Individuals with mood disorders (MDs), such as depression and bipolar disorder, have been observed to have distinct changes in cognition with advancing age compared to healthy controls. However, the temporal evolution of these cognitive changes, especially amongst an older population, has not been well characterized at the individual level due to the limitations of currently employed analytic approaches, which are insufficient to capture the complex relationship between mood disorders and cognitive impairment with advancing age. We propose to utilize novel Bayesian statistical methods to better characterize longitudinal trajectories of cognitive function in older patients with mood disorders (MD) at the individual level. We first describe a Bayesian hierarchical linear model for longitudinal data to test whether older adults with MDs have a significantly greater rate of cognitive decline compared to healthy controls (i.e., accelerated cognitive aging), and to identify the specific age range where accelerated cognitive aging is most pronounced. We then extend the hierarchical model to incorporate population subgroups for personalized predictions of cognitive function using baseline variables (demographics, medical history, etc.). We further employ an ensemble learning approach to integrate information from other data sources, potentially from studies with different designs, into the Bayesian personalized prediction model to enhance its accuracy and generalizability. Finally, we present some initial results of our approaches based on a longitudinal dataset from the McLean Geriatric Mood Disorders Database and a cross-sectional dataset from the McLean Neuropsychology Research Database.