Recently, two simple criteria were proposed to assess if vacua emerging from an effective scalar field theory are part of the string "landscape" or "swampland". The former are the vacua that emerge from string compactifications; the latter are not obtained by any such compactification and hence may not survive in a UV completed theory of gravity. So far, these criteria have been applied to inflationary and dark energy models. Here we consider them in the context of solitonic compact objects made up of scalar fields: boson stars. Analysing several models (static, rotating, with and without self-interactions), we find that, in this context, the criteria are not independent. Furthermore, we find the universal behaviour that in the region wherein the boson stars are expected to be perturbatively stable, the compact objects may be part of the landscape. By contrast, in the region where they may be faithful black hole mimickers, in the sense they possess a light ring, the criteria fail (are obeyed) for static (rotating) ultracompact boson stars, which should thus be part of the swampland (landscape). We also consider hairy black holes interpolating between these boson stars and the Kerr solution and establish the part of the domain of existence where the swampland criteria are violated. In interpreting these results one should bear in mind, however, that the swampland criteria are not quantitatively strict.