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OPTIMISATION OF GRADIENT FACTOR SELECTION IN MILITARY DIVING

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Introduction
In 2018, the Belgian Defence introduced a commercial dive computer (Shearwater Perdix) for use by its military divers. Initial experience indicated several operational constraints when using its default Gradient Factors. The main purpose of this research is to provide guidelines for optimal gradient factor selection based on scientific evidence.

Methods
The algorithms of the Cochran dive computer and the Shearwater Perdix dive computer are programmed in Python and validated against publicly available data. Next, these validated algorithms are used to assess the gradient factor settings, and determine which settings approach the decompression profiles used as a reference by the Belgian Defence (Thalmann/NEDU and DCIEM). The optimization uses a nested do-loop for each gradient factor and the cost function is the minimization of the integrated difference between the reference profile and the profile calculated with a particular gradient factor setting.

Results
All reference profiles are approached when GFLO is kept equal to 1.0 and only GFHI is decreased down to a minimum of 0.75 to enlarge the stop times. Using the default settings (GFLO =0.3 and GFHI =0.7) would yield deeper and shorter stops, leading to increased supersaturation for the relatively slower tissues, potentially leading to an increased DCS risk. The current software (embedded rules) inside the Shearwater Perdix dive computer does not allow the selection of the optimal settings. Taking into account the constraints, sub-optimal settings are calculated: a symmetric GF of 0.9/0.9 is the best suboptimal setting to approach the DCIEM tables, except for small bottom times where the lowest setting found amongst all the dives is 0.75/0.75.

Discussion / Conclusions
The default GF settings of the Shearwater Perdix is GFLO=0.3 and GFHI=0.7. Our optimization analysis indicates that it was never required to use a GFLO of 0.3 to approach the targeted reference decompression profiles. On the contrary, all optimal solutions keep the GFLO parameter fixed to 1.0 while, ideally, the GFHI parameter is lowered to increase the shallower stop times. During this research study, no evidence is found that the default GF setting would lead to a safer decompression profile for air dives up to a depth of 60msw. Based on this research, the Belgian Navy divers refrain from using the default gradient factor settings of the Shearwater Perdix dive computer, and instead adopt a symmetrical GF settings approach.