

Index

Page numbers in *italics* represent figures, those in **bold** represent tables.

- A/E ratio 220
 abdomen 19, 20, 21, 21
 ablation
 androgenic gland 24, 291, 293, 298, 326
 chelipeds/claws 330, 333–4
 eyestalk 28, 32, 44, 477, 526
 acclimatisation/acclimation 162, 240
 acetic acid 269
Acineta 268, 364
 adenosine diphosphate (ADP) 407
 adenosine monophosphate (AMP) 403
 adenosine triphosphate (ATP) 403, 407
 adhesion factor 258, 259
 aeration/aerator
 bubble 245
 in grow-out ponds 152
 in hatcheries 64, 90
 mechanical 245–6, 245
 oxygen transfer efficiency **246**
 paddlewheels 245
 splasher 245
Aeromonas 76, 265, 365
 A. hydrophila 408
 Africa 389–91
 African river prawn *see* *Macrobrachium vollenhovenii*
 aggression *see* agonism/agonistic
 behaviour; cannibalism; social
 behaviour
 agonism/agonistic behaviour 318–19
Ailanthus altissima 219
 alanine **93**, 401, 480
 algae
 control by tilapia 198
 filamentous 195, 196, 232, 245, 268
 algicides 163, 252, 269
 alkalinity 30, 61, 111, 112, 130, 163, 168,
 241–4, **241**, **243**, 246, 252, 269,
 492, **496**, **497**
 all-female culture *see* monosex culture
 all-male culture *see* monosex culture
Alteromonas 408
 alum 253
 Amazon river prawn *see* *Macrobrachium amazonicum*
Amblypharyngodon mola 106, 205–6, 467
 American lobster *see* *Homarus americanus*
 American white shrimp *see* *Litopenaeus vannamei*
 amino acids **93**, **221**
 free, effect on flavour 401
 see also individual amino acid names;
 nutrition
 ammonia (NH₃) 24, 47, 56, 61–2, **65**,
 72–3, 111, 158, 160, 161, 163,
 239, 479
 excretion 24, 32
 ionised 43, 72–3, 490
 nitrogen NH₃-N 24, 111
 tolerance test 77, 242
 total 62, 73, 240, **241**, **243**, 490, **496**
 toxicity 66, 72, 73, 240, 260, 269, 416
 unionised (non-ionised) 47, 72–3, 122,
 242
 ammonium sulphate **250**
Amphiprion
 A. bicinctus 331
 A. clarkii 331
 amylase 219
 andrectomy 24, 291, 293, 298, 326
 androgenic gland 24, 44, 172, 293–4,
 325–6
 ablation 24, 291, 293, 298, 326
 anemone fish *see* *Amphiprion bicinctus*
 antennae
 first 19
 second 19
 antennal gland 23
 extracts 227
 antennal scale 12, 15, 19, 20, 29
 antennulae 19
 regeneration 31
 antibiotics 76, 261
 indiscriminate use of 262–3
 antimicrobial drugs 262, 265
 appendage deformity syndrome (ADS)
 269
 appendages 18, 19–20, 22, 23, 31, 32
 appendix masculina 20, 21, 21, 25, 44,
 299, 300, 326, 327, 337
 apple snail *see* *Pila globosa*
 arachidonic acid (20:4 n-6) **95**, 219
 Argentina 3, 377–8
 arginine **221**
Aristichthys nobilis 198, 465, 478
 stocking density **205**
Armadillidium vulgare 300, 302
 Armenia **6**, 392–3
Artemia 55, 58–9, 73–4, 228, 360
 amino acid profile 92, **93**
 cyst disinfection 89–90
 cyst market 87–9, **88**
 cyst supply 58
 decapsulation 89–90
 enhancement/enrichment 93–7, **94**, **95**
 hatching 58, 59, 89–90
 hatching rate 58, **91**
 hatching tanks 58–9, 90, **90**
 ingestion rate **102**
 lipid content 92
 nutritional features 91–3, **93**
 preparation 87–97
 proximate composition 92
 size 91–2
 vitamin content 92–3, **93**
 A. sinica 88
 A. urmiana 88
 artificial brackishwater *see* brackishwater
 artificial seawater *see* seawater
 artificial substrates *see* substrates

- ascorbic acid *see* vitamin C
 ascorbyl palmitate 96
 ash 27, 92, **99**, **100**, **101**, 227, 400
 Asia 347–75
 see also individual countries
 Asian catfish *see* *Clarias batrachus*
 Asian lung fluke *see* *Paragonimus westermani*
 asparagine 220
 astaxanthin 29, 75
 attraction, males to females 26
Atya 383
 Australia 3, 395
 autotomy 31
 avocado Yamigata *see* *Persea americana*
 azodrin **251**
- Bacillariophyta* 510
Bacillus 76, 408
 B. licheniformis 228
 B. subtilis 77, 97, 228
 backyard hatcheries 57, 80, 452–3
 bacteria
 gram-negative 266
 gram-positive 266
 luminescent 266
 nitrifying 61
 psychotrophic 408, 409
 see also disease; and individual bacterial strains
 bacterial necrosis 265, 265, 266
 baculovirus 264
 balloon disease 269, 354
 Bangladesh 3, 66, 347–9
 farm-made feeds **231**
 farmed production 5, 7, 7
 marketing 425–6
 nursery rearing 162
Barbodes gonionotus 200
 basis 19
 batch culture/system *see* grow-out, monoculture, in ponds; harvesting
 BC males *see* male morphotypes
 behaviour *see* aggression; agonism; cannibalism; chemical communication; mating, behaviour; social behaviour
 Belarus 392
Bellamyia bengalensis 528
 benthic 45, 147
 detritus 157, 196
 invertebrates 185, 187, 218
 organisms 127, 157, 158
 prey 225
 benzalconium chloride **251**
 benzethonium chloride **251**
 berried females *see* females
- betaine 227, 327–8
Bifido-bacterium 228
 bighead carp *see* *Aristichthys nobilis*
 binders *see* nutrition
 biochemical oxygen demand (BOD) 47
 bio-encapsulation 93, 94
 biofilters *see* filters, biological
 biological filters *see* filters, biological
 biomass curve 170, 170
Biomphalaria
 B. glabriata 528
 B. tenagrophila 528
 biotic community 156, 159
 biotin **93**
 birds *see* predation
 black clam *see* *Villorita cyprinoides*
 black gill disease 350
 black spot disease 219, 265–6, 350
 black tiger shrimp *see* *Penaeus monodon*
 bladder 23
 blanching *see* processing and storage
 blood 22, 32, 257, 260
 blue claw males *see* male morphotypes
 blue crab urine 227
 blue shrimp *see* *Litopenaeus stylirostris*
 bopyrid isopods 268, 507
 Botswana 391
Brachionus plicatilis 75, 86, 97
 brackishwater 1, 31, 43, 47, 50, 55, 57–60, 72, 76, 92, 98, 219, 242, 283, 347, 350, 353, 363, 365, 465, 485, 490, **504**, 510, 512, 515–16, 527
 artificial 66–8, **67**
 grow-out 130–31, 154, 161
 larval need for 1, 64, **65**
 brain 24, 25
 branchiostegal blister disease *see* balloon disease
 branchiostegal line 19
 branchiostegite 22
 Brazil 3, 63, 65, 375–7, 376, 377, *Plate 8*
 farm-made feeds **230**
 farmed production 5, 7, 375–7
 M. amazonicum 485–97
 M. rosenbergii 375–7, 375, 376, **377**
 harvesting of postlarvae 79
 marketing 438–9
 micro-encapsulated diet **102**
 water quality **241**
 water/soil variables **243**
 brine 8, 65, 66, 89, 164, 347, 353, 365, 409, 411
 brine shrimp *see* *Artemia*
 brood chamber 25
 broodstock 40–51
 collection 40–43
- cryopreservation 44–5
 culture systems 67–8
 environmental requirements 46–7
 feeding strategies *see* feeding
 genetic degradation *see* genetics
 handling 42–3
 holding systems 45–6
 hybridisation *see* genetics
M. amazonicum 489
M. nipponense 476–7
 maintenance/management 43–8
 male/female ratio 46
 manipulation *see* genetics
 nutrition *see* nutrition
 salinity requirements *see* salinity
 selection 41
 sex ratios 46
 source 40–41
 stocking density *see* stocking/stocking rates/stocking density
 in temperate zones 181
 transport 42–3
 Brunei Darussalam 371–2, 374–5
Bryozoa 241
 bulls *see* male morphotypes
 Burma river prawn *see* *Macrobrachium birmanicum*
 business planning and management
 aquaculture 448–50
 staffing 449
 see also economics
- C6/C36 mosquito cell line 264
 cadaverine 228
 cadmium (Cd) **251**
 cages
 for grow-out cage culture *see* grow-out, monoculture, in cages and pens
 for hatching eggs and rearing larvae 48, 196, 198, 374, 489
 nursery 109–10
 calcite 32
 calcium (Ca) 30, 32, **65**, 241–2
 calcium carbonate 65, 241, 242–3
 calcium hydroxide **250**
 calcium hypochlorite **250**
 see also disinfection
 calcium oxide 242, **250**
 calcium peroxide 249
 calcium sulphate (gypsum) 244
Callinectes sapidus 402
 Cambodia 372
 Canada 385
 Cancer
 C. carcinus 13
 C. jamaicensis 13
 C. squilla Linnaeus 14

- Candida* 267
C. sake 267
C. utilis 96
- cannibalism 1, 45, 48, 56, 68–9, 73, 76–7, 78, 108, 109, 111, 114, 117–19, 181, 187, 195, 196, 318, 322, 329, 331, 371, 513, 514
- capture fisheries 2, 40, 172, 346, 347, 358, 364, 370, 373, 383, 407, 515, 526
- carapace 317
- carapace/propodus length relationship 317
- carbohydrase 219
- carbohydrates *see* nutrition
- carboxypeptidase 219, 406
- Carcinus maenas* 30
- Caribbean 381–5, 383
- Carica papaya* 208
- carideans 21, 21
 circulatory system 22
- carpus 12, 19, 20
- catfish *see* *Clarias batrachus*; *Mystus planiceps*
- Catla catla* 200, 202, 207, 348, 466, 508
- Cauque river prawn *see* *Macrobrachium americanum*
- caeca 23
- cellulase 219
- Cellulomonas* 76
- cellulose 199, 223
- Central America 380–81
- cephalon 19
- cephalothorax 19
- cetylpyridinium chloride 251
- channel catfish *see* *Ictalurus punctatus*
- Chanos chanos* 466
- Chara* 113
- chefs 401, 435
- chelae 19, 31
- chelipeds 15, 18, 19–20, 31, 326
- chemical communication 197
- chemoattractant 227
- chemoreceptors 20
- chemotherapy 262
- chemotrypsin 406
- Cherax quadricarinatus* 389
- Chile 378
- China 2, 3, 349–52
 farmed production 7
M. nipponense 6, 7
M. rosenbergii 5, 7, 7
 total 7
 feeds 164
M. nipponense farming 476–80, 476
 nursery rearing 162
 pen culture 155
 polyculture 202
- Chinese river prawn *see* *Macrobrachium nipponense*
- Chinese white shrimp *see* *Penaeus chinensis*
- chironomids 218, 333
- chitin 28
- chitinase 219
- chitosan 28
- chloramine 57
- chloramphenicol 251, 263
- Chlorella* 55, 371
- chloride 65
- chlorination 248
- chlorine (Cl) 180, 243, 266
- Chlorophyta 113, 268
- cholesterol 221–3
- chromium (Cr) 65
- Chryseomonas* 76
- Cinnamon river prawn *see* *Macrobrachium acanthurus*
- circulatory system 21–2, 22
- Cirrhinus mrigala* 200, 202
- Clarias batrachus* 166, 465
- clarosan 251
- claws *see* chelae
- climatic factors *see* ponds, site selection
- Clostridium perfringens* 408
- coelomosac 23
- collagen 404
- collagenase 44, 406
- Colombia 3, 378
- Colossoma*
C. macropomum 465
C. mitrei 207
- colour
 of larval tanks *see* larvae
 of male chelae *see* male morphotypes
 of prawns 18–19, 408
- commercial feeds *see* feeds
- commercial prawn farming 346–96
- commercial status of prawn farming *see* status
- common carp *see* *Cyprinus carpio*
- compensatory growth *see* growth
- competitors 164–6
 control of 164–6, 165, 166
- composition
 feed *see* feeds
 prawns 400
 condition 256
- condition index of larvae *see* larvae
- constraints 8–9, 481–2
- continuous culture *see* grow-out, monoculture, in ponds; harvesting
- Cook Islands 396
- cooking 414, *Plate* 8
see also recipes
- copper (Cu) 65, 251
- copper sulphate 251, 251, 252
- coprophagous 228
- copulation *see* mating behaviour
- corallanid isopod 268
- Corineformes* 408
- cornea 19
- Costa Rica 3, 380
 marketing 439
- costs, investment and operating *see* economics
- Côte d'Ivoire 391
- Cothurnia* 268
- coxa 19
- Crangon 421
- creatine phosphate 407
- crop rotation 205–6, 351, 361, 371, 478
- crustacean hyperglycaemic hormone (CHH) *see* hormones
- Cryphiops* 14
- Ctenopharyngodon idella* 196, 200, 204, 252, 348, 465, 508
 stocking density 205
- Cuba 381
- cull-harvesting *see* harvesting
- culture systems *see* broodstock; grow-out; hatchery; nursery
- culture in temperate zones *see* temperate zone culture
- cuticle 28, 29, 32, 257
- Cyanophyceae* 510
- cyanophyta 268
- Cyprinus carpio* 200, 204, 508
 stocking density 205
- dactylus 19
- Daphnia* 118
- Debaryomyces hansenii* 267, 363
- decapsulation *see* *Artemia*
- density *see* stocking/stocking rates/stocking density
- diatoms 103
- diet *see* feeds
- dietary preferences, natural 196, 199, 218
- digestibility 89, 98, 101, 221, 225
- digestion 219
- digestive physiology 218–19
- digestive system 23
- Dimua river prawn *see* *Macrobrachium villosimanus*
- disease 263–70, 482
 bacterial 76, 265–6, 265
 control 262–3
 environmental 269
 fungal 267–8, 267
 rickettsia 266–7
 syndromes of unknown aetiology 269–70

- disease (*Cont.*)
 viral 263–5
see also epibionts; health; parasites
- disinfection 55, 56, 57, 67, 76, **250**
 of *Artemia* cysts 89–90
 of grow-out ponds 248, **250**
 of hatcheries 76
 of processing facilities 404
- dissolved oxygen (DO₂) 43, 64, 65, **65**, 72,
 111, 112, 121, 130, 131, 144,
 157–8, 161, 163, 164, 182, 186,
 198, 201, 239, 240, 242, 244–7,
 249, 252, 257, 260, 268, 269,
 353, 480, 481, 490, 492, 495,
 496, **496**, 514
- dissolved solids **65**
- diverticulae 23
- docosahexaenoic acid (DHA; 22:6 n-3)
 92, 94, **95**, 100
- domestication 41, 168, 224, 285, 288
- dominance hierarchies 318–19
- Dominica 3, 381–2
- Dominican Republic 382
- dorado *see Mahi mahi*
- dot-blot hybridisation 261
- dragonflies *see* insects
- drain harvesting 166–7
- EAA *see* nutrition
- ecdysis 28–31
- ecdysis obstacle disease *see* exuvia
 entrapment disease
- ecdysone *see* hormones
- ecdysteroids 28, 30, 34
- economic modelling 468–9
 bioeconomic modelling 468–9
 risk modelling 469
- economics 448–69, 482
 costs and profitability 452–64
 growout 459–64
 comparative cost analysis 463–4,
 464
 costs and profitability 459–64
 hatchery 452–8
 comparative cost analysis 457–8,
 458
 investment 452–5, **453–5**
 operating costs and profitability
 455–7
 nursery 458–9
 polyculture and integration 206–11,
 209, 464–8
 high technology production 191–2
 income 195, 206–7, 209, 335, 450, 460,
 509, 527
see also value
see also financial feasibility analysis;
 financing aquaculture projects
- ecotypes 279
- Ecuador 378
- edge effect 117
- EDTA 65
- EED *see* exuvia entrapment disease
- EFA *see* nutrition
- egg custard *see* feeds, hatchery, inert
- eggs, prawn 25, 27
 chemical composition 27
 colour and ripeness 41
 hatching rates 47
 incubation 49–50
 number *see* females, fecundity
- Egypt 3, 390–91
- Eichhornia crassipes* 253, 496
- eicosapentaenoic acid (EPA; 20:5 n-3) 92,
 94, **95**, 100, 219
- ejaculatory ampullae 317
- El Salvador 380, 381
- ELISA 261
 sandwich enzyme linked
 immunosorbent assay
 (S-ELISA) 261
 triple antibody (TAS-ELISA) 261
- endites 20
- endocrine control 27
- endopods 20
- endosulfan **251**
- endrin **250**
- energy *see* nutrition
- enhancement, fisheries *see* fisheries,
 enhancement
- Enterococcus* 266, 408
- environment 482–3
see also sustainability
- environmental
 control of size variation 327–8
 impact assessments (EIA) 129, 482–3
- environmental protection 172–3
- enzyme action 219
- enzymes
 collagenolytic 44, 406
 dietary *see* nutrition
 effect on texture *see* texture
 lipolytic 219
 proteolytic 219
- Ephelota* 268
- epibionts 268–9
- Epistylis* 42, 241, 268, 364, 388
- escapes *see* environmental protection;
 introductions
- essential amino acids EAA *see* nutrition
- essential fatty acids EFA *see* nutrition
- esterases 219
- Europe 391–3
- eutrophic/eutrophication 156, 195, 239,
 253, 267
- excretory system 23–4
- exocytosis 259
- exoskeleton *see* cuticle
- extra small virus (XSV) 42, 261, 263–4,
 353
- extrusion of feed 182, 225
- exuvia entrapment disease (EED) 219,
 220, 270, 370
- exuviae 29
- eyes 19
see also ablation
- eyestalks 19, 27
 ablation 28, 32, 44, 477, 526
- FAA *see* free amino acids
- faecal pellets of freshwater prawns 23
- faeces, fish 117, 199
- FAO Code of Conduct for Responsible
 Fisheries 524, 528
- Farfantepenaeus*
F. duorarum 21
F. paulensis 402
- farm design 160
- farming
 constraints to 8–9, 481–2
 expansion of UNDP/FAO project 2,
 524, 528
 forecasts of future production from *see*
 status, of global freshwater
 prawn culture
 opportunities for 8
 status of *see* status
see also grow-out; hatchery; nursery
- fatty acids
 essential (EFA) 59, 92, 94, 96, 221,
 222
 synthesis 92, 100
see also individual fatty acid names;
 nutrition
- FCR *see* feed conversion ratio
- fecundity *see* females
- feed conversion ratio 155, 158, 171–3,
 187–9, 191, 199, 204, 205, 207,
 221, 223–4, 226, 228–9, 232,
 240, 328, 330, 332, 348, 351,
 354, 361, 362, 366, 371, 374,
 376, 378, 380, 382, 384, 386,
 388, 389, 393, 394, 426, 527
- feeding 86–103, 218–32, 491–2, **492**
 behaviour 75, 102, 196, 328, 510
 of broodstock 47–8
 frequency **492**
 of grow-out animals 479–80, 495
 polyculture 199
 of juveniles 117–18, **118**
 of larvae 73–5, 102–3, **102**, 103
 phase-feeding 189
 strategies 231–2
 trays 227, 374, 495

- feeds 86–103, 218–32, 491–2
 composition **227, 230, 231**
 grow-out see feeds, grow-out, formulae
 inert see feeds, hatchery, inert desirable characteristics of 86–7
 effect on behaviour see flavour
 farm-made 229–31, **229, 230, 231**
 grow-out 230–31
 larval 219
 FCR see feed conversion ratio
 grow-out 224–31, 479–80, 495
 commercial 224–8, **225, 227**
 protein level **225**
 complete 225
 cost of **230**
 experimental 224–8, **225, 227**
 formulae **227, 230, 231**
 natural 225
 palatability 227
 supplemental 225
 water stability of 225
 hatchery
 inert 74, 98–102, **99, 100, 101, 102**
 live see *Artemia*; *Brachionus plicatilis*;
Moina micrura
 ingredients **225, 228–9**
 juvenile 220–24
 larvae 219–20
 natural 225
 organic *Plate 5b*
 see also nutrition
 females
 berried 20, 28, 40, 47, 353, *Plate 2b*
 fecundity 41
 gravid see females, berried
 ovigerous see females, berried
 selection 41–2
 spawning 25–6, 27
 spawning system 25
 see also monosex culture; sex reversal
 fence culture 155
Fenneropenaeus
F. chinensis 198, 350
F. indicus 264, 266, 374
F. merguensis 403
 fertilisers/fertilisation 186, **186, 250, 479**
 mineral chemical 244–5
 organic manures 189, 245
 fibre see nutrition, fibre
 Fiji **3, 393–4**
 filter media 62
 filters
 biological 61–2, 61
 see also filter media; substrate
 activation
 mechanical 63
 financial feasibility analysis 450
 financing aquaculture projects 450–52
 sources of capital 451–2
 types of financing 451
 fish see individual fish names;
 plankton-feeding fish;
 polyculture
 fish/prawn interactions see interactions
 fisheries
 enhancement 346–96
 freshwater prawn 346–96
 social 355, **356**
 species of interest to capture fisheries
 347
 statistical information 346, 347, 350,
 363, 370, 372, 378–80, 393
 fishing gears
 brushwood 370
 nets 516
 traps 372, 510
 fishmeal 224–6, **227, 228, 230, 231, 526**
 flagella 19
 flavour 401–4
 feed, effect on 401
 free amino acids, role of 401
 freshness 402, 416
 non-protein nitrogen 401
 salinity, effect on 401
 see also processing and storage; sensory
 evaluation
 folate **93**
 food web 157, 158
 formalin **250, 251, 266, 269**
 Fortuna 396
 fouling see epibionts
 France 422
 free amino acids (FAA), effect on flavour
 401
 freezing see processing and storage
 French Guiana **3, 378–9**
 marketing 439–40
 French Overseas Departements and
 Territories see Guadeloupe,
 Martinique and others
 French Polynesia 395
 freshwater 18, 20, 31, 32, 43, 48, 58, 60,
 64–6, 131, 156, 163–5, 168, 239,
 242, 244, 246, 248, 346–96, 475,
 477, 478, 489, 490, 504, 510,
 511, 516
 Fujimura, Takuji 1, 2, 4
 fungal infections 267–8, 267
 furazolidone **251, 266, 267**
Fusarium 265
F. solani 267
Gambusia 198
G. affinis 165
Gammarus 392
 ganglia 24, 25
 gastric mill 23
 gastroliths 29
 gastropods 117, 218
 see also individual snail types
 genetically distinguishable hatching
 groups see hatching
 genetics 278–306
 control of size variation 289
 degradation 2, 351, 357, 358, 386, 482
 see also inbreeding
 development 280, 282, 283
 genetic variation 282–4
 hybridisation
 interspecific 281–2
 intraspecific 44–5, 280, **281**
 markers of 282
 interbreeding 281–2
 manipulation 290, 291, 304
 population 278, 279–85
 genital pores see gonopores
 geothermal waters, culture in 242, 394
 Germany 392
 Ghana 391
 gher 127, 129–30, 137, 139, 140, 155,
 162, 169, 173, 206, 210, 211,
 348, 467
 giant (Asian) tiger shrimp see *Penaeus*
monodon
 ‘Giant Prawn 1980’ conference 4
 Giant river prawn see *Macrobrachium*
rosenbergii
 gill/gill chamber 22, 260
 see also respiration
 gilthead seabream see *Sparus aurata*
 global status of freshwater prawn culture
 see status
 glutamate-oxaloacetate-transaminase
 locus 320
 glutamic acid **93, 401**
 glycine **93, 101, 227–8, 401–2, 480**
 glycogen 29, 407
golda chingri 347
 gonad-inhibiting hormone 27
 gonad-stimulating hormone 27
 gonadosomatic index (GSI) 44, 317
 gonopores 24, 317
 grading see size, grading
 grass carp see *Ctenopharyngodon idella*
 gravid females see females
 Greece 392
 green gland see antennal gland
 green sunfish see *Lepomis cyanellus*
 Grenada 385
 grow-out 127–52, 478–80, 481, 493–6
 culture system intensity 154–6, 478
 extensive 154–5
 intensive 155–6

- grow-out (*Cont.*)
 semi-intensive 155, 160
 batch system 159, 160
 combination system 159–60
 continuous system 159
 economics *see* economics
 ecosystem *see* ponds
 environmentally controlled 252–3
 feeding *see* feeding
 feeds *see* feeds
 in geothermal waters 242, 394
 in ghers 127, 129–30, 137, 139, 140,
 155, 162, 169, 173, 206, 210,
 211, 348, 467
 integrated culture with crop
 production 155, 162, 173, 206,
 208–11, **209**, 210, 354, 371, 374,
 376, 466–7, 468, 478, 511
M. acanthurus 514–15
M. carcinus 513, 513
M. malcolmsonii 507
M. vollehovenii 511
 management/operation of ponds
 160–61
 monoculture
 in cages and pens 155, 156
 in ponds 154–73
 nutrition *see* nutrition
 operation 160–67
 polyculture 191, 195–211
 with finfish 196–7
 with other crustacea 197
 productivity 169–71, 170
 salinity *see* salinity
 site selection 128–34
see also ponds
 stocking rates *see* stocking/stocking
 rates/stocking density
 in temperate zones 182
 transport to 121–2
 growth 28–31
 compensatory 112, 316, 324
 curve 169, 169
 enhancement of OC males *see* leapfrog
 growth pattern
 grow-out 167–9, 169, 493–5, 494,
 495
 larval 76, 490–91
 patterns of 30–31
 promoters 228
 quantification of 331–2
 rate 323–4, 323, 326–8, 333, 334
 somatic 51, 167, 182, 318, 487
 suppression of runts 330–32
 variation in 327–31
 Guadeloupe 382
 Guam 395
 Guatemala 3, 380
- farmed production, freshwater
 crustaceans 6
- habitat 18, 487
 HACCP 262, 403, **405**
 haemilamella 22
 haemocyanin 23
 haemocytes 257, 258, 259, 260
 haemolymph 22, 32, 257
 Hairy river prawn *see* *Macrobrachium*
rude
- Haiti 385
 handling
 flavour, effect on 402–4
 post-harvest 400–416
 postlarvae 79–80, 79
 hapas 108, 113, 162, 360, 374, 477, 481
Haplochromis burtoni 331
 hardness *see* water, hardness
 harvest weight 182, 183–4, 189, **190**, 199,
 202, 203, 204, 462
- harvesting
 drain 166–7, *Plate* 6g
 efficiency 333
 grow-out animals 166–7, *Plates* 5d, 6a
 batch 180, 202, 333, 366, 379, 384,
 394, 395, 465, 468, 469
 selective 333–4, *Plates* 4b, 4c
 in temperate zones 185, *Plate* 6
 juveniles 119–20
 postlarvae 78–9
 seine 166
- hatchery 48–50, 49, 55–81, 347–50,
 352–3, 355, 357, 358, 362–5,
 367–9, 371–87, 389, 391–5, 477,
 489–92
 backyard 57, 80, 452–3
 commercial large scale 56–7
 daily operations 75–6, 75
 economics *see* economics
 flow-through 55–6, 58
 hygiene 67, 76
 maintenance 64
 management 67–76
 physical plant 57–9, 58
 recirculating
 backyard recirculating 80
 dynamic closed system 56–7, 56
 static closed system 56–7
 salinity requirements *see* salinity
 in temperate zones 181–2
 water distribution and drainage 59
 water quality for *see* water, quality
 water storage and preparation 67
- hatching 27
 groups, genetically distinguishable
 325
 time 325
- Hawaii 3, 68, 388–9
 Anuenu Fisheries Research Center 1
 marketing 422–3
 Hazard Analysis and Critical Control
 Point (HACCP) 262, 403, **405**
- health
 defence mechanisms 257–60, 258
 diagnosis of diseases 260–61
 diagnostic tools 261
 hygiene
 hatchery 67, 76
 personal 76
 management 76, 256–71, 480
 prophylaxis 261–2
 quarantine 262
 sanitation 76, 261–2, 403, 404
 therapeutics/therapeutants 251–2,
 262–3
- heart 22
 heavy metals 47, 64, 65, 66, 111, 245,
 403
see also under individual chemical names
- hepatopancreas 23, 219
 herbicides 163, 252
 heritability 289
 heterogenous individual growth (HIG)
 118, 120, 121, 331, 334, 335,
 462, 469, 493
- heteromorphosis 31
 high polarity immunoreactive products
 30
 high technology production 187–92
 combined technologies 189–91, **190**
 economics 191–2
 feeds and feeding 189
 pond preparation and stocking 187
 size grading 187
 substrate 187–9, 188
- highly unsaturated fatty acids HUFA *see*
 nutrition
- histidine 221
 history of freshwater prawn farming 1–9
 Holmenkollen Guidelines for Sustainable
 Aquaculture 524
- Homarus* 20
H. americanus 330
- Honduras 3, 381
- hormones
 androgenic 172, 291–2, 293, 298–9
 assay 299, 300–301
 cloning 302
 commercial production 302–3
 downregulating 303–4
 recombinant 302
 crustacean hyperglycaemic hormone
 (CHH) 28
 ecdysone 34
 20-hydroxyecdysone 30

- hyperglycaemic hormone (HGH) 28, 30
 juvenile 28, 30
 pheromones 197
see also physiology
- hotels *see* marketing
- HUFA *see* nutrition
- humoral 197, 257, 259
- hybridisation, intraspecific *see* genetics
- Hydrilla* 508
- hydrogen peroxide 50, 163, 249
- hydrogen sulphide (H₂S) 65, 251
- hydroxyproline 407
- hygiene *see* health
- hyperglycaemic hormone (HGH) *see* hormones
- hypochlorite *see* calcium hypochlorite; disinfection; sodium hypochlorite
- Hypophthalmichthys molitrix* 196, 200, 207, 348, 465, 466, 478, 508
 stocking density 205
- hypoxanthine 408
- Iceland 391–2
- Ictalurus punctatus* 197, 198, 465
- idiopathic muscle necrosis (IMN) 269
- immunoglobulins 257
- inbreeding 285–7
- income *see* economics
- incubation 48–50, 49
- India 1, 5, 63, 65, 352–8, *Plate* 5
 combined culture 160
 farmed production
M. malcolmsonii 502, 503, 504–9, 506, 508
M. rosenbergii 5, 6, 7, 7, 355, 356, 356, 357, 358, 359
 harvesting 167
 marketing 425
 monoculture 155
 nursery rearing 162
 rice-prawn farming 210, 354, 371, 376, 511
 transport conditions 161
- Indian carp rohu *see* *Labeo rohita*
- Indonesia 358–9
 egg-custard feed composition 99
 farm-made feeds 230
 farmed production, *M. rosenbergii* 5, 7
- inosine 408
- inosine monophosphate (IMP) 403, 408
- insecticides 113, 251
- insects 165
 control of 113, 165
- integrated culture *see* grow-out
- interactions
 between male morphotypes 318–19
 fish and prawn 196–7
- intermoult 28–9, 42, 43, 318, 409, 488
- introductions 2, 3, 7, 172, 262, 351–2, 385, 386, 393, 527
see also environmental protection
- investment *see* economics
- Iran 3, 7, 372
- iron (Fe) 65
- ischium 19
- isoleucine 221
- isosmotic point 32
- Israel 3, 231, 372
- Italy 3, 392
- Jamaica 3, 382–3
- Japan 3, 6, 372–3
- Java carp *see* *Puntius javanicus*
- Jordan 373
- jumpers 323, 324
- juveniles 323
 hatchery reared *see* hatchery
 nursed *see* nursery
 organically raised *Plate* 5c
 stocking rates *see* stocking/stocking rates/stocking density
 tolerance to chemicals 251
 wild caught 162
see also feeds; nutrition
- Kenya 391
- Kole* lands 210, 354, 468
- Kuncho river prawn *see* *Macrobrachium lamarrei lamarrei*
- Kuruma *see* *Penaeus japonicus*
- Kuttanad* fields 210, 354
- Labeo rohita* 196, 202, 204, 207, 508
- labour requirements 129, 449
- labyrinth 23
- lactic acid 407
- Lactobacillus* 96
L. acidophilus 228
L. sporogenes 228
- Lactococcus garvieae* 260, 266, 363, 364
- Lagenidium* 267, 267
- Lagenophrys* 268
- laggards 323, 324
- Lamellidens* 506
L. marginalis 528
- land preparation *see* ponds, land preparation
- larvae *Plates* 1, 6c
 clearwater systems 55–7, 63, 77–8, 96, 101, 112, 353, 358, 360, 362, 364, 365, 370, 373, 376, 378–87, 389, 390, 392, 393, 394
- collection 48–50
 condition index 70, 71
 development 32–4, 33, 477, 506
 enumeration 50, 68
 fatty acid composition 99–100
 feeding *see* feeding
 feeds *see* feeds; nutrition
 greenwater systems 55, 77, 112, 348, 360, 364, 370–71, 373, 384, 386, 388
 hatching systems *see* hatchery
 nutrition *see* nutrition
 packing and transport *see* postlarvae
 quality, *see also* larvae, condition index; larvae, tolerance to stress
 salinity requirements *see* salinity
 size 33
 stages/staging/stage index (LSI) 32–4, 69, *Plate* 1
 stocking *see* stocking/stocking rates/stocking density
 tank colour 60–61
 temperature requirements *see* water, temperature
 tolerance to chemicals 251
 tolerance to stress 75
 water quality requirements *see* water, quality
see also specific pathogen resistant stocks
- lead 65
- Leander squilla* 14
- leapfrog growth pattern 167
 growth enhancement of OC males 328–30, 329, 330
 significance of 331
- lecithin 222–3
- lectins 259
- legal regulations and responsibilities 129, 262–3, 432
- length frequency distribution 321
- length/weight relationships 25, 167
- lentic environment 156
- Lepomis cyanellus* 388
- leucine 221
- leucine aminopeptidase 219, 406
- Leucothrix* 266, 369
- levamisole 228
- life cycle 18, 19, 487
- light
 intensity 181
 quality 63
 requirements 63–4, 111
see also ultraviolet light
- lime 161, 267
 requirements 244
- liming 206, 242–4, 244, 248
- Ling, Shao-Wen 1, 2, 4

- linoleic acid (18:2 n-6) 51, 219
 linolenic acid (18:3 n-3) **95**, 219
 lipase 219
 lipid
 in *Artemia* 92
 enrichment 94, **95**
 oxidation 415–16
 requirement *see* nutrition
Litopenaeus
 L. stylirostris 290, 395
 L. vannamei 219, 226, 290, 293, 350,
 352, 365, 366, 374, 378, 401
 live feeds *see Artemia; Brachionus plicatilis; Moina micrura*
 live sales *see* marketing
Liza parsia 208
 loop mediated isothermal amplification
 261
 lotic environment 156
 low input production 185–7
 economics 186–7, 186
 fertilisation 186, **186**
 pond preparation/stocking 185–6
 luminescent bacteria *see* bacteria
Lyngbya 268
 lysine **93**, 96, 220, **221**, 229, 495

Macrobrachium 12–13
 M. acanthurus 12, 27, 31, 266, 377, 386,
 503, 513–15, 514
 grow-out 514–15
 larval development **506**
 seed production 514
 M. amazonicum 12, 77, 375, 377,
 485–97, 486
 biology 486–9
 broodstock 489
 grow-out 493–6
 habitat and life cycle 487
 hatchery 489–92
 larval development **506**
 morphology 487–8
 nursery 492–3
 physiology 488–9
 taxonomy and population structure
 486–7, 486
 M. americanum 12, 380, **503**, 515
 M. asperulum 281
 M. australiense 268, 285, **503**, 517
 M. birmanicum **503**, 515
 M. borelli 31
 M. carcinus 12, 31, 281, 377, 380, 383,
 384, 386, 429, **503**, 511–13, 512
 grow-out 513, 513
 larval development **506**
 M. choprai **503**
 M. dayanum **503**
 M. dux **503**
 M. equidens 33, 375, **503**, 515
 M. felicinum **503**, 510
 M. formosense 12, 281
 M. gangeticum **503**, 516
 larval development **506**
 M. hainanense 281, 352
 M. heterochirus 386, 515, 515
 M. idae **503**
 M. idella 375, **503**
 M. japonicus 403
 M. jelskii **503**
 M. kistensis **503**
 M. lamarrei 12, 268, **503**
 M. lamarrei lamarrei 515
 M. lanceifrons 12, 375
 M. lanchesteri 6, 12, 350, 369, **503**, 515,
 516
 M. lar 395, **503**, 515, 516
 M. macrobrachion **503**, 510, 515
 M. malcolmsonii 12, 47, 204, 268, 281,
 352, 355, 373, **503**, 504–9, 504
 farmed production **6**
 grow-out 507
 larval development **506**
 monoculture 507–8, 508
 polyculture 508–9
 seed production 505–7, **506**
 M. mammillodactylus 375
 M. mirabile 14, **503**
 M. nipponense 5, 80, 156, 224, 268, 281,
 285, 350, 475–83, 476
 farmed production **6**
 farming in China 476–80, 476
 farming in Vietnam 480–41
 larval development **506**
 M. nobilii 50, 268, **503**
 M. novaehollandiae 25
 M. ohione 12, 268
 M. olfersii 20, 22, 386, **503**, 515
 M. palaemonoides 14
 M. petersi 31
 M. rosenbergii 1, 12, 13
 biology 18–34
 farmed production **5**, 7
 genetic diversity 285, **286**
 geographic distribution 282–4, 283
 history of farming 13–14
 identity of 15–16
 initial introductions **3**
 larval development **506**
 see also various biological processes
 M. rosenbergii dacqueti 15, 16
 M. rosenbergii rosenbergii 15
 M. rosenbergii schenkeli 15, 16
 M. rude **503**, 515
 M. shokitae 281
 M. tenellum 515
 M. villosimanus **503**, 515
 M. vollenhovenii 12, 391, **503**, 509–11,
 510
Madhuca indica 353, 507
 magnesium carbonate 242
 magnesium (Mg) **65**
 magnesium oxide 242
Mahi mahi 428
 mahua oil cake 353, 507
 malachite green **250**, **251**
 malathion **250**, **251**
 Malawi 391
 Malaysia 360–62
 farmed production, *M. rosenbergii* **5**, 7
 Marine Fisheries Research Institute 1
 male morphotypes 316–21, 317, 322–4,
 323, 486–7, 486, *Plate 2a*
 blue claw (BC) males 25, 26, 42, 204,
 290, 316, 319, 331, *Plates 3, 5e*,
 6d
 bulls 321
 cinnamon claw (CC) males 486–7
 green claw (GC) males 486–7
 orange claw (OC) males 25, 42, 182,
 204, 295, 317, 318, 319, 320,
 328–30, 331, *Plates 3, 6b*
 runts 182, 316, 321
 small males 25, 316, 331–2, *Plate 3*
 strong orange claw males (SOC) 42,
 316–17, 318
 transforming orange claw males (TOC)
 317, 318
 translucent claw (TC) males 486–7
 weak orange claw males (WOC)
 316–17, 318
 see also heterogenous individual
 growth (HIG); monosex
 culture; sex reversal
Malva parviflora 219
 management
 best practice (BMP) 253, 403
 grow-out *see* grow-out
 hatchery *see* hatchery
 nursery *see* nursery
 in polyculture systems *see* grow-out
 in temperate zones *see* temperate zone
 culture
 see also monitoring
 mandibles 19, 20
 manganese (Mn) **65**
 manuals on freshwater prawn and fish
 farming 4, 128
 manures *see* fertilisers/fertilisation
 marine shrimp *see Farfantepenaeus; Fenneropenaeus; Litopenaeus; Marsupenaeus; Metapenaeus; Penaeus*
 mark-time moulting 33
 market prices *see* value

- market research 420, 422, 423, 435
marketable product, seasonal availability of 180
marketing 192, 192, 420–46, 449–50, 480, 482
 case studies 421–6, 438–40
 domestic 420, 426, 428
 export 420, 422, 425, 426
 farm-gate 192, 427–9, *Plate 6a*
 festivals 431–4, 433
 fresh on ice 429–30, 429
 frozen 430–31
 general advice 436
 head-off 421, 424, 426, 429, *Plate 5g*
 head-on whole 404, 405, 420, 421, 424, 425, 429, *Plate 5f*
 live 416, 427
 organic/natural product markets 437
 plans 437–8
 strategy 434–5
 to restaurants and hotels 435–6
 to retail outlets 192, 192, 431, 435–6
- Marsupenaeus*
 M. japonicus 101, 220, 264, 373
Martinique 3, 383–4, 383
mating 25–6
 pre-mating moult 1, 25, 26, 319
 sneak 317, 320, 331
mating behaviour 26, 319–21
maturation 26–8, 31, 44, 488
Mauritius 3, 389–90
maxillae
 first 19, 20
 second 19, 20
maxillipeds 19
maxillulae *see* maxillae, first
meat and bone meal (MBM) 226
mechanoreceptors 20
melanin 259, 265, 265
Melicertus laticulcatus 21
mercury (Hg) 251
Merthiolate 267, 269
merus 19, 20
metabolism 27, 28, 90, 222, 223, 240
 see also protein metabolism
metamorphosis 18, 72, 76–7, 96–7, 97, 98–101, 220, 323–5, 323, 373, 490–92
 larvae to postlarvae 220
 of male morphotypes 316–17
 moult mortality syndrome *see* exuvia entrapment disease
metanauplii 91
Metapenaeus 1
 M. dobsonii 99
methionine 92, 93, 94, 96, 220, 221, 229
methyl farnesoate (MF) 28, 30
methyl-parathion 251
- Metschnikowia bicuspidata* 267, 363
Mexico 3, 6, 385–6
micro-encapsulated diets (MED) *see* feeds, hatchery, inert
microbial
 contamination 409
 count 408
Micrococcus 408
Micronesia 396
mid-cycle disease (MCD) 269–70
milkfish *see* *Chanos chanos*
mineral
 fertilisation 244–5
 requirement *see* nutrition
Mirex 251
MMV 263
Moina micrura 86, 98
 ingestion rate 102
mola carplet *see* *Amblypharyngodon mola*
Monitar 251
monitoring
 in grow-out ponds 163–4
 in hatcheries 67, 72, 75
monk *see* ponds, outlets
Monkey river prawn *see* *Macrobrachium* lar
monoclonal antibodies 261
monoculture 154–73
 environmental protection 172–3
 growth and survival 167–9
 M. malcolmsonii 507–8, 508
 operation 160–67
 production models and productivity 169–71
 rearing systems 154–60
monosex culture 171–2, 171, 278, 290–306, 337–8
 see also sex reversal
monounsaturated fatty acids *see* nutrition
Monsoon river prawn *see* *Macrobrachium malcolmsonii*
morphology 18–25, 487–8
 external 18–21
 internal 21–5
mortality *see* survival
mosquito fish *see* *Gambusia*
Mossambica tilapia *see* *Oreochromis mossambicus*
moult
 death syndrome (MDS) *see* exuvia entrapment disease
 inhibiting hormone (MIH) 27, 30, 34
 mark-time moulting 33
 pre-mating *see* mating behaviour
 stress 122
 see also ecdysis
moult cycle 28–31
 in zoea 34
- moult death syndrome (MDS) *see* exuvia entrapment disease
moult hormone 27
Mozambique 391
mrigal *see* *Cirrhinus mrigala*
MrNV 42, 261, 264, 353
mullet *see* *Liza parsia*
multiplex RT-PCR 261
mushiness *see* texture
Myanmar 362–3
myofibrillar protein degradation *see* texture
Mysidopsis bahia 92
Mystus planiceps 166
- n-3 fatty acids *see* nutrition
n-6 fatty acids *see* nutrition
Namibia 39
nauplii 55, 58–60, 64, 73–5, 77, 80, 86, 88–93, 93, 95, 96–9, 101–3, 219, 348, 353, 360, 362, 364, 370–71, 373, 376, 381, 386, 387, 392, 506, 512, 514
necrosis 69, 71, 119, 256, 260, 263, 265, 266, 267, 269
nekton 157
nematodes 73, 218, 303, 333
neofemales 44, 291, 292, 326
neomales 44, 291–2, 293, 295, 296
Nepal 3, 373, 375
nephridial canal 23
nervous system 24–5, 24
nets
 for fishing *see* fishing gears
 seine *see* seine nets/seining
neuston 157
New Caledonia 395
New Zealand 3, 394–5, 394
niacin 93
Nicaragua 381
nifurpirinol 266
Nigeria 391
Nile tilapia *see* *Oreochromis niloticus*
Nitosomonas 61
nitrate (NO₃) 47, 61, 62, 65, 66, 72, 73, 73, 111, 241, 242, 243, 246, 248, 249, 490, 497
nitrifying bacteria *see* bacteria
nitrite (NO₂) 47, 56, 61, 62, 65, 72–3, 75, 111, 131, 239, 240–42, 240, 246, 260, 392, 490, 496, 497
 tolerance to 73
Nitrobacter 61
Nitrococcus 61
nitrofurazone 251
nitrogen excretion 24
Nitrosococcus 61
Nitrospora 61

- nodavirus 42, 261, 264, 353
 nomenclature 13–14
 non-protein nitrogen *see* flavour
 North America 385–9
Notonecta 113
 nucleotides 264, 282, 303, 401, 402, 403, 408
 nursery 55, 108–22, 138, 144, 160–62, 171, 180–83, 187, 209, 220, 226, 231, 241, 251, 264–5, 332, 334, 335, 348, 353–5, 358, 360, 362, 364, 365, 367, 370, 371, 373, 375–7, 379–82, 384, 386–7, 389, 392–4, 454, 477–8, 492–3
 in cages 109–10
 culture systems 110–11, 110
 facilities 110–11, 110
 indoor (primary) 108–9, 109
 management 108–22
 multi-phase multi-stage 110
 outdoor (secondary) 109, 109
 production 458–9
 in temperate zones 181–2
 water quality 111–13
 nutrition 218–32
 adult 224
 amino acids
 enrichment 94, 96
 essential (EAA) 92, 96, 219, 220, 221, 224, 232
 profile 92, 93
 see also names of individual amino acids
 binders 225
 broodstock 224
 carbohydrates 223
 cholesterol 221–3
 energy 219–20, 221–3, 224
 enzymes 92
 fatty acids
 essential (EFA) 59, 92, 94, 96, 221, 222
 HUFA 51, 93, 95, 96, 100, 222, 224
 n-3 series 51, 75, 92, 95, 100, 219
 n-6 series 95, 219
 PUFA 222
 see also individual fatty acids
 fibre 223
 grow-out 224–31
 juvenile 220–24
 larval 86–106, 219–20
 lipid requirement 221–3
 mineral requirements 92, 223–4
 see also nutrition, relationship with water hardness
 phospholipids 221–3
 protein requirements 220–21, 221
 protein/energy (P:E) ratio 221
 relationship with water hardness 224
 sterols 222
 synthesis 222
 triglyceride 221–3
 vitamin requirements 92–3, 93, 223–4
 see also individual vitamins
 see also feed conversion ratio (FCR); feeds; feeding
 nutritional physiology *see* digestive physiology
 nutritional requirements *see* nutrition
 OC males *see* male morphotypes
 Oceania 393–6
 odour 408
 of deterioration 409
Oedogonium 268
 oesophagus 23
 oleic acid 18:1 222
 oligochaetes 117, 218, 333
Oncorhynchus mykiss 181
 ontogeny 323–5, 323
 oocytes 28, 44, 488
 oogenesis 28
Opercularia 268
Ophiocephalus
 O. micropeltes 166
 O. striatus 166
 opportunities 8
 orange claw males *see* male morphotypes
 orbit *see* eyes
Orchestia gammarella 291, 326
Oreochromis 200, 252, 389
 O. aureus 200, 205, 465
 O. hornorum 198, 200, 205
 O. mossambicus 196, 200, 386, 402
 O. niloticus 117, 191, 348, 380, 386, 390, 465
 polyculture 181, 191, 195, 196, 198, 200, 203, 208
 stocking density 205
 organ of Bellonci 25
 organic
 farming *Plate* 5
 fertilisers *see* fertilisers/fertilisation, organic manures
 iodine 250
 markets 437
 matter, in soils *see* soil, organic matter
 silver 250
 organoleptic 403, 408, 416
 Oriental river prawn *see* *Macrobrachium nipponense*
 osmo-ionic regulation (osmoregulation) 31–2
 ovalbumin 101
 ovarian stages 27–8
 ovaries 24
 overwintering 40
 oviducts 24, 24, 296
 ovigerous *see* females
 oxidants *see* soil
 oxidation-reduction *see* soil
 oxolinic acid 265
 oxygen *see* dissolved oxygen
 oxytetracycline 267
 ozone 261
 Pacific blue shrimp *see* *Litopenaeus stylirostris*
 packing *see* postlarvae, packing and transport
 pacu *see* *Colossoma mitrei*
 Painted river prawn *see* *Macrobrachium carcinus*
 Pakistan 373, 375
Palaemon
 P. adspersus 14
 P. carcinus 15
 P. rosenbergii 13, 14, 15
Palaemonetes 33
 palatability *see* feeds
 Palau 396
 palp 20
 Panama 3, 381
Pandalus 414
 pantothenic acid 93
Panulirus cygnus 26
 papaya *see* *Carica papaya*
 Papua New Guinea 396
Paragonimus westermani 268
 Paraguay 3, 379
 parasites 268
Pasteurella 76
 PCR *see* polymerase chain reaction
 peduncle 15, 19, 20
 pelecypods 218
 pen culture 155
 penaeids 21, 21
 see also marine shrimp
Penaeus 1
 P. chinensis 290
 P. duorarum 21
 P. japonicus 290
 P. latisulcatus 21
 P. monodon 202, 208, 210, 220, 260, 264, 290, 348, 353, 365, 421
 People's Republic of China *see* China
 pepsin 219
Perca flavescens 181
 pereopods 19
 periphyton 202–3
 peritrichous ciliates 268
 peroxide *see* hydrogen peroxide
Persea americana 208
 Peru 379

- pesticides 64, 66, 111, 113, 210, 211, 252, 269, 353, 383, 384, 403, 404, 477, 478
- pH 24, 43, 47, 65, 89, 90, 191, 196, 198, 209, 242, 243, 496, 497, 506
- grow-out 133, 134, 157, 162–3, 168, 239, 241–4, 243, 244, 247, 248, 250, 252, 260, 266, 353, 366, 407, 479, 481
- hatchery 55, 62, 64, 65, 68, 72–3, 490
- nursery 112–13, 492
- Phaeodactylum tricornutum* 103
- phagocytosis 257, 259
- phagostimulant 227
- phenylalanine 221
- Philippines 3, 66, 373–4, 375
- phosphatidylcholine (PC) 222
- phospholipids *see* nutrition
- phosphorus (P) 66, 224, 241, 241, 243, 244, 245, 246, 248, 250, 251, 253, 527
- photoperiod 46–7, 63–4
- physiology, *see also* digestive physiology
- phytoplankton 55, 157, 207, 220
- bloom 55, 250
- control of 252–3
- phytosterol 222
- Pila globosa* 348, 508, 528
- piscicides 250, 250, 509
- Pistia stratiotis* 496
- PL *see* postlarvae
- plankton 127
- plankton-feeding fish 252
- plans
- business *see* business planning and management
- marketing *see* marketing
- plasma 257
- pleopods 20
- plcura 21, 25
- Podophrya* 268
- pollutants 172–3
- see also* heavy metals
- pollution 172–3
- polyculture 181, 191, 195–211, 218, 230, 252, 321, 328, 333, 348, 350–51, 354, 362–3, 366, 383–4, 386–7, 389–90, 392, 464–8, 478, 505, 507–11, 514, 526
- feed 199
- fish and prawn interactions 196–7
- integration with crop production 155, 163, 167, 173, 206, 208–11, 209, 209, 210, 354, 371, 373, 375–8, 380–81, 466–7, 468, 478, 511
- M. malcolmsonii* 508–9
- profitability 206–8
- rotation 205–6
- stocking 200–205, 205
- water quality 198–9
- polymerase chain reaction (PCR) 261
- multiplex 261
- reverse transcriptase (RT-PCR) 261
- polysaccharides *see* nutrition
- polyunsaturated fatty acids PUFA *see* nutrition
- ponds
- bottom management 247–50
- see also* soil, sediment management
- construction 139–52, 145
- dimensions 139–41, 140
- discharge channels 147–51, 148–52
- diversion/derivation 127
- ecosystem 156–9, 157–9
- embankment 127
- environmental issues 253
- grow-out 128–34
- infrastructure 138
- inlets 146, 146
- interception 127
- land preparation 141–3, 142, 143, 249, 478
- landscaping 152
- layout 137–8
- management, production and operation *see* grow-out
- nursery 144
- outlets 147–51, 148–52
- sediments *see* soil
- site development 134–9
- site selection 128–34
- site topography 129–30
- water supply *see* water, supplies
- see also* farm design; soil
- population density 168–9
- effective population size 288, 288
- population structure 486–7
- Porcellio*
- P. dilatatus* 300
- P. scaber* 300
- postlarvae (PL)
- cost of *see* value
- harvesting 78–9
- packing and transport 79–80, 79
- quality 77
- stocking rates *see* stocking
- postmoult 26, 29, 30, 318, 409, 488
- potassium cyanide 250
- potassium (K) 32, 65
- potassium permanganate 250, 251
- potassium ricinoleate 252
- power supplies 151
- ppA (pro PO-activating enzyme) 258, 259
- predation 108, 113, 165, 166, 169, 172, 196, 209, 218, 224, 225, 360, 369, 371, 379–80, 385, 386, 388, 480, 510, 527
- predator control/elimination 113, 164–6, 165, 166, 250–51, 251
- premoult 29
- preparing for consumption 440–46
- see also* recipes
- prices *see* value
- probiotics 228
- Probopyrus* 268
- Procambarus clarkii* 181, 196, 205, 465
- processing and storage *Plate* 5fg
- blanching 409
- canning 414
- cooling 410
- deheading, effect of 409
- flavour, effect on 402–4
- freeze drying 415, 416
- freezing 410–16, 411–13, 415
- blast 409
- cryogenic 411
- effect of 414–16
- fast air circulation 411
- immersion 409–10, 411
- individual quick (IQF) 413
- industrial scale 414
- liquid nitrogen 409
- plate/contact 411
- fresh chilled on ice 406
- post mortem* changes 407–9
- practical processing on-farm 416
- shelf life 408–9
- spoilage 408
- thermal shock 409–10
- see also* cooking; recipes
- production 5, 493–5, 494, 495
- global *see* status
- hatchery efficiency 77–8, 78, 97
- models 169–71, 170
- national *see* status
- productivity 400–401, 401, 490–91
- grow-out *see* grow-out, productivity
- hatchery 66, 78, 79, 80
- unit *see* biomass curve
- profitability *see* economics
- proline 93, 101, 401, 480
- prophenoloxidase (proPro) system 259
- propodus 19
- protein metabolism 24
- protein requirement of feeds *see* feeds; nutrition
- protein/energy ratio (P:E ratio) *see* nutrition
- protozoa 42, 268
- proventriculus 23
- Pseudomonas* 76, 265, 266, 408

- Puerto Rico 3, 384–5
 marketing 423
 multi-stage nursery systems 110
- PUFA *see* nutrition
- Puntius javanicus* 208
- putrescine 228
- pyridoxine 223
- quality
 larval *see* larvae
 postlarval *see* postlarvae
- quarantine 262
- quicklime 161
- quinones 259
- r-strategists 163
- rainbow trout *see* *Oncorhynchus mykiss*
- recipes 441–6
 microwave 446
 traditional 441–6, *Plate 8*
- red claw crayfish *see* *Cherax quadricarinatus*
- red swamp crawfish *see* *Procambarus clarkii*
- regeneration *see* autotomy
- regurgitation 219
- reproduction 25–8
 physiology of 27–8
 sexual dimorphism 25, 291, 294, *Plate 2*
- reproductive behaviour *see* mating behaviour
- reproductive system 24, 24, 295
- Republic of China *see* Taiwan
- respiration 72, 73, 113, 158, 159, 198, 240, 246–7
- respiratory system 22–3, 22
- restaurants *see* marketing
- retail outlets *see* marketing
- Réunion 391
- reverse transcriptase polymerase chain reaction (RT-PCR) 261
- riboflavin 93
- rice/prawn aquaculture *see* grow-out, integrated culture with crop production
- Riceland prawn *see* *Macrobrachium lanchesteri*
- rickettsial disease 266–7
- rigor mortis* *see* processing and storage
- RNA dependent polymerase (RdRp) 263
- rohu *see* *Labeo rohita*
- rostrum 12, 14, 15, 19
- rotational strategy *see* crop rotation
- rotenone 180, 250, 250
- Rough river prawn *see* *Macrobrachium equidens*
- runts *see* male morphotypes
- Ruppia maritima* 80
- Russian Federation 6, 392
- Saccharomyces cerevisiae* 96, 228
- Saccharum officinarum* 228
- St Kitts 385
- St Lucia 385
- St Vincent 385
- salinity 18, 23, 30, 32, 260, 266, 269, 365, 371, 374, 390, 475, 477, 479, 490, 506–7, 509, 512, 514
 broodstock 47, 50
 effect on flavour *see* flavour
 grow-out 111, 122, 130–31, 136, 163, 207, 209
 hatchery 59–60, 62, 64–8, 72, 78, 90, 96, 98
- salt 66
- Samoa 396
- saponin 251
- Saprolegnia* 267
- Sardinella longiceps* 220
- sardines *see* *Sardinella longiceps*
- Saudi Arabia 374
- scampi 421
- scaphocerite 19
- scaphognathite 20, 23
- screens, *see also* filters
- seawater 8, 55, 59, 63–5, 90–92, 94, 353, 360, 363, 373, 388, 402, 409, 504, 506, 507
 artificial 47, 48, 55, 58, 66–7, 67
 natural 58, 66
- Secchi disk visibility 245
- sediment management *see* soil, sediment management/removal
- seine nets/seining 166, 185
- selective harvesting *see* harvesting, grow-out animals, selective
- Senegal 3, 391
- sensory cells 25
- sensory evaluation 403, 415
- serine 93, 401
- sex determination 171, 292, 296–8, 297, 298
 molecular sexing 301, 301
- sex ratio 321–2
- sex reversal 278, 290–306, 337–8
see also monosex culture
- sexual
 differentiation 325–7, 326
 dimorphism *see* reproduction hormones 291–2
- shelf life *see* processing and storage
- shelters *see* substrate
- Sherpa 251
- Sierra Leone 391
- silicon 65
- silver barb *see* *Barbodes gonionotus*
- silver carp *see* *Hypophthalmichthys molitrix*
- Simaroubaceae *see* *Ailanthus altissima*
- simazine 252
- Singapore 3, 374
- site selection *see* hatchery; ponds size
 distribution 280, 321, 321
 in fisheries 321
 grading 120–21, 120, 121, 183–4, 187, 331–2, 334–8, 334–7, *Plate 7a,b*
 variation 118, 280, 316–38
 biological significance 331–2
 commercial significance 332–8
 development 323–5
 significance 331–2
 social control 328–31
see also heterogenous individual growth (HIG)
- SM *see* male morphotypes, small males
- small males *see* male morphotypes, small males
- smell *see* odour
- snails *see* *Pila globosa*
- snakehead fish *see* *Ophiocephalus*
- snakeskin gourami *see* *Trichogaster pectoralis*
- SOC *see* male morphotypes
- social behaviour 156, 168, 316
- social control *see* size, variation
- sodium bicarbonate 72
- sodium carbonate 72
- sodium carbonate peroxide 163
- sodium hypochlorite 250
- sodium (Na) 65
- sodium pentachlorophenate 250
- sodium tripolyphosphate (STPP) 415
- soft shells 113, 205, 332, 371
- soil 133–4, 134, 239–53
 drying 248
 evaluation 247–8
 nutrients 246
 organic matter 246–7
 oxidants 248–9
 oxidation-reduction 246–7
 respiration 246–7
 sediment management/removal 247
 soil-water exchange 246
see also ponds, site selection
- Solomon Islands 396
- somite 21
- South Africa 391
- South America 375–9
see also individual countries
- soy lecithin *see* lecithin

- soybean protein 226
Sparus aurata 228
 spawning *see* females
 spawning system *see* females
 specific dynamic action (SDA) 223
 specific pathogen resistant (SPR) stocks
 270
 sperm 24, 26, 42, 44, 47, 48, 317, 318, 321,
 506–7
 spermatogenesis 317
 spermatophores 24, 26
 spermatozoa 26–7
 spines 19
 spinules 20
Spirulina 117
 SPR stocks *see* specific pathogen resistant
 (SPR) stocks
 Sri Lanka 374, 375
 staffing *see* labour requirements
 staging of larvae *see* larvae
Staphylococcus
S. aureus 408
S. xylosus 266
 statistics
 production from capture fisheries *see*
 fisheries, statistical information
 production through aquaculture *see*
 status
 statocyst 20
 status
 of commercial prawn farming
 nationally 346–96
 of global freshwater prawn culture 5–8,
 5, 6, 7, 7, 8
 total volume and value 8
 stearic acid 18:0
 sterols *see* nutrition, sterols
 stocking/stocking rates/stocking density
 46, 490–91
 grow-out 479, 493–5, 494, 495
 in monoculture 161–2
 in polyculture 200–205, 205
 high technology production 187
 larvae 68–9
 low input production 185–6
 nursery 113–17, 114, 115–16
 in temperate zones 182, 185–6
 stomach 23, 24
 stomach contents 196–7
 storage of prawns *see* processing and
 storage
 strong orange claw males *see* male
 morphotypes
 substrate 113, 117, 122, 155, 160–62,
 187–9, 188, 203, 332–3,
 337, 373, 376, 387, 388,
 392
 activated 62
 artificial, for nursery and grow-out
 ponds 109, 113–14, 117, 170,
 182, 184, 184, 187–8, 203, *Plate*
 7a,c,d
 materials 188
 supplementary 332–3
 sumithion 251
 Suriname 3, 379
 survival
 breakpoint 119
 broodstock 41–8
 grow-out 167–9, 169
 larval 55, 57, 60, 63, 65, 68, 77
 nursery 108–111, 112, 113, 115, 116,
 118–19
 in polyculture 197, 200, 202–6
 sustainability 524–8
 ancillary benefits of freshwater prawn
 farming 528
 areas of concern 527–8
 environmental and social benefits of
 freshwater prawn farming
 525–7
 FAO Code of Conduct for Responsible
 Fisheries 524, 528
 Holmenkollen Guidelines for
 Sustainable Aquaculture 524
 Sweden 392
 swimmerets *see* pleopods
Tachaea spongillicola 268
 tail fan 20, 21
 Taiwan 1, 3, 63, 363–4
 farmed production, *M. rosenbergii* 5, 7,
 7
 marketing 426
 tanks 59–61, 59, 60
 broodstock *see* broodstock, culture
 systems
 cleaning *see* hatchery, management
 colour of *see* larvae
 grading 120–21, 121
 hatchery *see* hatchery
 nursery *see* nursery, culture systems
 sedimentation 63
 Tanzania 391
 taurine 101, 227
 taxonomy 14–16, 486–7
Tectoma grandis sawdust 43
 teeth, ventral and dorsal 19
 telson 14, 15, 20, 21
 temperate zone culture 180–93
 broodstock 181
 grow-out 182
 growth maximisation 183–4, 184
 harvesting 185
 hatchery/nursery phases 181–2
 high technology 187–92
 low input approach 185–7
 marketing 192
 opportunities 181, 181
 population structure 182–3, 183
 problems 180–81
 temperature *see* water, temperature
 testes 24, 317
 tetracycline 251
 texture 404–7
 enzymatic action 406
 mushiness 167, 404, 406
 myofibrillar protein degradation 406
 sheer force 415
 Thailand 1, 41, 65, 66, 68, 364–9, *Plate 4*
 egg-custard feed composition 99
 Expansion of Freshwater Prawn
 Farming project 2–4, 524,
 528
 farm-made feeds 230, 231
 farmed production 5, 7, 7, 367, 368,
 369
 feed specifications 227
 harvesting of postlarvae 78–9
 marketing 426
 monoculture 155
 therapeutics *see* health,
 therapeutics/therapeutants
 thiamine 93
 thorax 18–19
 threonine 221
 tilapia 206
 genetically improved farmed (GIFT)
 203
see also Oreochromis
 tilling (ploughing) 249
see also ponds, land preparation
 TOC *see* male morphotypes
Tokophrya 268
 tolerance to chemicals *see* larvae
 topography *see* ponds
Torulopsis 228
 total haemocyte count (THC) 260
 transforming orange claw males *see* male
 morphotypes
 transport 42–3
 broodstock *see* broodstock
 larvae/postlarvae *see* postlarvae,
 packing and transport
 market-sized animals live 416
 to grow-out ponds 121–2, 161–2
 traps *see* fishing gears
 trays, feeding *see* feeding
 trichlorfon 113
Trichogaster pectoralis 201
 trifluralin 267
 triglycerides 221–3
 trimethylamine 227, 402
 Trinidad & Tobago 385

- trophic 75, 157, 158
 autotrophic 156, 231
 heterotrophic 60, 75, 156, 185, 199,
 231, 295
- trophic level 157, 158, 165, 514
- trypsin 259
see also nutrition, enzymes
- tryptophan **221**
- Uganda 391
- Ukraine 392
- ultraviolet light (UV) 61, 63
- United Kingdom (UK) **3, 4, 349, 354, 368**
- United States of America (USA) **3, 387–9,**
Plates 6, 7
 farmed production, *M. rosenbergii* **5, 7**
 Hawaii *see* Hawaii
 high technology production 187–92
 low input production 185–7
 marketing 423–5, **423**, 431–4
 nursery feeding 118
- urine 23, 32
- uropods 21
- Uruguay **3, 379**
- Vaginicola* 268
- valine **221**
- value 1, 6, 346–96
 of the industry *see* status
 of market-sized animals
 farm-gate 425, 480, 509, 511
 retail 186, 431
 wholesale 186, 187, 377, 425, 428,
 460, 461, 463, 469
 of postlarvae (PL) 349, 350–51, 354,
 355, 357, **358**, 361, 364, 369,
369, 371, 375, 388–9, 395, 427
- Vanuatu 395
- variation, intraspecific 278, 279, 280–81
- vas deferens 24, 295, 317
- vegetable-prawn culture *see* grow-out,
 integrated culture with crop
 production
- Venezuela 379
- ventral nerve cord 24, 25
- Vibrio* 76, 89, 265, 266, 365
V. alginolyticus 266
V. carchariae 266
V. cholerae 266
V. harveyi 266
V. mimicus 266
- vibriosis 266
- Vietnam 41, 209–10, 370–71, 370
 farmed production 7
M. rosenbergii **5, 7**
 integrated culture *see* grow-out,
 integrated culture with crop
 production
M. nipponense farming 480–81
 pen culture 155
Villorita cyprinoides 354
- viruses *see* disease, viral; and individual
 virus names
- vitamins 51
 dietary requirements of prawns *see*
 nutrition
 enrichment 96
 leaching 223
- vitamin A 96
- vitamin B₆ **93**
- vitamin B₁₂ **93**
- vitamin C 92, **93**, 96, 224
- vitamin E 93, 96
- vitellogenin 28, 44
- Vorticella* 42, 268, 364, 381
- waste treatment 151
- water
 chemical characteristics for hatcheries
see water, quality
 effluent 495, **497**
 exchange 164, 253
 hatcheries *see* backyard hatcheries;
 hatchery, flow-through;
 hatchery, recirculating
 ponds *see* grow-out,
 management/operation of
 ponds
 fresh *see* freshwater
 hardness **65, 242**
 relationship with dietary calcium *see*
 nutrition
 natural seawater 66
 quality 490
 for broodstock 64–5, **65**
 control of 242–6
 for grow-out 65, 133, 198–9, 239–53,
 495–6, **496**
 for larvae 69, 72–3
 for nurseries 112–13
see also ammonia; dissolved oxygen;
 nitrite; nitrate; larvae, tolerance
 to chemicals; pH; etc.
- replacement *see* water, exchange
- salt *see* seawater
 sea *see* seawater
 stability of feeds *see* feeds, grow-out
 supplies
 development of 135–7, 137
 for grow-out 130–33, 131, **132**,
 144–7
 for hatcheries 59
 temperature **65**, 240–41
 broodstock 46
 control of 168
 grow-out 130, 168
 hatchery 90
 larval 72
 nursery 111–12
 and population structure 182–3,
 183
 transparency 164, **242**
 transportation 65
 treatment *see* hatchery, water storage
 and preparation
see also dissolved oxygen; pH
 water hyacinth *see* *Eichhornia crassipes*
 weak orange claw males *see* male
 morphotypes
 weeds 163
 white muscle disease (WMD) 42, 256,
 263–4, 351
 white spot diseases (WSBV, WSSV) 264
 white tail disease *see* white muscle disease
 whiteleg shrimp *see* *Litopenaeus vannamei*
 whitish disease 256
 WOC *see* male morphotypes
 World Aquaculture Society 1
- x-organ sinus gland (XOSG) 27, 28
 XSV *see* extra small virus
- Y organ 30
 yeast infections *see* disease, fungal
 yellow head virus 265
 yellow perch *see* *Perca flavescens*
 yield
 of ponds *see* productivity
 of tail meat 293, 400
- Zimbabwe 391
- zinc (Zn) **65, 224, 251**
- zoa 27, 31, 32
 moult cycle 34
- zooplankton 157
- Zoothamnium* 42, 268, 365