
Sound Underwater A Diver's Perspective

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The Players

- SCUBA Diving is broken into five general areas:
 - Military
 - Commercial
 - Recreational
 - Scientific
 - Public Safety
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The Players

- The Recreational group is by far the largest.
 - Annually there are an estimated 1,000,000 active recreational divers in the U.S. (Divers Alert Network 2007)
 - It is estimated that 300,000 to 400,000 new divers are certified in the U.S. every year
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The Playing Field

- The general depth limit for recreational diving is 130' (40 m)
 - Scientific dives are generally logged from 0-300'
 - Commercial diving has the capability to log dives considerably deeper (1000 – 1500') but generally work 700' or shallower.
 - Military diving has worked deep in the past, but don't seem to be doing so now.
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What's on the sonar screen?

- “Because of the greater density of water compared to air, sound waves travel about 4 times faster in the water than they do in the air.” (NAUI 2000)
 - The NOAA Diving Manual devotes about ½ a page of the 585 page document to the physics of sound.
 - The US Navy Diving Manual devotes about a page.
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What's on the sonar screen?

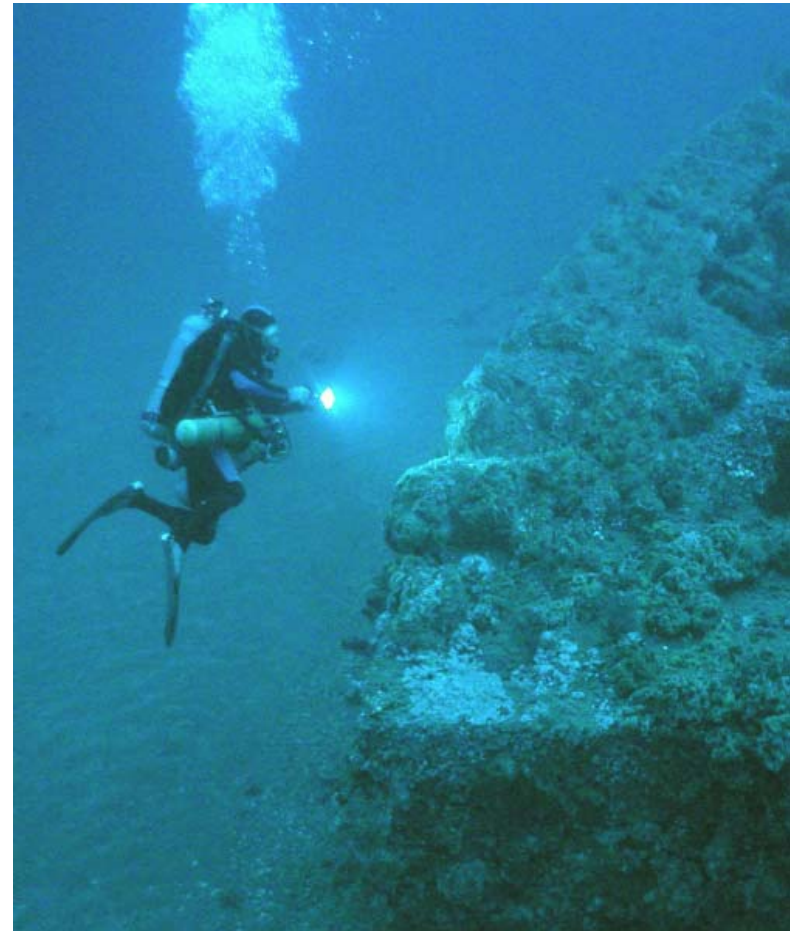
- Only the Navy Manual mentions the possibility of sound causing injury.
 - This mention is restricted to high-intensity anti-submarine sonar and explosions, and is restricted to sounds effects on humans.
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General Diving Modes

- Open Circuit
 - Semi-Closed Circuit Rebreathers (SCR)
 - Closed Circuit Rebreathers (CCR)
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Open Circuit SCUBA

- An Open Circuit Diver inhales compressed gas and exhales bubbles into the water column.
- This creates high noise levels at the diver's head.



Semi Closed Rebreathers

- Like open circuit, SCRs release bubbles into the water column.
 - They just release fewer bubbles and do so less often.
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Closed Circuit Rebreathers



- A diver using a fully closed circuit rebreather produces virtually no bubbles.
- Rebreather divers start to hear all of the sounds underwater.

SCUBA Noise

- Open Circuit and SCR noise are detectable by fish at distances > 200 meters in calm conditions.
 - Mean CCR noise is detectable by fish at 12.5 to 16 meters in calm conditions (Radford, et al 2005)
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SCUBA Noise

- Under noisy conditions Open Circuit is detectable by fish at distances >200 meters, while CCR noise would be virtually undetectable (0.3 meters) (Radford, et al 2005)
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What does this mean for this conference?

- Sound in the ocean is currently not a significant topic within the general diving communities.
 - This may well change as the diving community moves to quieter diving equipment and as others portray sound levels as detrimental to the aquatic environment.
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References

- Petar Denoble, Divers Alert Network, 6 West Colony Place, Durham, NC 27705 (4/18/2007 Phone Conversation)
 - NAUI Scuba Diver Instructor Guide, Peter Oliver Editor, 2000
 - NOAA Diving Manual, Diving for Science and Technology, Fourth Edition, James T. Joiner Editor
 - U.S. Navy Diving Manual, Volume 1, Revision 3
 - Craig A. Radford, Andrew G. Jeffs, Chris T. Tindle, Russell G. Cole, and John C. Montgomery; “Bubbled Waters: The noise generated by underwater breathing apparatus” *Marine and Freshwater Behavior and Physiology*, 38(4): 259-267, 2005
 - Photo one: Doug Kesling, NURC UNCW
 - Photo two: Joe Hoyt, East Carolina University
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