Assignment 1: Target Strength Evolution
Due: Oct. 8, 2018

Target strength (TS) is critical parameter when calculating fish density using echo integration and has a history in attempts to identify fish species. How has the availability and use of different technologies (i.e. single beam, split beam, acoustic camera, multiple frequencies, broadband) and analytics changed approaches to classifying acoustic targets? In the final paragraph of your report, forecast important research areas that should be pursued in this area.

Note:
Assignment should not exceed 3 pages in length. Please include reference list at the end of the document. Please don't fill up pages with summaries of reference papers. I am looking for a critical review of target strength research, contribution milestones, and where you think research in this area is headed.

Rubric:
Judgement (4); Changes in research (12); Future Research Areas (4)

References
Foundation TS papers include: Love (1971, Fish. Bull. 69:703-715), Midttun (1984, Rapp. P.-v. Réun. Cons. int. Explor. Mer. 184: 25-33), and Ona (1990, J. Mar. Biol. Ass. U.K. 70: 107-120).

Early experimental studies include: McCartney and Stubbs (1971, J. Sound Vib. 15: 397-420), Foote (1980, J. Acoust. Soc. Am. 67: 2084-2089), and Miyanohana et al. (1990, Rapp. P.-v. Réun. Cons. int. Explor. Mer. 189: 317-324).

Multifrequency papers include: Madureira et al (1993, J. Plank. Res. 15: 787-802), Kang et al. (2002, ICES J. Mar. Sci.59: 794-804), Korneliussen and Ona (2003, ICES J. Mar. Sci. 60: 636-640), and Sato et al. (2015, Fish. Res. 172: 130-136).

Broadband papers include: Lundgren and Nielsen (2008, ICES J Mar. Sci. 65:581-593), Stanton et al. (2010, ICES J Mar. Sci. 67: 365-378), Jech et al (2017, ICES J Mar. Sci. 74: 2249-2261

Additional References (and why included)
Benoit-Bird 2009 ICES J. Mar. Sci. 66: 1081-1090 (frequency response of volume backscatter)
Boswell et al. 2008. N. Amer J. Fish Manage 28: 799-807 (Didson application)
Burwen et al acoustic camera and didson (behavior and TS)
Demer et al. 2009 ICES J. Mar. Sci. 66: 2084-2089 (need to check)
De Robertis and Higginbottom 2007 ICES J. Mar. Sci. 64: 1282-1291 (background noise to improve TS S/N)
De Robertis et al (2010) ICES J. Mar. Sci. 67:1459-1474 (species separation)
Gauthier and Horne (TS identification)
Henderson et al 2008 ICES J. Mar. Sci. 65: 226-237 (orientation effect)
Horne 2000. Fisheries Oceanography 9: 356-371 (review paper)
Korneliussen and Ona 2002 ICES J. Mar. Sci. 60: 293-313 (visualizing multi-frequency, frequency response)

Korneliussen and Ona 2003 ICES J. Mar. Sci. 60: 636-640 (frequency response)
Lavery et al. 2007 JASA 122: 3304-3326. (zooplankton discrimination using multifreq and models)
Pedersen & Korneliussen 2009. ICES J. Mar. Sci. 66: 1149-1154 (frequency response of 3 species)
Robotham et al. 2010 Fisheries Research 102: 115-122 (neural network)
Sato et al. 2015 (frequency differencing)