**Diversification dynamics of *Agave sensu lato***

Using the phylogenetic branching date information from the whole Agavoideae data set, the diversification dynamics of the Agavoidae family best supported by the data is one with initial low diversification and extinction rates, with a slight increase in speciation rate towards the present (Table 4). On the other hand, the best diversification model of *Agave sensu lato*, suggests that the family has had a very high speciation rate and very low extinction rate, in which the rate of speciation has decreased slightly towards the present, but remains high, at an estimated 1.48 species/Ma at present. Lastly, the best model of diversification for *Furcraea/Beschorneria* predicts a constant rate of speciation and extinction (Table 5). To examine more complex models of diversification, we examined whether the data are more consistent with models in which one, two or three shifts in diversification rate occurred over time in different lineages. The model with the lowest AICc shows two shifts in diversification, one in *Agave sensu lato* and the other in *Furcraea/Beschorneria*; this model had a ΔAICc = 72.53 suggesting strong support (Table 4). The only other models with strong support compared to the null model (no shifts), all included an independent shift in diversification rate in *Agave sensu lato* (Table 4). These models indicate that a shift in the diversification rate occurred ~8 Mya in the stem *Agave sensu lato* lineage as well as in the stem lineage of the *Furcraea/Beschorneria*, with negligible extinction rates persisting in both clades (Tables 4 and 5, Fig. 1, inset). In particular, the diversification rate of *Agave sensu lato* is almost three times higher than for the rest of the Agavoideae (Table 5).

Table .4. Evaluation of shifts in diversification dynamics among clades of Agavoideae *sensu stricto* with RPANDA. nPar = number of parameters in model; logLH = logarithm Likelihood; AICc = second order Akaike Information Criterion. The model best supported by AICc is marked in bold.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Diversification Dynamics Shift Model** | **nPar** | **logLH** | **AICc** |
|  |  |  |  |  |
|  | No shifts in Agavoideae | *3* | *-94.8778* | *196.2890* |
|  |  |  |  |  |
|  | in *Agave s.l.+Furcraea*-*Beschorneria* | *5* | *-89.2925* | *189.9803* |
| One | in Yucca+*Hesperoyucca*-*Hesperalöe* | ***5*** | *-89.1728* | *189.7409* |
| shift | in *Agave s.l.* | *6* | *-89.8342* | *193.6684* |
|  | in *Furcraea*-*Beschorneria* | *5* | *-95.5270* | *202.4494* |
|  | in *Yucca* | *6* | *-92.4539* | *198.907* |
|  | in *Hesperoyucca*-*Hesperalöe* | *5* | *-104.4168* | *220.229* |
|  |  |  |  |  |
|  | in Yucca+*Hesperoyucca*-*Hesperalöe* and in *Agave s.l.* | *8* | *-89.9315* | *199.463* |
|  | in Yucca+*Hesperoyucca*-*Hesperalöe* and in *Furcraea*-*Beschorneria* | *7* | *-88.6429* | *194.0175* |
|  | in *Agave s.l.+Furcraea*-*Beschorneria* and in *Yucca* | *8* | *-86.2422* | *192.0845* |
| Two shifts | in *Agave s.l.+Furcraea*-*Beschorneria* and in *Hesperoyucca*-*Hesperalöe* | *7* | *-88.5339* | *193.7995* |
|  | **in *Agave s.l.* and *Furcraea*-*Beschorneria*** | ***8*** | ***-52.0623*** | ***123.7245*** |
|  | in *Agave s.l.* and in *Yucca* | *8* | *-90.0175* | *199.6349* |
|  | *in* *Agave s.l.*and in *Hesperoyucca*-*Hesperalöe* | *8* | *-88.3214* | *196.2428* |
|  | in *Furcraea*-*Beschorneria* and in *Yucca* | *9* | *-92.6556* | *207.9266* |
|  | in *Furcraea*-*Beschorneria* and in *Hesperoyucca*-*Hesperalöe* | *7* | *-91.9109* | *200.5535* |
|  | in *Yucca* and in *Hesperoyucca*-*Hesperalöe* | *8* | *-56.0393* | *131.6786* |
|  |  |  |  |  |
|  | in *Agave s.l*., *Furcraea*-*Beschorneria* and *Yucca* | *11* | *-52.67375* | *134.4826* |
| Three shifts | in *Agave s.l*., *Furcraea*-*Beschorneria* and *Hesperoyucca*-*Hesperalöe* | *11* | *-52.5885* | *134.312* |
|  | in *Agave s.l*., *Yucca* and *Hesperoyucca*-*Hesperalöe* | *11* | *-56.0604* | *141.256* |
|  | in *Furcraea*-*Beschorneria*, *Yucca* and *Hesperoyucca*-*Hesperalöe* | *10* | *-56.2753* | *138.34* |

Table 5. Parameter values of the best diversification model inferred with RPANDA for the Agavoideae clade. Two shifts in diversification dynamics were supported by the data: one in *Agave sensu lato* and another one in *Furcraea*-*Beschorneria* clade.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Clades | **Diversification Dynamics** | **Par.** | **Speciation Rate Dynamics** | **Speciation Rate at present\*\*\*UNITS spp/Ma** | **Change in speciation rate** | **Extinction Rate** |
| *Agave sensu lato* | **Variable Speciation -Constant Extinction** | **3** | increasing | 1.4778 | -0.2108 | 5.42E-08 |
| *Furcraea-Beschorneria* | **Constant Speciation and Extinction** | **2** | constant | 0.5638 | NA | 5.65E-07 |
| Other *Agavoideae (Yucca+Hesperoyucca-Hesperalöe)* | **Variable Speciation -Constant Extinction** | **3** | increasing | 0.4731 | 0.0302 | 0.0244 |

DISCUSION

**Diversification Rates Analysis in *Agave sensu lato***

The ML estimates of diversification rate of *Agave sensu lato* and the next most species rich genus at present, *Yucca,* are highly different, 1.478 and 0.473 spp/MY respectively. The latter appears to be slightly lower than that of *Furcraea/Beschorneria* (0.564 spp/MY), the sister group of *Agave sensu lato* (Table 5). *Agave sensu lato* and *Yucca* estimates are higher than values previously reported by Good-Avila et al. (2006).

This is probably due to the differences in the estimated crown age of each group, which are OLDER OR YOUNGER IN GOOD-AVILA??. Both groups have undergone considerably higher diversification than the average estimates reported for all flowering plants: 0.089 (Magallón & Sanderson, 2001) and 0.12 - 0.39 (Bremer, 1992), and they are also higher than some angiosperm groups known to be rapidly diversifying, such as the Asteraceae (Magallón & Sanderson, 2001). The rate of diversification of *Agave sensu lato* falls within the range (0.56 ± 0.17 spp/MY) of one of the most outstanding island adaptive radiations described: the Silversword Alliance in Hawaii (Baldwin & Sanderson, 1998). Island radiations have generally been considered to display higher speciation rates, on average, than continental radiations. However, similarly high rates of diversification in the western New World genus *Lupinus* (0.6 – 1.1 spp/MY)(Drummond, 2008) and in the Mexican and central American ant associated *Acacia* (0.496 spp/MY) (Gómez-Acevedo et al., 2010), suggest that continental radiations can equally exhibit very high rates of speciation(??). Diversification dynamics observed in *Agave* and *Yucca* are comparable to the radiation of South African Cape Flora Poaceae which reached a peak 2.9 spp/my diversification rate in the start of their radiation (Verboom et al., 2003).The onset of *Agave sensu lato* diversification is coincident with the aridification of central Mexico: the formation of the Sonoran Desert (Axerold, 1979; Van Devender, 2000) occurred when the Mexican Central Basin was divided by the Neovolcanic Belt (Morán Zenteno & Sanchez-Barreda, 1994), a biogeographical event that changed rainfall patterns and promoted population isolation events resulting in an impressive continental radiation in other plant groups CITAS (sugiero el Nuevo paper de Arturo De Nova pero todavía está por someterse también).