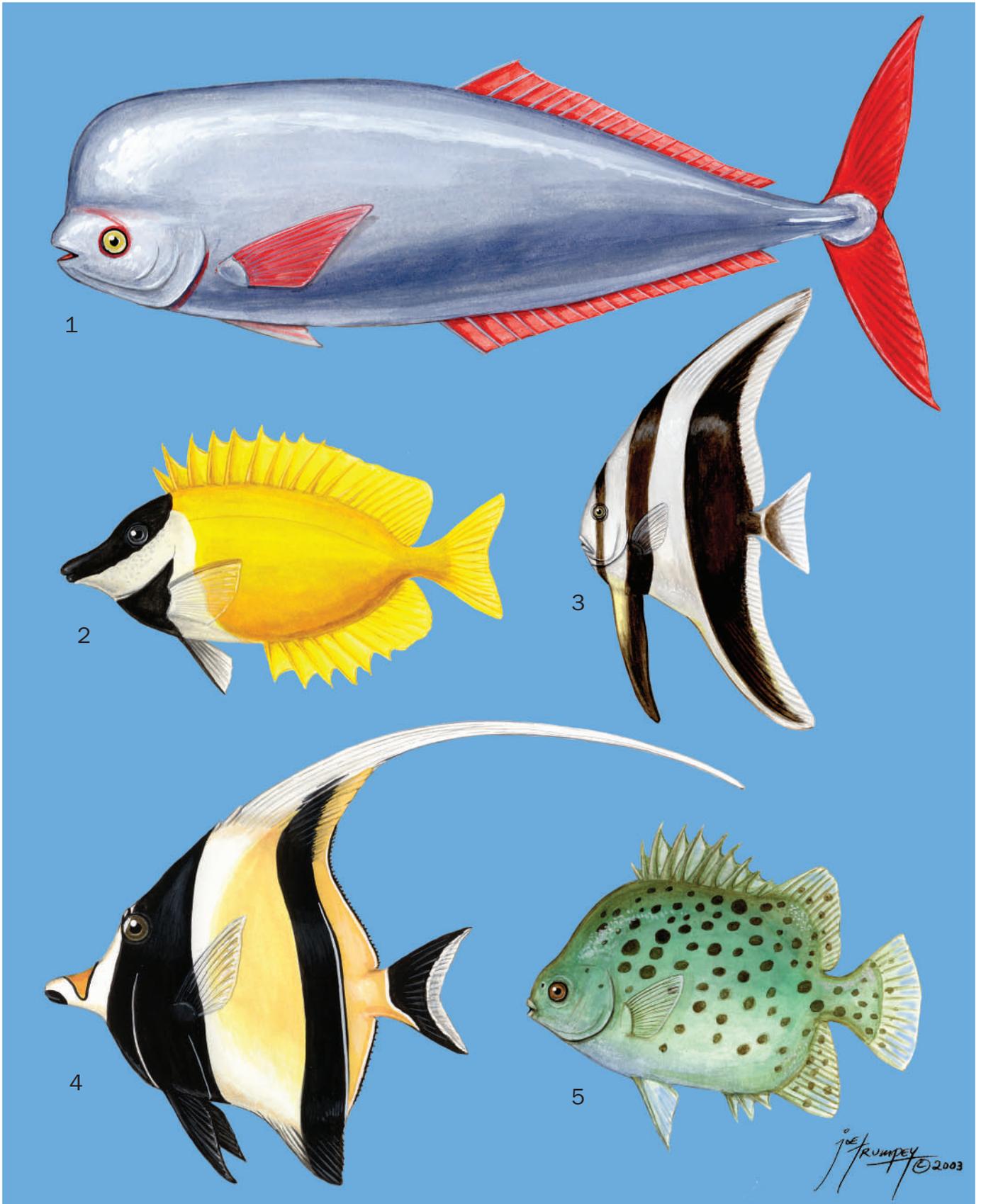
1. Violet goby (*Gobioides broussoneti*); 2. Large-scale spinycheek sleeper (*Eleotris amblyopsis*); 3. O'opo alamo'o (*Lentipes concolor*); 4. Neon goby (*Gobiosoma oceanops*); 5. Fire goby (*Nemateleotris magnifica*); 6. Dwarf pygmy goby (*Pandaka pygmaea*); 7. Atlantic mudskipper (*Periophthalmus barbarus*). (Illustration by Amanda Humphrey)



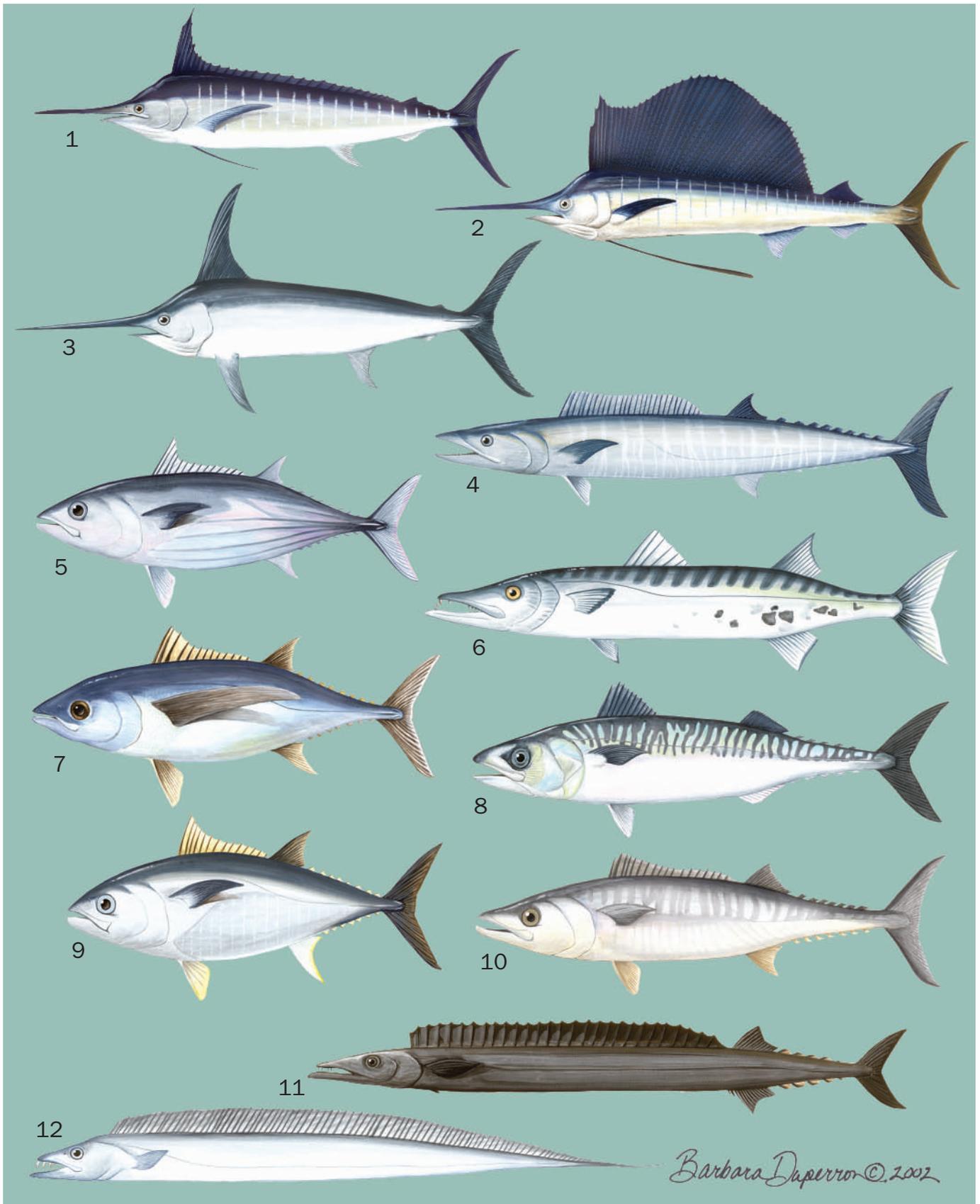
1. Whip coral goby (*Bryaninops yongei*); 2. Gorgeous prawn-goby (*Amblyeleotris wheeleri*); 3. Arno goby (*Padogobius nigricans*); 4. Samoan sand dart (*Kraemeria samoensis*); 5. Blind cave gudgeon (*Milyeringa veritas*); 6. Marble sleeper (*Oxyeleotris marmorata*); 7. Loach goby (*Rhyacichthys aspro*). (Illustration by Amanda Humphrey)



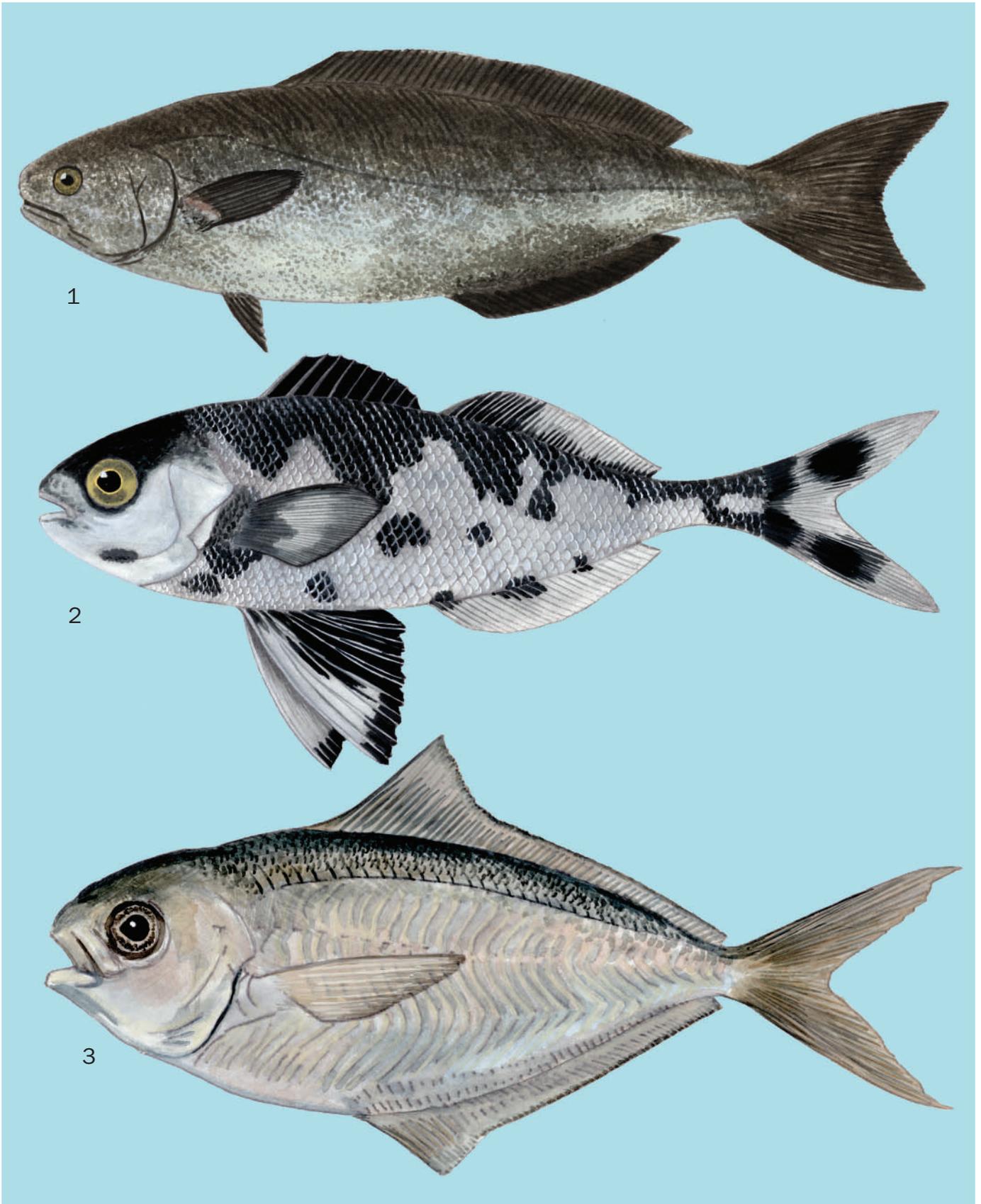
1. Yellow tang (*Zebrasoma flavescens*); 2. Striped bristletooth (*Ctenochaetus striatus*); 3. Yellowspotted sawtail (*Prionurus maculatus*); 4. Orangespine unicornfish (*Naso lituratus*); 5. Palette tang (*Paracanthurus hepatus*); 6. Lined surgeonfish (*Acanthurus lineatus*). (Illustration by Joseph E. Trumpey)



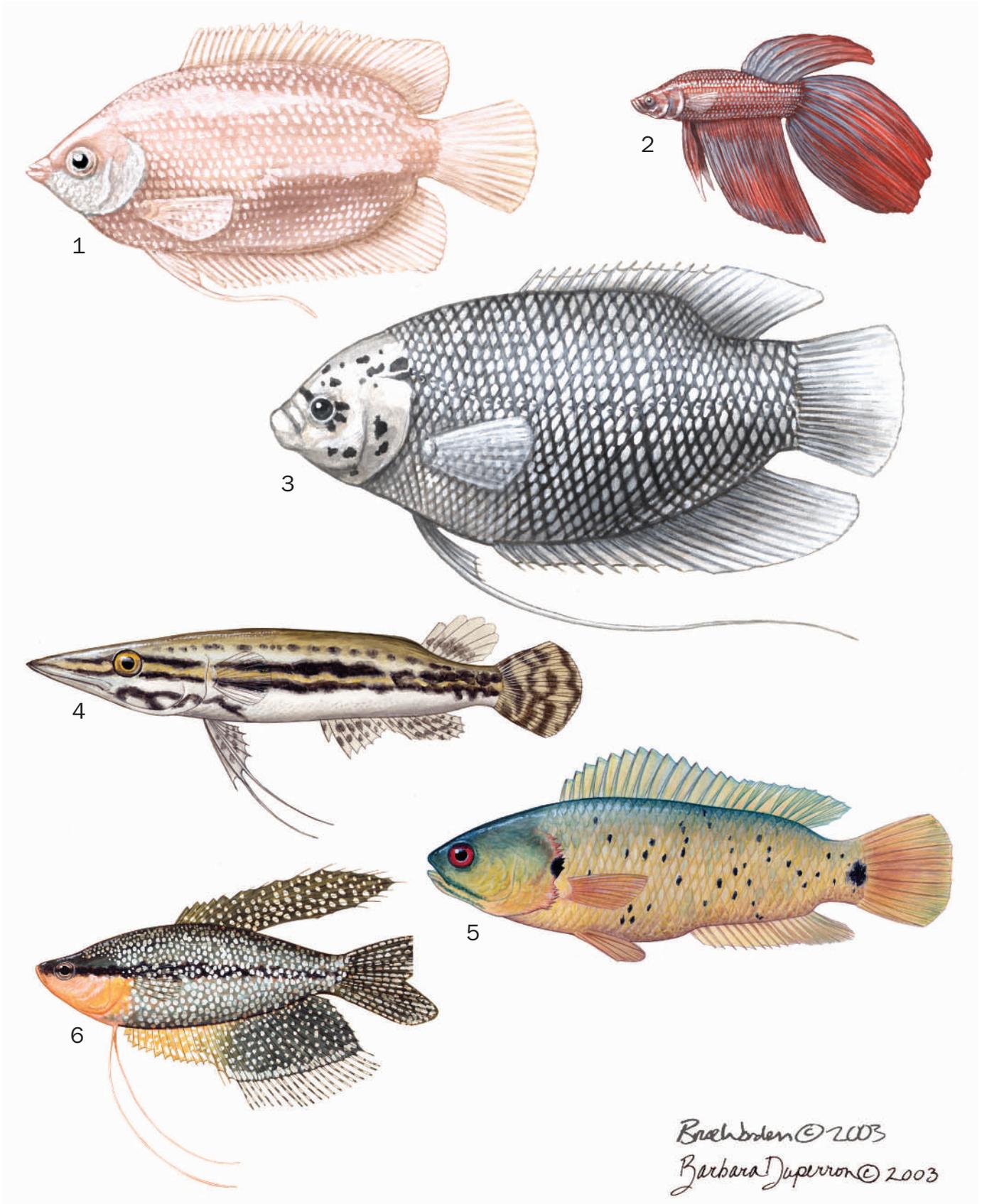
1. Louvar (*Luvarus imperialis*); 2. Foxface rabbitfish (*Siganus vulpinus*); 3. Intermediate stage of longfin spadefish (*Platax teira*); 4. Moorish idol (*Zanclus cornutus*); 5. Spotted scat (*Scatophagus argus*). (Illustration by Joseph E. Trumpey)



1. Blue marlin (*Makaira nigricans*); 2. Sailfish (*Istiophorus platypterus*); 3. Swordfish (*Xiphias gladius*); 4. Wahoo (*Acanthocybium solandri*); 5. Skipjack tuna (*Katsuwonus pelamis*); 6. Great barracuda (*Sphyræna barracuda*); 7. Albacore (*Thunnus alalunga*); 8. Atlantic mackerel (*Scomber scombrus*); 9. Atlantic bluefin tuna (*Thunnus thynnus*); 10. King mackerel (*Scomberomorus cavalla*); 11. Snake mackerel (*Gempylus serpens*); 12. Largehead hairtail (*Trichiurus lepturus*). (Illustration by Barbara Duperron)

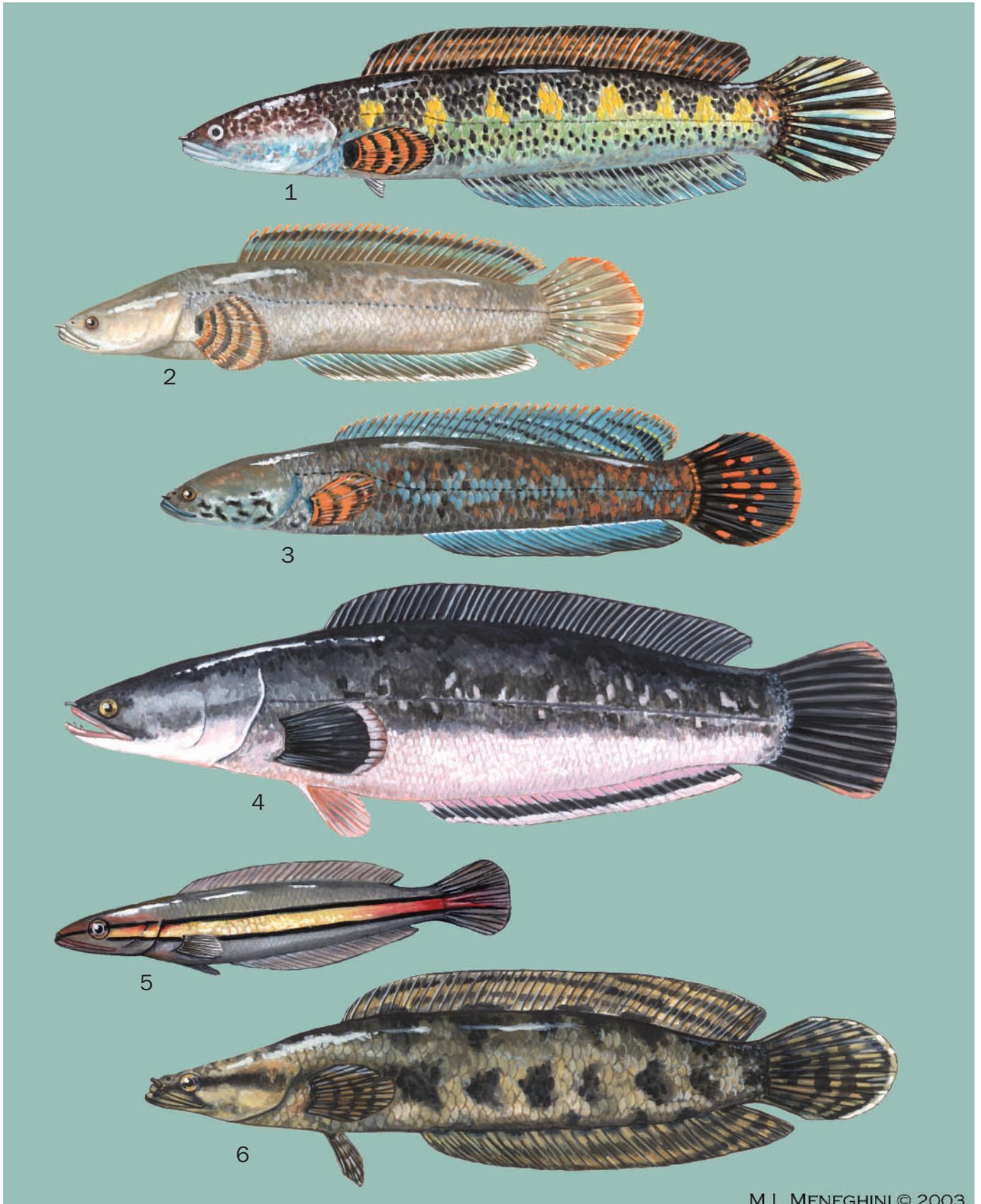


1. Black ruff (*Centrolophus niger*); 2. Man-of-war fish (*Nomeus gronovii*); 3. Butterfish (*Pepilus triacanthus*). (Illustration by Dan Erickson)



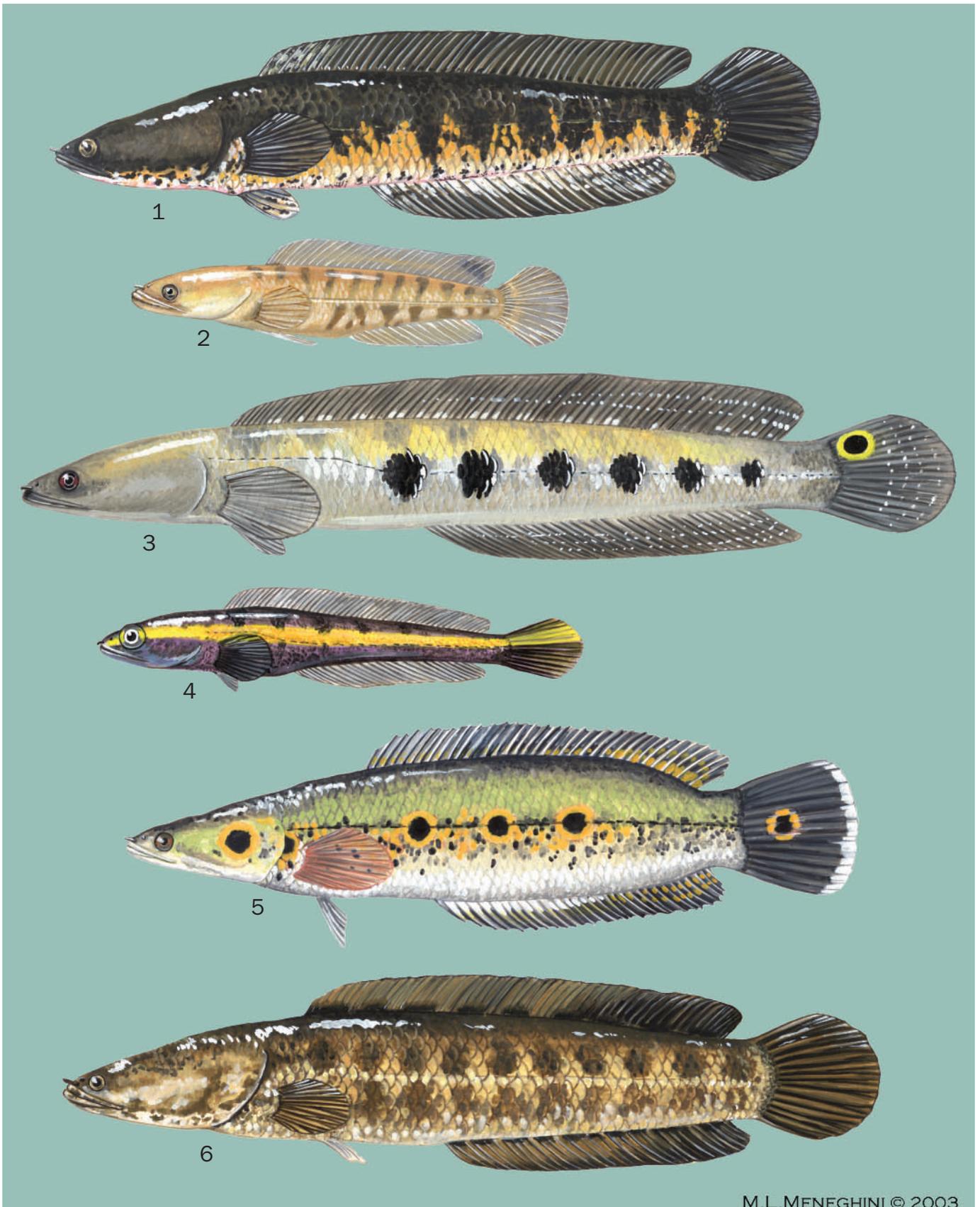
Bruce Worden © 2003  
 Barbara Duperron © 2003

1. Kissing gourami (*Helostoma temminckii*); 2. Siamese fighting-fish (*Betta splendens*); 3. Giant gourami (*Osphronemus goramy*); 4. Pikehead (*Luciocephalus pulcher*); 5. Climbing perch (*Anabas testudineus*); 6. Pearl gourami (*Trichogaster leerii*). (Illustration by Barbara Duperron and Bruce Worden)



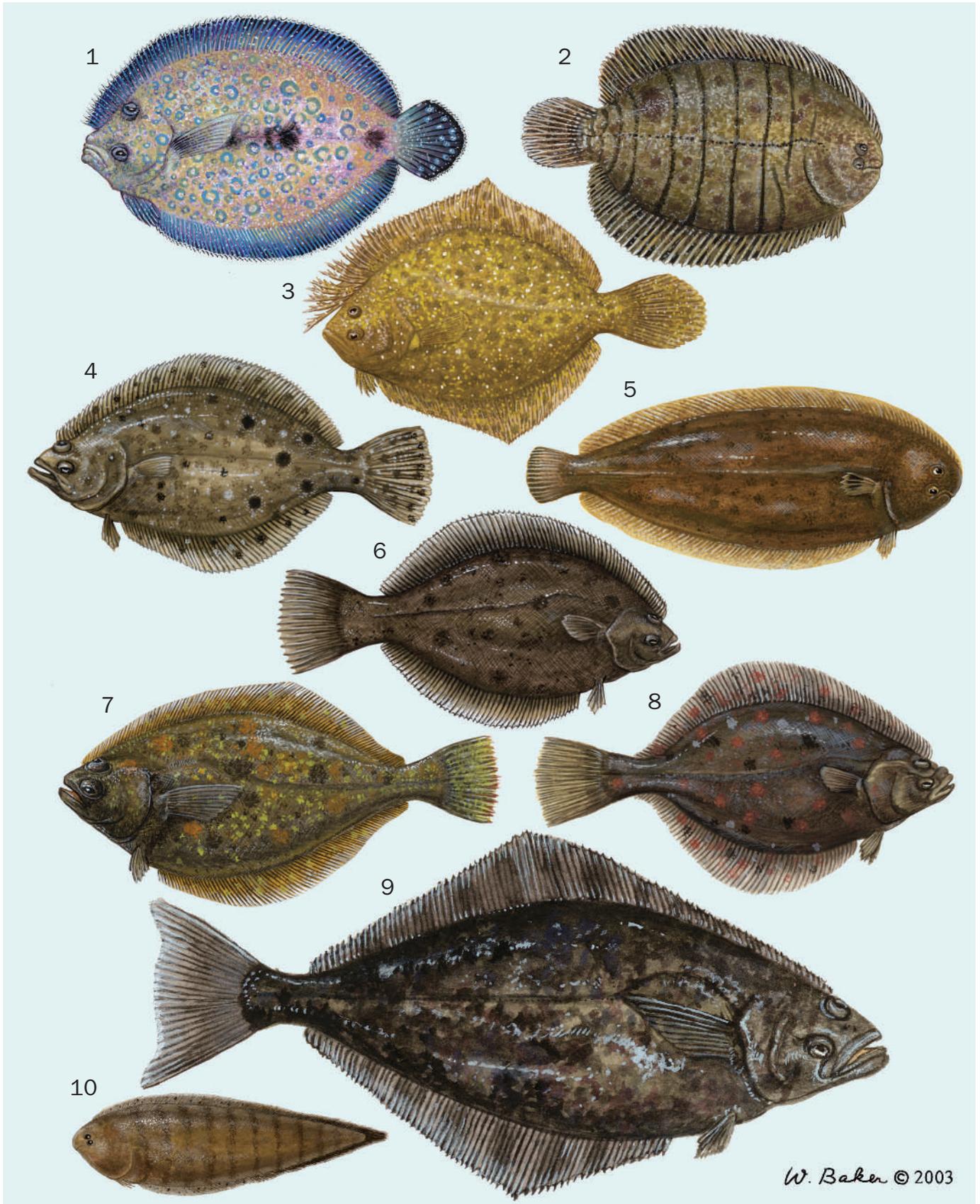
M.L.MENEGHINI © 2003

1. Orange-spotted snakehead (*Channa aurantimaculata*); 2. Walking snakehead (*Channa orientalis*); 3. Rainbow snakehead (*Channa bleheri*); 4. Giant snakehead (*Channa micropeltes*); 5. Giant snakehead (*Channa micropeltes*) juvenile; 6. African snakehead (*Parachanna obscura*). (Illustration by Michelle Meneghini)

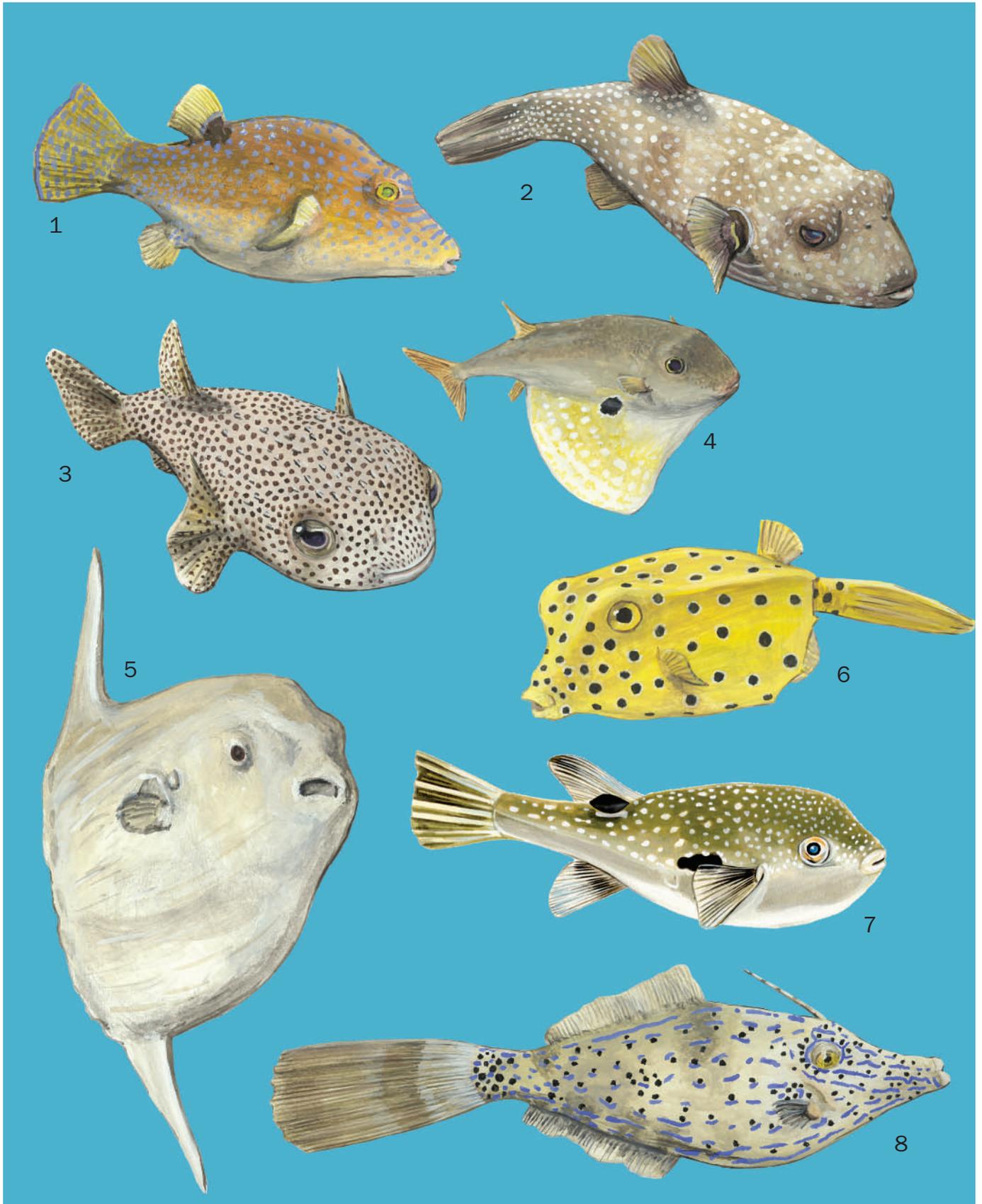


M.L.MENEGHINI © 2003

1. Striped snakehead (*Channa striata*); 2. Striped snakehead (*Channa striata*) juvenile; 3. Bullseye snakehead (*Channa marulius*); 4. Bullseye snakehead (*Channa marulius*) juvenile; 5. Ocellated snakehead (*Channa pleurophthalmus*); 6. Northern snakehead (*Channa argus*). (Illustration by Michelle Meneghini)



1. Peacock flounder (*Bothus lunatus*); 2. Hogchoker (*Trinectes maculatus*); 3. Windowpane flounder (*Scophthalmus aquosus*); 4. Summer flounder (*Paralichthys dentatus*); 5. Common sole (*Solea solea*); 6. Winter flounder (*Pseudopleuronectes americanus*); 7. Pacific sanddab (*Citharichthys sordidus*); 8. Plaice (*Pleuronectes platessa*); 9. Pacific halibut (*Hippoglossus stenolepis*); 10. California tonguefish (*Symphurus atricaudus*). (Illustration by Wendy Baker)



1. Spotted toby (*Canthigaster solandri*); 2. White-spotted puffer (*Arothron hispidus*); 3. Spot-fin porcupinefish (*Diodon hystrix*); 4. Threetooth puffer (*Triodon macropterus*); 5. Mola (*Mola mola*); 6. Yellow boxfish (*Ostracion cubicus*); 7. Fugu (*Takifugu rubripes*); 8. Scrawled filefish (*Aluterus scrip-tus*). (Illustration by Brian Cressman and Patricia Ferrer)



1. Spikefish (*Halimochirugus alcocki*); 2. Blackbar triggerfish (*Rhinecanthus aculeatus*); 3. Clown triggerfish (*Balistoides conspicillum*); 4. Orange-striped triggerfish (*Balistapus undulatus*); 5. Triplespine (*Triacanthus biaculeatus*); 6. Longnose filefish (*Oxymonacanthus longirostris*); 7. Long-horn cowfish (*Lactoria cornuta*). (Illustration by Bruce Worden)