Transition metal complexes with bipyridine ligands are of great interest in metal-organic chemistry, since they are prototypes for many applications in photochemistry and homogeneous catalysis. Under-coordinated bipyridyl complexes are elusive species in the condensed phase, and the ligand-induced changes in electronic structure are of fundamental interest. We present UV photodissociation spectra of mass-selected monocationic copper(I)-bipyridyl complexes \([\text{bpy-Cu-L}]^+\) with different ligands (L = H$_2$O, D$_2$, N$_2$, MeOH, Cl). Complexes were prepared via electrospray ionization of copper/bipyridine solutions followed by accumulation and buffer gas cooling in a cryogenic Paul trap. In addition, we show spectra of similar species based on copper oxide, \([\text{bpy-CuO-L}]^+\).