

# Index

## A

- Abiotic sources, 23
- Absolute hearing thresholds, 199
- Absolute sensitivity, 201
- Abudefduf abdominalis*, 164
- Abudefduf saxatilis*, 128
- Accessory auditory organ, 91
- Accessory hearing structures, 128, 130
- Acipenseriformes, 44, 47
- Acoustic behaviour, 150
- Acoustic communication, 128, 143, 145, 146, 157, 177
- Acoustic environment, 196
- Acoustic impedance, 92
- Acoustic playbacks, 60
- Acoustic pressure, 191, 196
- Acoustic signalling, 155
- Actinopterygian, 47, 48
- Actinopterygii, 44, 46
- Active space, 3, 177, 184
- Adults, 106
- Advertisement, 49
- Advertisement calling, 60
- Advertisement calls, 3, 160
- Advertisement signals, 129
- Aggressive, 129
- Aggressive behaviour, 144
- Aggressive sounds, 167
- Agnathan, 46
- Agonistic behaviour, 78, 129, 131, 149, 150, 161
- Agonistic context, 156
- Agonistic encounters, 154, 156, 163
- Agonistic interactions, 129, 155, 157
- Agonistic sounds, 162, 165
- Agonistic vocalizations, 141
- Anabantiformes, 42
- Anterior hypothalamus (AH), 56
- A/I junction, 105
- Air, 85, 87
- Air-breathing chamber, 145
- Air-breathing organ, 129
- Air-filled cavities, 146
- Algorithms, 84
- Alosa sapidissima*, 128
- Alternative reproductive, 56
- Alternative reproductive tactics, 58
- Amatitlania nigrofasciata*, 162
- Amphibian, 39, 56, 106, 113
- Ambient noise, 24, 176, 187, 190, 197–199, 201
- Amiiformes, 44
- Amphiprion*, 164
- Amphiprion clarkii*, 164
- Amplitude, 10
- Amplitude gain, 182
- Anabantoidei, 129
- Anabantoids, 128
- Androgen, 56, 60, 63–66, 208
- Androgen receptor (AR), 36, 60, 62, 63
- Anthropogenic noise, 23
- Apomorphic trait, 107
- Aponeurosis, 90, 96
- Apoptosis, 113
- Arginine-vasopressin, 56
- Arginine-vasotocin, 56, 58
- Argyrosomus argentatus*, 152, 160
- Argyrosomus japonicus*, 152, 160, 161
- Ariidae, 40
- Ariopsis*, 50
- Ariopsis felis*, 40
- Aromatase, 62–66
- Artificial covers, 180
- Artificial shelters, 182
- AT, 36, 59, 66
- Astatotilapia burtoni*, 208
- Atlantic croaker, 88, 90, 91
- Atlantic croakers *Micropogonias undulatus*, 85

- ATP, 104  
 ATPase, 105, 106  
 Attenuate, 85  
 Attenuation, 80  
 Audiogram, 127, 132, 141, 195  
 Audiogram/noise matching, 198  
 Auditory generalist, 91  
 Auditory organ, 91  
 Auditory masking, 23  
 Auditory nonspecialists, 196  
 Auditory performances, 200  
 Auditory peripheries, 129  
 Auditory scene analysis, 202  
 Auditory sensitivity, 127, 128, 132, 133, 137, 146, 157, 179, 195, 196, 199, 200  
 Auditory sensitivity maximum, 134  
 AVP, 56, 58  
 AVT  
   Arginine vasotocin, 36, 56, 58, 59
- B**  
 Background noise, 178, 192, 193, 199, 200  
*Bagre marinus*, 40, 50  
 Bathygobius soporator, 14  
 Batrachoididae, 40, 127, 150, 151, 156  
 Batrachoidid *Batrachomoeus trispinosus*, 91  
 Batrachoidids, 3  
 Batrachoidiformes, 39, 40, 47  
 Beryciformes, 40  
 Betta, 152  
 Bichir, 44  
 Biochemistry, 103  
 Bioluminescence, 79  
 Biotic sources, 23  
 Bird, 42, 44, 47, 48, 53, 56, 68, 113  
   Songbird, 67  
 Biting, 108  
 BK channels, 217  
 Black drum, 85, 88  
 Black tilapia *Oreochromis niloticus*, 100  
 Bladder, 49  
 Bladder deflation, 92, 100  
 Bladder resonance, 100  
 Blue catfish *Ictalurus furcatus*, 91  
 Blue gourami, 92  
 Boatwhistle, 37, 83  
 Boatwhistle calls, 60  
 Boatwhistles, 68, 84  
 Bound, 108  
 Boundary, 85  
 Boundary-element model, 87  
 Bowfins, 44  
 Breeding aggregations, 19  
*Brienomyrus* sp., 40  
 Bubble, 77, 87, 88, 93  
 Bubble model, 88  
 Bubble noise, 187, 191  
 Buoyancy, 86, 91  
 Butterflyfish (Chaetodontidae), 100
- C**  
 Calcium, 104  
 Calcium spike, 103  
 Callichthyidae, 86, 157  
 Calling activity, 14  
 Calling periodicity, 85  
 Calling rate, 1  
 Carapid, 92, 181  
 Carapidae, 155  
*Carapus*, 96  
*Carapus boraborensis*, 155  
 Catfish, 43, 46, 50, 86, 94  
 Cavefishes, 199  
 Cavity-nesting species, 184  
 Cell death, 114  
 Centrarchidae, 160  
 Centrarchids, 8  
 Cerato-mandibular (c-md) ligament, 107  
*Chaetodon ocellatus*, 128  
 Chaetodontidae, 40  
 Channel catfish *Ictalurus punctatus*, 87, 91  
 Characidae, 40  
 Characids, 91  
 Characiformes, 40  
 Cholesterol, 64  
 Chorus, 6, 20  
 Choruses, 84  
*Chromis chromis*, 24, 199  
*Cichlasoma nigrofasciata*, 162  
 Cichlid, 87, 100, 186  
 Cichlidae, 160, 162  
 Circadian, 85  
 Clades, 110  
 Cladogram, 77, 110, 111, 113  
 Clam shell, 184  
 Cleithrum, 109  
 c-md ligament, 108  
 Cod, 87, 201  
*Codoma ornata*, 186  
*Colisa lalia*, 197  
 Communication, 107, 144  
 Comodulation masking release, 201

- Competitive feeding, 78  
 Condition, 11  
 Congiopodus leucopaecilus, 51  
 Continental slope, 97  
 Convergences, 94  
 Convergent evolution, 102, 110  
 Corollary discharge, 38  
 Coronet, 108  
 Corticosteroid receptors, 63  
 Cortisol, 60, 62–64, 80  
*Corydoras paleatus*, 153, 157  
 Cottidae, 40–42, 159  
 Cottids, 79  
*Cottus gobio*, 159  
 Courtship, 3, 78, 97, 157, 163  
 Courtship behaviour, 162  
 Courtship calls, 3  
 Courtship sounds, 156, 162, 185  
 CPG, 47, 68  
   Central pattern generator, 36  
*Crassostrea gigas*, 183  
 Crevice-spawners, 186  
 Croaking gourami, 20, 37, 42, 55, 179  
 Cross channel analysis, 201  
 Crossmodal, 15  
 Cusk-eel, 79  
 Cutoff, 177–179, 184, 187, 189, 194, 198  
*Cynoscion*, 85  
*Cynoscion regalis*, 5, 50, 152  
*Cyprinella*, 157, 193  
*Cyprinella analostana*, 59, 157  
*Cyprinella lutrensis*, 157  
*Cyprinella venusta*, 157  
 Cyprinidae, 157  
 Cyprinids, 186, 198, 200  
 Cypriniformes, 47
- D**
- Daily rhythms, 67, 68  
 Damp, 87, 93  
 Damping, 87, 93, 102  
 Damping coefficient, 88  
 Damsel fish, 55, 177, 199  
 Damsel fish (Pomacentridae), 101  
 Damsel fish swimbladders, 87  
*Danio rerio*, 48, 128  
 Darters, 191  
*Dascyllus albisella*, 18, 164, 177  
 Decay, 88  
 Deflating the bladder, 92  
 Deflation, 93  
 Detection, 201  
 Detection distance, 3
- Development, 127, 140, 145  
 5 $\alpha$ -dihydrotestosterone, 64  
 Dipnoi, 46  
 Dipole, 89  
 Directional pattern, 88  
 Directional sound field, 89  
 Discrimination, 201  
 Distress situations, 157  
 Disturbance calls, 85, 96  
 Diverticula, 87, 88, 92  
 Dolphin sounds, 80  
 Domestication, 108  
 Dominant frequency, 8, 127, 135, 157, 161, 169  
 Dominant males, 220  
 Doradidae, 40  
 Dorsal process, 109  
 Drumming muscles, 151, 152, 160  
 Drumming sounds, 129  
 Duration, 6, 35–38, 44, 52, 53, 84  
 Duty cycle, 3
- E**
- Ears, 86, 92  
 Echolocation, 90  
 Ecoacoustical constraints hypothesis, 199  
 Ecological–structural mechanism, 194  
 Ecological factors, 195  
 Efferent nucleus, 44  
 Elastic spring, 90  
 Elastic spring mechanisms, 95  
 Electric fishes, 200  
 Electromyograms, 96  
 Embryonic, 114  
 Environmental constraint, 198  
 Epineurals, 97  
 Estradiol, 63, 66  
 Estrogen, 56, 64, 65, 208  
 Estrogen receptor (ER), 36, 62, 63, 65–67  
 Estuaries, 79  
*Etheostoma*, 191  
*Etheostoma crossopterum*, 171  
*Etheostoma flabellare*, 191  
*Eupomacentrus partitus*, 164  
 Euteleosteomorpha, 40, 42  
 Evolution, 94, 109  
 Evolution of hearing, 199  
 Exaptation, 86  
 Extirpation, 92  
 Extrinsic, 77, 78, 106  
 Extrinsic and intrinsic swimbladder, 110  
 Extrinsic muscles, 94, 113

**F**

- Far-field, 196
- Fast-Fourier transform, 83
- Fast Extrinsic Muscles, 94, 98
- Fast Intrinsic Muscles, 93
- Fast oxidative glycolytic (FOG), 105
- Fat reserves, 12
- Fatigue, 11, 105
- Fatigue resistance, 104
- Fawn cusk-eel, 91
- Feeding, 108
- Feeding sounds, 107
- Female agonistic sounds, 149, 165
- Female pre-spawning sounds, 165
- Ferry-boat noise, 24
- Fictive call, 52, 63, 64, 66, 67
- Fictive calling, 60
- Field crickets *Gryllus lineaticeps*, 6
- Fighting ability, 166
- Fish audiograms, 196
- Flat stones, 182
- Forced response, 93
- Forebrain, 35, 36, 53, 58, 64, 65
- Forelimb, 46
- Fossilized catfish pectoral spine, 78
- Frequency, 44, 53, 83
- Frequency modulation, 94
- Frequency response, 181
- Frequency sensitivity, 194
- Frequency spectra, 80
- Frequency spectrum, 87, 180, 182
- Freshwater bodies, 79
- Freshwater goby, 181
- Frogs, 44
- Fundamental, 53
- Fundamental frequency, 35, 82–84, 94, 141, 155, 157, 160

**G**

- Gadidae, 151, 154, 155
- Gadus morhua*, 151, 154
- Gaff-topsail catfish, 50
- Galeichthys, 50
- Gas secreting and reabsorbing, 91
- Gaucosomatids, 77
- Generative homology, 113
- Geographical, 84
- Glaucosomatid, 94
- Glucocorticoid receptor, 63
- Glucocorticoids, 56
- Glycogen, 13
- Gnathostome, 46

- Gobies, 79, 179, 181, 190
- Gobiidae, 160, 163
- Gobiids, 185, 186
- Gobiosoma bosci*, 185, 186
- Gobius cobitis*, 191
- Gobius cruentatus*, 24, 199
- Gobius jozo*, 163
- Gobius niger*, 163
- Gobius nigricans*, 178, 179, 187, 194, 198
- Gobius paganellus*, 191
- Goby, 8, 80, 92
- Goldfish, 47, 92
- Gouramis, 43, 50, 92
- Growth, 87
- Grunt sounds, 140
- Grunt train, 37
- Gulf toadfish, 39, 45, 54, 60, 64
- Gulf toadfish (*Opsanus beta*), 80

**H**

- Habitat acoustics, 194
- Haddock, 201
- Hair cell density, 212
- Hair cells, 195
- Halobatrachus didactylus*, 5, 60, 127
- Harmonic, 82, 83, 94
- Hearing, 22, 86, 92, 127
- Hearing enhancement, 146, 196
- Hearing loss, 200
- Hearing nonspecialist, 198
- Hearing sensitivity, 127, 143, 190, 198
- Hearing specialist, 196, 198
- Hearing specializations, 141
- Hearing thresholds, 127, 133, 136, 198
- Hemichromis bimaculatus*, 162
- Hemitaurichthys polylepis*, 40
- Hermaphrodite, 160
- Herotilapia multispinosa*, 186
- Herrings, 87
- High-frequency communication, 186
- High-pitched sounds, 197
- Hindbrain, 35–39, 41, 43–45, 47, 48, 51–53, 55, 64–67
- Hippocampus erectus*, 169
- Hippocampus kuda*, 169
- Hippocampus reidi*, 169
- Holocentridae, 11, 40, 43
- Holocentriformes, 40
- Holocentrus rufus*, 11, 40
- Holothuria stellati*, 181
- Homologies, 113
- Homologous, 113

Homoplasy, 113  
 Hormone, 55, 56, 58, 59, 61, 64, 67, 68  
 Hum, 49  
 Hydrophone arrays, 80  
 Hyoid apparatus, 108  
 Hypaxial musculature, 96  
 Hypaxial sonic muscles, 113  
 Hypertrophy, 149  
 Hypoglossal, 39  
 Hypoglossal homolog, 113  
 Hypoglossal nucleus, 113  
*Hypoplectrus unicolor*, 160  
 Hypothalamus  
   anterior hypothalamus, 36  
   anterior tuberal hypothalamus, 36, 58, 66

## I

Ictalurids, 95  
 Index signal, 8  
 Inner ear, 44, 129, 194, 195  
 Interception, 107  
 Intermediate, 98  
 Interpulse interval, 83  
 Intrasexual dimorphism, 43, 152  
 Intrinsic, 77, 78, 106  
 Intrinsic muscles, 93, 113  
 Intrinsic swim bladder muscles, 145  
 IT  
   Isotocin, 36, 56, 58, 59

## J

Jaw-snapping, 108  
 Juveniles, 143

## K

*Knipowitschia panizae*, 191  
 11-Ketotestosterone, 36, 60–64, 66  
 Ketotestosterone, 61  
*Knipowitschia puctatissima*, 184

## L

Labyrinth fishes, 129  
 Lagoon ambient noise, 195  
 Larvae, 106  
 Larynx, 39, 54, 78  
 Lateral line, 44, 194  
*Leiostomus xanthurus*, 152  
*Lepomis*, 8  
*Leptocottus armatus*, 40  
 Levator pectoralis muscle, 102  
 Lift, 86  
 Light, 79  
 Lipid levels, 12

Loading, 85  
 Local flow, 194  
 Localize, 80  
 Locked, 108  
 Longhorn sculpin, 50  
*Lophiobagrus cyclurus*, 128  
 Loricariidae, 86  
 Low-frequency communication, 178, 181, 184,  
   187, 194  
 Low-frequency sounds, 176, 178, 180,  
   186  
 Low-frequency vocalisations, 179, 194  
 Lungfish, 46  
 Lusitanian, 60  
 Lusitanian toadfish, 60  
 Lusitanian toadfish *Halobatrachus*  
   *didactylus*, 94

## M

*Macropodus*, 152  
 Macrourids, 79  
 Male morph, 56, 60, 63–66  
 Male quality, 2  
 Mammals, 42, 44, 47, 113  
 Man-made noise, 202  
 Masking, 20, 200  
 Mate assessment, 3  
 Mate attraction, 2  
 Mate choice, 2  
 Mating behaviour, 165, 166  
 Mating sounds, 165  
*Maylandia zebra*, 163  
*Megalechis thoracata*, 153, 158  
*Melanogrammus aeglefinus*, 151  
*Melanogrammus aeglefinus*, 154  
 Melatonin, 67, 68  
 Melatonin receptors, 67  
*Merluccius merluccius*, 151  
 Merlucciidae, 151, 154, 155  
*Micropogonias undulatus*, 152  
 Midbrain, 35, 36, 38, 53, 54, 58, 59, 62,  
   64–66  
 Midshipman  
   Type I male, 50, 58  
   Type II males, 3, 37, 39, 43, 47–49, 53–55,  
   58, 60, 67  
 Midshipman *Porichthys notatus*, 38, 80  
 Mitochondria, 103–105  
 Mochokidae, 40, 42, 43, 127, 129  
 Model, 87  
 Monocentridae, 40  
*Monocentris japonica*, 40  
 Monopole, 88, 89

Morids, 79  
 Mormyrid, 8, 41, 92  
 Mormyridae, 40  
 Morphology, 86  
 Motivation, 8, 11  
 Motoneuron, 36, 40–42, 46, 48, 54, 55  
 Motor, 68  
 Motor neurons, 113  
 Multimodal communication, 15  
 Multipath propagation, 177, 194  
 Multiple innervation, 103  
 Muscle, 55, 89  
 Muscle fatigue, 88  
 Muscle fibres, 151  
 Muscle twitch, 88  
 Myofibrils, 103, 104  
 Myosin cross-bridges, 105  
 Myotomes, 48  
*Myoxocephalus octodecimspinosus*, 50  
*Myoxocephalus scorpius*, 40, 51

**N**

Naked goby, 186  
 Narrow-band filter widths, 82  
 Near field, 191, 194  
 Near-field vibrations, 86  
 Neck vertebrae, 110  
*Neogobius melanostomus*, 128, 164  
 Nest, 180  
 Nest acoustics, 195  
 Nest cavity, 180, 184, 192  
 Nest cover, 182  
 Neural rocker, 97  
 Neuropeptide, 35, 56, 67, 68  
*Nibeia albiflora*, 152, 160  
 Noise, 23, 80, 83, 85, 177  
 Noise levels, 188, 191, 202  
 Noise masking, 198  
 Noise spectra, 187, 193  
 Noise spectral subtraction, 201  
 Noise spectrum, 188, 191  
 Noise spectrum level, 198  
 Noise window, 187, 192, 193, 195  
 Nonapeptide, 56, 59, 58, 63  
 Nonspecialists, 196  
 Northern sea robin, 39, 51, 52  
*Notropis analostanus*, 157  
 Nuclear and one mitochondrial gene, 110  
 Nucleus rostralateralis, 113  
 Number of pulses, 8, 140  
 Numerous sciaenids, 87

**O**

Occipital, 39, 47, 48, 52  
 Occipital innervation, 103  
 Occipital nerves, 113  
 Occipital spinal, 113  
 Olfactory communication, 79  
 Omnidirectional, 87  
 Omnidirectionally, 88  
 Onomatopoeic names, 107  
 Ontogenetic, 129, 143  
 Ontogenetic development, 128, 145, 146  
 Ophidiid, 91  
 Ophidiidae, 150, 151, 155  
 Ophidiids, 79  
 Ophidiiform, 77  
*Ophidion marginatum*, 151  
*Ophidion rochei*, 155  
*Opsanus*, 193  
*Opsanus beta*, 6, 39, 40, 45, 179  
*Opsanus tau*, 4, 40, 52, 151, 156, 179, 180  
 Origins, 94  
 Oscillograms, 80, 82  
 Osphronemidae, 42, 127, 129, 150, 151, 153, 160, 165  
 Ostariophysine, 91  
 Osteoglossiformes, 40  
 Osteoglossomorpha, 40  
 Osteostracans, 46  
 Otomorpha, 40, 42  
 Otophysans, 196  
 Otophysines, 128  
 Oxygen reservoir, 86  
 Oxytocin, 56, 58  
 Oyster toadfish, 39, 51, 52, 54, 60, 66, 86, 90, 180  
 Oyster toadfish *Opsanus tau*, 38

**P**

Pacemaker, 43, 45, 53, 55  
 Paddlefish, 47  
*Padogobius bonelli*, 4, 178, 179, 181, 187, 191, 194, 195, 198  
 PAG  
     Periaqueductal gray, 36, 53, 59, 66  
 Particle acceleration levels, 143  
 Particle motion, 91, 194, 196  
 Particle velocity, 191  
 Parvalbumins, 103, 106  
 Passive acoustics, 84, 96  
 Peak frequency, 85  
 Peak or dominant frequency, 83

- Pearl perch *Glaucosoma buergeri*, 98  
Pectoral, 37, 41–43, 46–49, 51, 55  
Pectoral fin, 50  
Pectoral girdle, 41, 102  
Pectoral mechanisms, 153  
Pectoral radials, 94  
Pectoral spine, 108–110, 135  
Pectoral stridulatory apparatus, 130  
Peeper *Pseudacris crucifer*, 5  
Pelvic girdles, 100  
*Pennahia argentata*, 160  
*Perca fluviatilis*, 198  
Perciformes, 40  
Percomorpharia, 40  
Period, 88  
Period  $\tau$ , 83  
Peripheral hearing structures, 146  
Pharyngeal jaw, 107  
Pharyngeal teeth, 100, 107, 110  
Phase, 85  
Phonotaxis, 4  
Phylogenetic tree, 110  
Physiology, 103  
Piezoelectric hammer, 102  
Pimelodidae, 40, 42  
Pimelodid catfishes, 94  
Pimelodids, 95  
*Pimelodus blochii*, 40, 42  
*Pimelodus pictus*, 40, 42  
Piranhas, 91, 95  
Plainfin, 51  
Plainfin midshipman, 3, 38, 39, 45, 49  
*Platydoras armatulus*, 37, 40, 46  
Playback, 80, 128  
Playback experiments, 2, 62, 129, 145  
Plucking mechanism, 130  
POA  
  POA-AH, 56, 58–62, 66  
*Pogonias cromis*, 4  
*Pollimyrus*, 8  
*Pollimyrus adspersus*, 8  
*Pollimyrus castelnaui*, 8  
*Pollimyrus isidori*, 8, 41, 192  
*Pollimyrus marianne*, 8  
Polypteriformes, 44  
Pomacentridae, 160, 164  
Pomacentrids, 4, 79, 92  
*Pomatoschistus*, 195  
*Pomatoschistus canestrinii*, 191  
*Pomatoschistus marmoratus*, 191  
*Pomatoschistus minutus*, 11  
*Pomatoschistus pictus*, 10  
*Porichthys*, 193  
*Porichthys notatus*, 17, 37, 38, 40, 48–50, 52, 128, 151, 152, 156, 178, 179, 208  
Preadapt, 114  
Predator defence, 144  
Pre-motoneuron, 39, 51  
Premotor, 43, 44, 48, 54, 55, 68  
Preoptic area, 36, 56, 58  
Preoptic area-anterior hypothalamus, 62  
Pre-pacemaker, 43, 45  
Pressure audiograms, 197  
Pressure release surface, 91  
Primates, 49  
*Prionotus carolinus*, 39, 40, 50  
Prolate spheroid, 87  
Protandrous hermaphrodites, 164  
*Proterorhinus marmoratus*, 164  
PRR/fundamental frequency, 54  
Pseudoreplication, 84  
*Pseudotropheus zebra*, 162  
Puberty, 96, 98  
Pulsating resonant bubble, 87  
Pulsating underwater bubble, 86  
Pulse duration, 161  
Pulse interval, 8  
Pulse numbers, 145  
Pulse period, 6, 140, 145  
Pulse repetition rate (PRR), 36, 38, 51–54, 83  
Pulses, 83  
Pure tones, 182  
*Pygocentrus nattereri*, 40
- Q**  
Quadrupole, 89  
Quadrupole motion, 89  
Quality factor Q, 84  
Quiet window, 186, 190, 191, 193, 198
- R**  
Radiation pattern, 181  
Rat penis muscles, 114  
Ray-finned, 44  
Recognition, 201  
Red-mouthed goby, 199  
Redundancy, 84  
Reflecting boundaries, 177  
Release mechanism, 97  
Reproductive behaviour, 150, 155, 166  
Reproductive morph, 157  
Reproductive success, 184  
Resonance, 92  
Resonant bubble, 86, 87, 107  
Resonant bubble model, 88  
Resonant frequency, 85

- Resonant monopole, 86  
 Respiration, 47, 49  
 Respiratory, 49  
 Retrograde transport, 113  
 Rhombomere, 8, 113  
 Ridges, 109  
*Rissola marginata*, 151  
 Ritualization, 107  
 Rocker bone, 97, 98  
 Rockfish, 43  
 Rubber, 87
- S**
- Saccular otoliths, 89  
 Salmon, 47  
 Salmoniformes, 47  
 Sand goby, 182, 184, 186, 195  
 Sand pile, 182, 184, 195  
 Sarcolemma, 105  
 Sarcoplasmic reticulum (SR), 103, 104  
 Sarcopterygii, 46  
*Sargocentron seychellense*, 40  
*Sargocentron xantherythrum*, 40  
 Satfin shiner, 59  
 Scaling effect, 88  
*Scapharca inaequivalvis*, 184  
 Scattering, 181  
*Sciaena umbra*, 24  
 Sciaenid, 4, 80, 82, 96  
 Sciaenidae, 150, 152, 160  
 Scorpaenidae, 40, 43, 158  
 Scorpaenids, 42  
 Sculpin, 42, 50, 52, 55  
 Sculpins and Gobies, 102  
 Sea catfish *Ariopsis felis*, 90  
 Sea cucumber, 92, 96, 181  
 Sea robin, 51, 54, 94  
 Seasonal, 85  
*Sebastiscus marmoratus*, 40  
 Selection pressures, 86  
 Sensory overstimulation, 200  
 Serranidae, 160  
*Serrasalmus rhombeus*, 40  
 Sex-specific differences, 150, 154, 155, 161, 165  
 Sexual dimorphism, 114, 149, 152, 153, 155, 160  
 Sexually dimorphic, 97  
 Shallow depths, 178, 179  
 Shallow environments, 187  
 Shallow habitats, 177, 179  
 Shallow water, 176–178, 194, 198  
 Shallow-water fishes, 178, 180, 201  
 Shallow-water habitats, 193  
 Shorthorn sculpin, 51  
 Short propagation distance, 194  
 Short-range communication, 194  
 Short-range propagation, 179  
 Signal-to-noise, 198  
 Signal recognition, 201  
 Siluriformes, 40, 42  
 Silver perch, 80  
 Size, 9, 88  
 Slow extrinsic swimbladder muscles, 96  
 Slow muscle, 77, 94, 98  
 Slow oxidative (SO), 105  
 Small fishes, 85  
 Snapping shrimp, 85  
 S/N ratio, 180, 187, 190, 195  
 Social communication, 79  
 SOFAR (Sound Fixing and Ranging) channel, 79  
 Sonagrams, 80  
 Sonar, 92  
 Songbirds, 47, 49, 67  
 Sonic, 39  
 Sonic motor nucleus, 113  
 Sonic muscles, 79, 151, 152, 194  
 Sonic muscle structure, 103  
 Sonic organ, 149  
 Sonic-pectoral, 47  
 Sonic predators, 63  
 Sonic swimbladder muscles, 79  
 Sonic, vocal, 36  
 Sound/ambient noise matching, 193  
 Sound amplification, 181  
 Sound amplitude, 184  
 Sound characteristics, 135, 145, 150, 155, 156, 160, 161  
 Sound communication, 128, 146  
 Sound detection, 128  
 Sound duration, 11, 145  
 Sound field, 180  
 Sound-generating mechanism, 129, 130, 152, 153, 160, 162  
 Sound interception, 194  
 Sound pressure, 176  
 Sound pressure level (SPL), 10, 80, 133, 140, 169  
 Sound production, 128, 145, 150, 162, 164  
 Sound propagation, 177, 179  
 Sound spectra, 127  
 Sound spectra levels, 136  
 Sound spectrum, 180  
 Sound transmission, 178, 201  
 Source levels, 80



- Southern pigfish, 51  
 Spawning, 78, 150, 156  
 Spawning calls, 160, 161  
 Spawning partners, 80  
 Specialist, 92  
 Species recognition, 2  
 Spectral, 36  
 Speed of sound, 78  
 Sphincter, 91  
 Spinal cord, 41, 44, 45, 47, 48  
 Spinal innervation, 103  
 Spinal nerves, 41, 113  
 Spinal nucleus, 114  
 Sphincter, 91  
 Springfederapparat, 95  
 Squirrelfish, 43, 95  
*Stegastes partitus*, 4, 128, 164  
 Steroid hormone, 35, 60, 62, 64, 67  
 Steroidogenic enzymes, 64  
 Steroid receptor, 65  
 Steroids, 59, 64, 67  
 Steroid synthetic enzymes, 63  
 Stone hollow, 195  
 Strategies, 56  
 Stream ambient noise, 186, 189, 191  
 Stream goby, 178, 187, 194, 195, 198, 199  
 Stream noise, 195  
 Stridulation, 42  
 Stridulation sounds, 129  
 Striped cusk-eel *Ophidium marginatum*, 97  
 Sturgeon, 44  
 Subordinate males, 220  
 Substrate breeding, 79  
 Superfast fibers, 103  
 Superfast muscles, 54, 55, 93, 103  
 Superfast sonic muscles, 93, 101  
 Superior oblique muscles, 101  
 Suprabranchial chamber, 92, 130  
 Supraoccipital ridge, 108  
 Swimbladder, 37–42, 44, 47, 50, 51, 77, 86–88  
 Swimbladder deflation, 107  
 Swimbladder fenestra, 98  
 Syngnathidae, 169  
 Syngeny, 113, 114  
 Syngnathidae, 169  
*Synodontis nigriventris*, 40  
*Synodontis nigromaculatus*, 40, 42  
*Synodontis schoutedeni*, 127, 128  
 Syrinx, 39, 48, 54, 78
- T**  
 Target strength, 87, 92  
 Temperature, 54, 84, 88
- Temporal, 36, 49, 54  
 Temporal code, 38  
 Temporal coding, 87  
 Tendon, 90  
 Terapontidae, 160  
 Territoriality, 79  
 Testosterone, 59–61, 63–66  
 Tetanic contraction, 97  
 Tetrapod, 35, 37, 39, 42, 44, 46, 47, 64, 66, 68  
 Therapon, 50  
 Thorny catfishes, 87  
 Thresholds, 92  
 Toadfish, 3, 39, 43, 47, 49, 53, 55, 60, 67, 80, 87, 92, 93  
 Toadfish grunt, 94  
 Transfer function, 181  
 Transmission loss, 179  
 Trawling, 79  
 Triads, 105  
*Trichopsis*, 152, 165  
*Trichopsis vittata*, 20, 37, 42, 127, 128, 166, 197  
*Trichopsis vittatus*, 152  
 Triads, 105  
 Triglidae, 40, 159  
 Troponin, 103  
 Trout, 47  
 Tunica externa, 96  
 Twitch, 97  
 Type I male midshipman, 104  
 Type II male, 60
- U**  
 Ultrastructure, 103  
 Umwelt, 80  
 Underwater resonant bubble, 78
- V**  
 Vasoactive intestinal polypeptide (VIP), 56  
 Vasotocin, 58  
 Vasotocin-like, 58  
 Vesica longitudinalis, 100  
 Viscoelastic, 87  
 Visual propagation, 79  
 Vivo neurophysiology, 63  
 VMN, 39, 51, 53–55, 65–67  
 Vocal, 39, 47, 49, 67, 68  
 Vocal-auditory, 44  
 Vocal central pattern generator (CPG)  
     vocal CPG, 38  
 Vocal CPG, 37, 49, 53, 68  
 Vocal duration, 54  
 Vocal hindbrain, 48

Vocal interactions, 21  
 Vocalization, 49, 53, 56, 127, 129,  
     132, 133  
 Vocal motor nucleus, 39, 45  
     sonic motor nucleus, 39  
     VMN, 36  
 Vocal muscle, 50, 66  
 Vocal nerve, 38, 39, 43, 52  
 Vocal organs, 46  
 Vocal pacemaker nucleus  
     VPN, 36  
 Vocal PAG, 53  
 Vocal–pectoral, 46  
 Vocal pre-pacemaker nucleus  
     VPP, 36  
 Vocal/sonic, 37  
 Volume velocity, 91  
 VPN, 53–55  
 VPP, 53, 66  
 VPP–VPN–VMN, 44

**W**

Water depth, 177, 179, 187  
 Waveform, 88  
 Waveform period, 88  
 Wavelength, 80, 92, 94  
 Weakfish, 88  
 Weberian, 146  
 Weberian apparatus, 127  
 Weberian auditory ossicles, 157  
 Weberian ossicle chain, 196  
 Weberian ossicles, 92, 130, 131, 153  
 Whale sounds, 79  
 White muscle, 106  
 White noise, 182

**Z**

Zebrafish, 47, 48  
 Zero-sum game, 103  
*Zosterisessor ophiocephalus*, 184, 191  
 Z-line, 105