FishBase, A DATABASE WITH KEY INFORMATION ON CORAL REEF FISHES

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ABSTRACT

FishBase is a biological database with key information- on more than 15,000 finfishes, including most coral reef species. In addition to current nomenclature, FishBase contains information on, e.g., maximum size and age, growth, length-weight relationship, reproduction, diet, predators, occurrence, preferred habitats and depth ranges. Most reef fishes are represented by color photos, and a Quick Identification routine based on dorsal and anal fin ray counts helps with identification. A FishWatcher module lets users create their personal or institutional database on fish encounters while maintaining a link to the full information in FishBase. A National Checklist module lets users create a fish biodiversity database for their country, through which they can keep track of distributional ranges within the country, existing regulations, common uses, etc.; again, all related information in FishBase is just a mouse-click away. The FishWatcher and the National Checklist modules can also be used to contribute information to the global version of the database. FishBase is developed and maintained by the International Center for Living Aquatic Resources Management (ICLARM), in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and many other partners, with support from the European Commission (EC). FishBase is available on CD-ROM for US$95. It is based on the Microsoft Access relational database and runs under windows on personal computers with at least 8 megabytes of RAM.

INTRODUCTION

FishBase, a large biological database on the biology of 15,000 finfish (McCall and May 1995; Froese and Pauly 1996), currently includes 2,576 species of, reef-associated, fishes, i.e., marine fishes that spend all or part of their life among or around rocks in 0-100 m depth. This number is fairly close to the total number of reef fishes, which may lie somewhere between 2,700 and 3,000 species. The data assembled in FishBase on various aspects of fish biology may thus be used to derive some generalizations on the biology of reef fishes.

Phylogeny

Reef-associated fishes can be found in 25 of 48 orders of marine fishes, from sharks and rays (about 50 species) through several orders of primitive bony fish (about 20 species) to morays (about 100 species), scorpion fishes (about 80 species) to the highly derived flatfishes (about 10 species), puffers and filefishes (about 100 species). However, four in five reef fishes (about 2,000 species) are perch-like fishes, i.e., members of the large, modern order Perciformes. The 6 families with the most reef fishes in FishBase are damselfishes (Pomacentridae, 307), groupers and fairy basslets (Serranidae, 212), wrasses (Labridae, 201), gobies (Gobiidae, 148), cardinalfishes (Apogonidae, 129) and butterflyfishes (Chaetodontidae, 109), all Perciformes.

Geographic Range

While the FishBase definition of "reef-associated" fishes includes cold water species such as wrasses in Norwegian fjords, the vast majority occur in tropical waters. The center of biodiversity is the Western Central Pacific with more than 1,500 species, followed by the Western and Eastern Indian Ocean with about 1,000 species each, the Hawaiian Archipelago with 340 species, ' the Western Central Atlantic with about 400 species and the Eastern Central Atlantic with about 100 species only.

Environment

Most reef fishes are non-migratory and spend except for their usually planktonic larval stage all of their life in or around reefs. Oceanic species, that visit reefs include a few sharks and rays as well as some tunas and needlefishes (Belonidae). Most reef fishes are strictly marine; only about 140 species are reported to enter brackish waters and only 30 species enter freshwater, usually as juveniles. The preferred depth of reef fishes range from rock pools and the immediate shoreline to depths well below 200 m. The number of species declines with depth, with highest species richness between 1-10 meters. About 60 species never go deeper than 5 meters (Fig. 1).

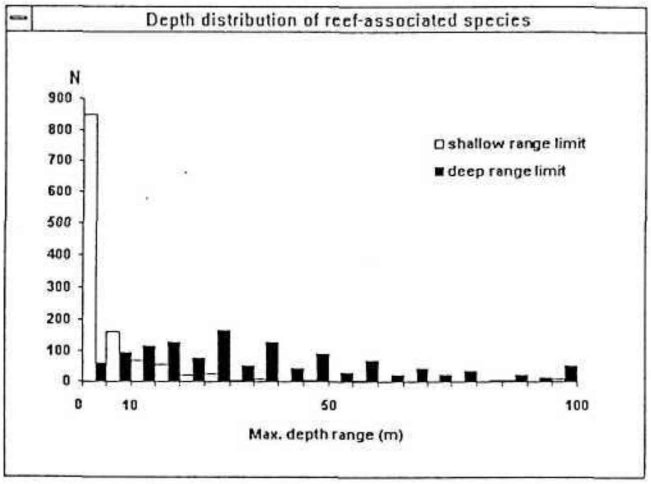

Fig. 1: Depth distribution of reef-associated fishes. Note that most species have their shallow range limit between 0-5 m, and about 60 species are restricted to this depth.

Size and Age

The largest fishes known to regularly visit coral reefs are the tiger shark (*Galeocerdo cuvier)* with 6.5 m total length and more than 800 kg, and the manta ray *(Manta birostris)* with a maximum reported width of 7 m and weight of about 1.6 tonnes. The smallest reef fish is the goby *Lythrypnus okapia* with a maximum standard length of 11 mm. Most reef fishes reach lengths of only 5-15 cm, a distribution clearly skewed towards small size but not markedly different from the overall size distribution of fish (Fig. 2). The predominance of small-size probably reflects the fact that access to reef habitats such as crevices and caves decreases with size (Caddy and Stamatopoulos 1990). Such access is essential in avoiding predators or finding prey.

Longevity of reef fishes follows the general rule that large fish live longer than small fish. However, quite a number of reef fishes seem to live longer than suggested by their size (Fig. 3), or rather to reduce growth once they approach the maximum size suitable for their particular niche. Morays appear to prefer to grow in length rather than in thickness, as is shown by the exponent of their length-weight relationship (b) lying between 2.57 and 2.87 for four out of five species for which data are available, i.e., well below b=3.0 which would indicate isometric growth.

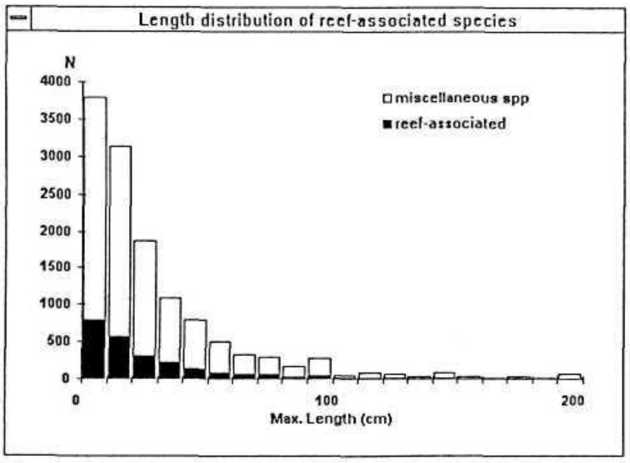

Fig. 2: Size distribution of reef fishes and miscellaneous fishes.

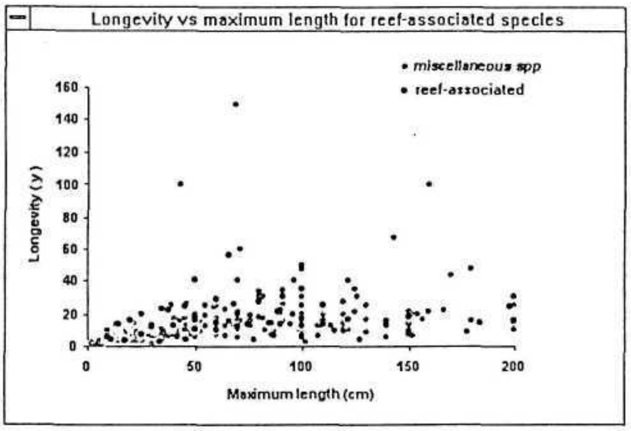

Fig. 3: Longevity vs maximum length in reef-associated fishes (dark dots) and all fishes (pale dots).

Growth, natural mortality, and metabolism

Growth of reef fishes as expressed by the relation between the von Bertalanffy growth parameters K and L_∞, is not different from that shown by other fishes, as can be seen from the auximetric grid of Pauly et al. (in press) shown in Fig. 4, where reef fishes seem to exhibit all possible combinations of K and L_∞. However, natural mortality M at a given K is often higher in reef fishes (Fig. 5), as can be expected in tropical fishes (Pauly 1984). A predominantly active life-style is indicated by the average oxygen consumption, usually above average (Fig. 6).

Prey and Predators

Of the 40 categories of food items reported in FishBase from the stomachs of reef fishes, bony fish were found in 287 stomachs, crabs in 99 stomachs, shrimps/prawns in 63 stomachs, annelid worms in 40 stomachs, corals in 39 stomachs, gastropods in 35 stomachs, copepods in 27 stomachs and bivalves in 22 stomachs. other items were found less often. These categories can be further summarized in benthic animals (561 stomachs), nekton (mainly fish; 320 stomachs), zooplankton (107 stomachs) and algae (90 stomachs). As can again be expected in tropical, active species, reef fishes often consume more food than other fishes at the same weight (Palomares 1991; Fig. 7).

The main predators of reef fishes are other bony fish (reported for 239 species), birds (reported for 34 species) and sharks (reported for 9 species).

Reproduction

Many reef fishes remain females or males throughout their lives. However, many wrasses, parrot fishes, and others begin their lives as females and change sex to male at a later stage. Several groupers, anemone fishes, and others are known to begin their lives as males and change sex to females at a certain size or opportunity. A few species are functional hermaphrodites and some are capable of self-fertilization.

Maturity is reached as early as after one year in some smaller species and may take up to 6 years, e.g. in the humphead snapper *Lutjanus sanguineus*. Most reef fishes shed eggs and sperms into open water where fertilization and development takes place without parental care. Fecundity (number of eggs per spawning female) is highly variable among species, e.g., from 26,000 in the sky emperor *Lethrinus mahsena* to 3.3 million in the red hind *Epinephelus guttatus*. The average egg diameter is about one millimeter, consequently large females can produce considerably more eggs than small ones. This may also explain that there are more guarders among smaller fishes such as damsel fishes, blennies, and gobies, which thus increase the chances of survival for their relative fewer eggs. Egg development time typically lasts a few days only (Fig. 8).

Internal fertilization is practiced by sharks and rays, which are either live bearers or lay relatively few large eggs. Anemone fishes guard a nest with relatively large eggs. Seahorses and pipefishes protect their eggs and larvae in a brood pouch. Cardinal fishes are mouthbrooders, and parents of the spiny chromis

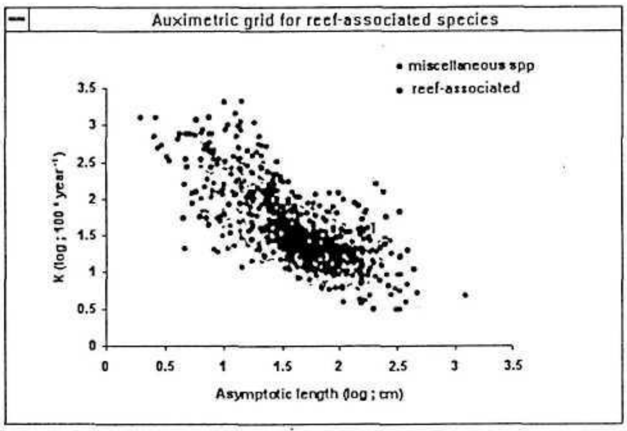

Fig. 4: K vs L_∞ for reef-associated fishes (dark dots) and all fishes (pale dots).

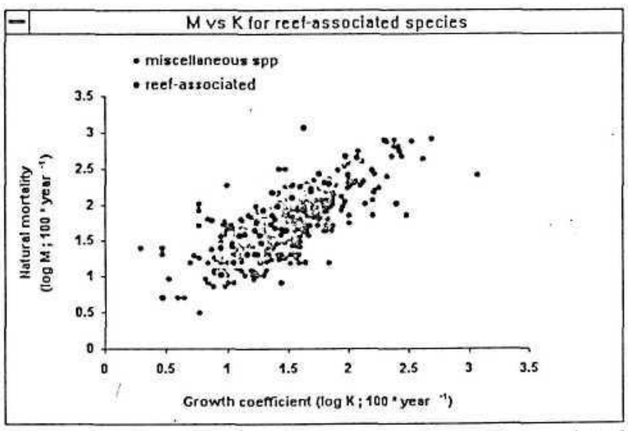

Fig. 5: Natural mortality M vs K in reef-associated fishes (dark dots) and all fishes (pale dots).

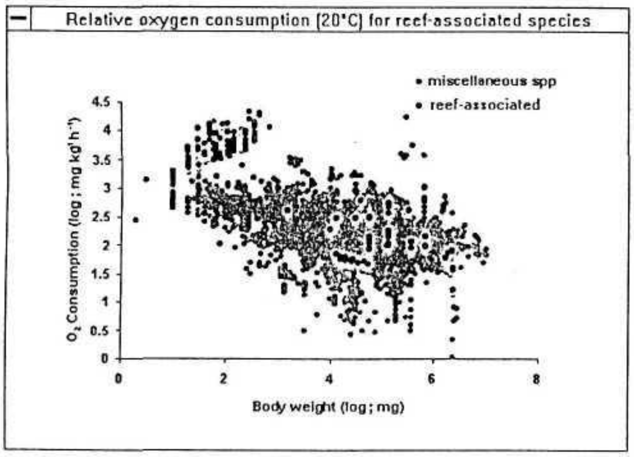

Fig. 6: Relative oxygen consumption of reef-associated fishes (dark dots) and all fishes (pale dots), expressed as calculated relative oxygen consumption at 20°C in mg $kg^{-1}h^{-1}$.

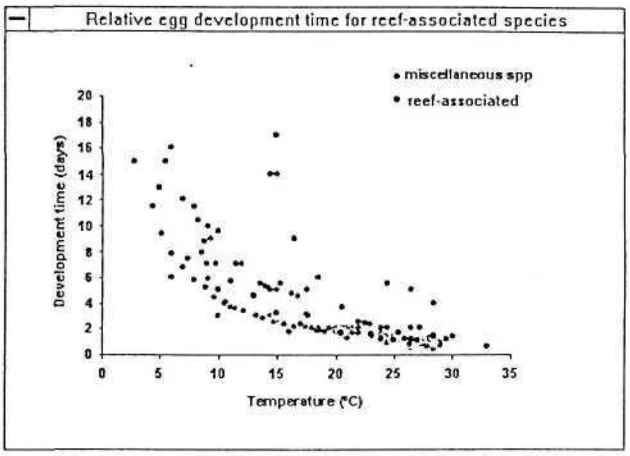

Fig. 8: Egg development time as a function of temperature for reef-associated fishes (dark dots) and miscellaneous fishes (pale dots).

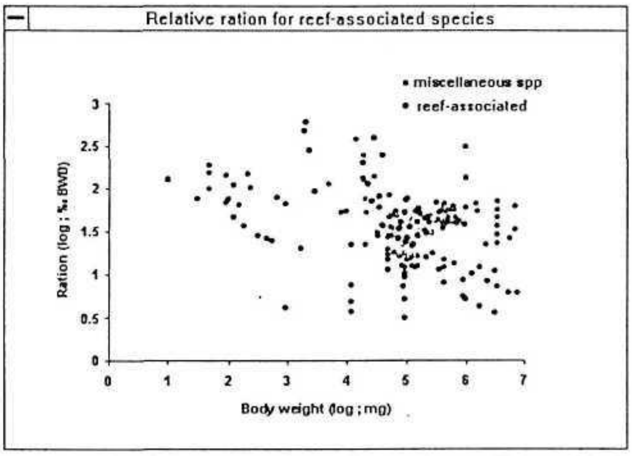

Fig. 7: Relative **ration of** reef-associated **fishes (dark dots) and all fishes (pale** dots).

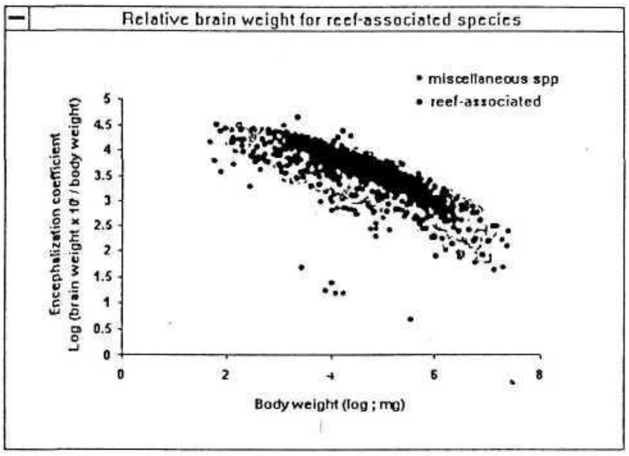

Fig. 9: Relative brain weight of reef-associated species (dark dots) and miscellaneous species (pale dots).

Acanthochromis polyacanthus are the only reef fishes that tend their cloud of larvae, similar to many cichlids. Dispersal of reef fishes is mainly determined by the duration of the planktonic larval stage, which ranges from about 16 days in anemone fishes to several months in, e.g., the moorish idol *Zanclus cornutus*.

Brains

One would expect active fishes in a densely populated and highly competitive environment to gain fitness from an enhanced central nervous system. This hypothesis is supported by Fig. 9 which shows reef fishes to often have more massive brains at a given body weight than other fishes (FishBase records from Bauchot et al. 1988).

Human uses

Only 31 reef fishes show up as species in FAO catch statistics, mostly with annual landings between 1,000 to 10,000 tons (FAO 1994}. The bigeye scad *Selar crumenopthalmus* is the sole exception with 10,000 to 50,000 tons per year, landed mainly in the Philippines. FishBase has found references for 773 reef fishes to be consumed by humans (see Table 1), with the real number probably being much higher because direct consumption by local people (=subsistence fisheries) often remains unreported. The main gears to catch various reef fishes are hooks and lines (reported for 140 species), traps (71 species), trawls (58 species), seines (46 species), and gill nets (29 species). About 180 species are considered game fishes.

At least ten reef fishes are commercially used in aqaculutre, seven are at an experimental stage, and four are considered for likely future use.

More than 800 reef fishes are regularly caught for the aquarium trade and 64 others and mostly larger ones are regularly exhibited in show aquariums. For example, The Vancouver Aquarium has 100 reef fishes on display.

Dangerous to humans

While most reef fishes are considered harmless to humans, 96 can produce venomous stings, 33 species are reported to have attacked humans, 13 are poisonous to eat and about 61 species may be ciguatera-toxic when they exceed a certain size.

Table 1: Reef-associated food fishes.

Importance	No. of species
highly commercial	19
commercial	319
minor commercial	327
of potential interest	5
subsistence fisheries	103

Literature

Reef fishes are relatively well studied. More than 1,600 references have been used to date in FishBase. However, the best studied species have only up to 66 references attached to them which falls short of the 113 references used for, e.g. the Nile tilapia *Oreochromis niloticus* or the 123 references used for the rainbow trout *Oncorhynchus mykiss*. For two thirds of the reef fishes in FishBase, less than ten references have been used.

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