Chapter 2
Aquatic Organisms of Concern

2.1 Fishes

There are over 32,000 extant fish species (Helfman et al. 2009; www.fishbase.org), more than all other vertebrate groups combined. Fishes show extensive variability in their behavior, ecology, and physiology. Moreover, fishes vary in their abilities to detect and utilize sounds, and very likely also vary in their potential susceptibility to damage by sound. The taxonomy and general biology of fishes is set out in Helfman et al. (2009).

Many factors are likely to be important in the effects of sound exposure and their longer-term consequences for fitness and survival, but one of the most important of these is the presence or absence of a gas bladder in the body (see also Chap. 3.1). Gas bladders, and their anatomical location within the body, make fish more susceptible to pressure-mediated (sound pressure and barotrauma[1]) injury to the ears and general body tissues than species lacking gas bladders (Stephenson et al. 2010; Halvorsen et al. 2011; Carlson 2012). The presence of a gas bladder is also likely to increase the ability of many species of fish to detect sounds over a broader frequency range and at greater distances from the source than fishes without such structures, thereby increasing the range from the source over which man-made sound sources have the potential to exert influence (Chap. 3.1).

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[1] As discussed in more detail in Chap. 5.1, barotrauma is tissue injury that results from rapid pressure changes (e.g., forced change in depth, explosions and intense sound) (e.g., Stephenson et al. 2010; Halvorsen et al. 2011, 2012a).

2.2   Sea Turtles

There are seven extant species of sea turtle: green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricate*), Kemp's Ridley (*Lepidochelys kempii*), loggerhead (*Caretta caretta*), olive Ridley (*Lepidochelys olivacea*), flatback sea turtle (*Natator depressus*), and leatherback (*Dermochelys coriacea*). All of these generally share a similar body form, although shell morphology is different in leatherback turtles compared to the hard-shelled species.

There are few data on hearing abilities of sea turtles (Chap. 3.3), their uses of sound, and their vulnerability to sound exposure. It has thus been necessary to extrapolate from other animal groups. Though there has been some discussion of using data from marine mammals to predict turtle responses (e.g., Finneran and Jenkins 2012), it is the view of the WG that, while still unsatisfactory, data from fishes provide a better analogy at this time (see also Chap. 3.3). The rationale is that the hearing range for turtles much more approximates that of fishes than of any marine mammal, and the functioning of the basilar papilla in the turtle ear is dissimilar to the functioning of the cochlea in mammals.

2.3   Eggs and larvae

We have separated out fish eggs and larvae for special consideration because of their vulnerability, reduced mobility, and small size. Very few peer-reviewed papers discuss the responses of eggs and larvae to man-made sound.