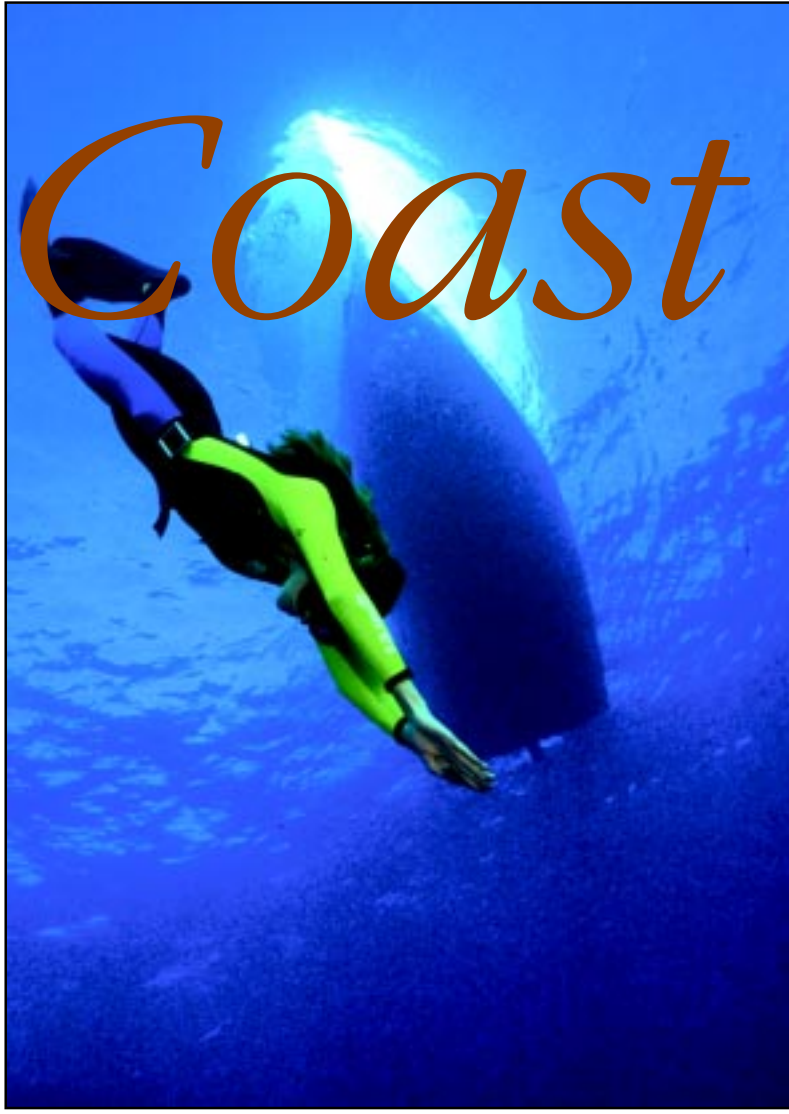
Diving to Great Depths

If you're interested in how the body reacts to severe stress, whether it be encountered at great depths, high altitude or heavy exercise, researcher **Claes Lundgren** says, "It is useful to push the body to its limits. These conditions allow you to look at how the body reacts as if it were under a magnifying glass." Lundgren is Director of the Center for Research and Education in Special Environments (CRESE) at SUNY Buffalo, which is set up to determine how the human body copes with extreme conditions.

Under the magnifying glass in Lundgren's studies is "the diving response," a universal reaction shared by all mammals to going underwater. And Lundgren's studies – including seven New York Sea Grant-funded projects since the early-1980s – provide new data to better understand how humans and other mammals sharing this deep diving mechanism react to underwater conditions.



With her training boat overhead, Mehgan dives in for a practice run in 1997. Learn more about her diving experiences at <*www.freediver.com*>.
Photo by Mark Rackley

Says Lundgren, "It's important to have a scientifically grounded understanding of the physiology of breath-hold diving. This knowledge is vital for recommending safe swimming and diving practices, training of both breathing and breath-hold divers, and the diagnosis and treatment of diving and near-drowning accident cases."

In the early 1990s, Lundgren headed a NYSG-funded investigation on the physiology of the diving response in male and female expert divers. Utilizing a state-of-the art hyperbaric chamber, where pressure can be increased to simulate great depths, his team examined the slowing of the heart, blood distribution, and gas uptake and exchange dynamics. Findings supported the idea that, especially in cold water, people with cardiovascular ailments have a greater risk of potentially serious circulatory disturbances if engaged in diving.

The practical results from Lundgren's breath-hold diving project peaked the interest of PBS's "Scientific American Frontiers" series in 1990 and Turner Broadcasting System's "Ripley's Believe it or Not!" in 2000. In the "Ripley's" segment, which also featured free-diver **Mehgan Heaney-Grier**, Lundgren offered his expertise on the topic of deep sea diving.

Caution Down Below

According to Lundgren, a professor of physiology and biophysics, "the diving response" kicks in when the diver starts to breath-hold and water cools the face as he or she glides further down into the depths of the ocean. Exposure to excessive depths, though, can cause a collapse of the lungs, cardiac arrest, blackouts, decompression sickness and, at worst, death.

Decompression sickness (DCS) can affect divers of all types – SCUBA and breath-hold, recreational and commercial – severely disabling them or causing death. DCS occurs when inert gas bubbles, usually nitrogen, accumulate in the body as a result of improper decompression during ascent. Utilizing

Watch

a hyperbaric chamber, Lundgren and his investigators conducted three NYSG-funded DCS research projects. The team examined methods of reducing the potential for decompression sickness by examining modifications of its effects on the human circulation.

Among the findings, breathing pure oxygen during decompression at the lowest possible ambient pressure was shown to reduce sickness-related symptoms. Also, the pharmacological agents, *Terbutalin* and *Isoproterenol*, were identified as possibly allowing faster decompression.

But if Mehgan let all the "what ifs" intimidate her, she may not have made it to such great depths with her breath-hold diving. On October 21, 1996, before boatloads of press, family and friends, Mehgan dove to 155 feet, more than half the length of a football field. Ten months later, she swam past her own record, reaching 165 feet below the surface. During her tests of human endurance, Mehgan holds her breath for minutes at a time underwater. So how is she able to stay below the surface for over four and a half minutes? As Lundgren explains, when trained divers such as Mehgan hold their breath, their oxygen consumption goes down, allowing them to be submerged for longer periods of time.

Practice or a Pre-determined Power?

The skill behind deep diving has more to do with training and technique than it does genetics. Lundgren cites that there are a number of factors that may make the diving response more effective, including underwater laps, actual free diving, and apnea training –activities done in a state of breath-hold, such as immersion of the face in cold water. "What happens in the training period is that the defensive protective mechanisms develop and become increasingly better," he says.

Before each dive into the depths, Mehgan says, "everything you do should be carried out in a very relaxed state." So once she engages in a period of reflection and breathing, she's ready to take the plunge. At 30 feet below, Mehgan's body loses its natural buoyancy. She stops kicking and begins to plummet through the sea. "You're sinking like a stone, but you still have that weightless feeling, like you're free-falling," she says. As she goes deeper, pressure begins to build on her head and body. Her internal organs contract, and her eardrums bend inward.

If Mehgan chooses the wrong spot to turn around, she'll be faced with dangers such as shallow water blackout. And if she does run out of oxygen before surfacing and passes out, it can be deadly. "There's no room for hesitation and panic, though" she says. "Fear and hesitation are natural feelings, there is no room for that with free-diving so you have to just set those feelings aside."

So now that Mehgan has gone to such great depths, what's next? She does have her sights set on another dive, but she's currently trying to catch her breath Her hope of reaching a depth of 200 feet, equivalent to diving off a 20-story building, is on the horizion, though. "I like the challenge that variety can bring, but the free diving brings me back to a simpler state, even though it's quite complex. I'm drawn to the idea of challenging both my physical and mental ability. For me, it's a good obsession."

– Paul C. Focazio

Mehgan is on her way to a depth of 165 feet (50.3m) in August 1997 (left). Although Mehgan has broken her previous record of 155 feet (47.2m) in October 1996 (top), it is six-time champion Tanya Streeter who holds the women's world record for an unassisted dive at 220 feet (67m). Streeter's Web site, <*www.redefineyourlimits.com*>, features an updated list of record breakers according to the International Association for the Development of Apnea's (AIDA) various diving disciplines.

Photos by Jim Edds

Flanked by two safety divers with scuba gear, Patricia Maiorca, a Sicilian breath-hold diver, ascends from a deep dive. The 1996 dive, which took place in the Mediterranean off Sicily, was part of a research study headed by NYSG-funded researcher Claes Lundgren.

Photos by Tommaso Nobili

Maiorca prepares for a deep breath-hold dive in the wet compartment in the CRESE lab's pressure chamber. Dr. Massimo Ferrigno (in foreground) assists her with the experimental set-up, recording heart rate and blood flow. A successful dive requires a lower heart rate, a reduction of the carbon dioxide levels in the diver's body, and ample room for additional reserves for air.