## **1. PHYLOGENETIC ANALYSES**

### 1.1 Taxon sampling and sequencing

We used tools in the GenBank browser PhyloTA<sup>1</sup> to gather sequence data for African cichlid taxa for the nine genes used in phylogenetic reconstruction (see Supplementary Table 1). As a check on the GenBank sequence data, we built single-gene trees and excluded from the dataset sequences where problems in species identification were apparent. We included sequences from all African cichlid taxa with unique species names, and in most cases excluded taxa not identified to species. We assembled the full genetic dataset with the help of functions in the R packages  $APE^2$  and Phyloch<sup>3</sup>, and aligned the dataset with MAFFT<sup>4</sup>.

Species sampled and GenBank numbers associated with gene sequences used in phylogenetic analyses are listed in Supplementary Table 1.

DNA was extracted from fin clips or muscle tissue using a standard phenol-chloroform extraction procedure. Two mitochondrial regions, the control region and NADH2 were amplified. PCR amplification of products, purification of PCR products, and sequencing of control region followed the protocol described in Joyce et al.<sup>5</sup>. The entire mitochondrial control region was amplified using forward primer

HAPThr-2+4F 5'-CCTACTCCCAAAGCTAGGATC-3' and reverse primer

FISH12s 5'- TGCGGAGACTTGCATGTGTAAG -3'.

PCR products were cleaned using exonuclease and shrimp alkaline phosphatase, and a combination of the amplification primers and two internal primers, a forward primer

Dloopint 5'-AGCCCACCATCAGTTGATT-3'

and reverse primer

HapDloop 5'-GGTTTGCAGGAGTCTTAGAG-3'.

These primers were used for cycle sequencing in both directions using DTCS quickstart (Beckman Coulter) according to the manufacturer's instructions, adding 1M betaine to the sequencing reaction. The NADH2 gene was amplified with primers GLN forward

(5'-CTACCTGAAGAGATCAAAAC-3')

and ASN reverse

(5'-CGCGTTTAGCTGTTAACTAA-3').

The PCR products were purified and sequenced in both directions as described above using the two amplification primers and two internal primers ND2.1int

(5'-ACAGGTCAATGAGAAATTCAACAA-3')

and reverse primer ND2.4int

(5'-AAGCCCTTGTTTGGTTAGTTCT-3')

to obtain the entire segment (1047bp) of the NADH2 gene. All sequences were resolved using a CEQ Automated Capillary Sequencer (Beckman Coulter).

## **1.2 Phylogenetic analyses**

We used RAxML for phylogenetic analyses<sup>6</sup>. We partitioned the dataset by gene, using a GTR+gamma model of sequence evolution for each gene partition. We completed a full maximum likelihood search and 100 bootstrap replicates of RAxML's rapid bootstrap algorithm<sup>7</sup>. To account for uncertainty in branch length estimates as well as topology, we estimated branch lengths for each bootstrap replicate topology in RAxML, giving a total of 101 trees with topology and branch length estimates.

To ultrametricize and time-calibrate this set of trees, we used  $PATHd8^8$ . We used four geological dates to time-calibrate the trees (see Supplementary Figure 1). Two of these dates were associated

with the breakup of Gondwana: the African-Madagascar split (121-165 million years ago), placed at the node representing the most recent common ancestor of mainland and Madagascan (Ptychochromine) cichlids; the Madagascar-India split (63-88 million years ago), placed at the node representing the most recent common ancestor of Indian and Madagascan Etropline cichlids9. We also included the age of the earliest known fossil Oreochromis (6 million years; <sup>10</sup>), placed at the node representing the common ancestor of Oreochromis and Sarotherodon (these genera cannot be distinguished based on fossilized characters, thus this placement is conservative). Additionally, we used the age of Lake Nabugabo (5000 years<sup>9</sup>) as a recent calibration point. Because cichlids from Lake Nabugabo are not reciprocally monophyletic, we applied this divergence time to the node representing each Nabugabo species and its most recent common ancestor in Lake Victoria, repeating this procedure for each of the four Nabugabo species included in the tree, and replicating this procedure over the set of 101 trees. We then drew 95% confidence intervals on node ages from the distribution of branching times estimated from these sets of calibrated ultrametric trees.

The best maximum likelihood topology from a full RAxML search, with bootstrap values from 100 rounds of bootstrapping, is provided in Supplementary Figure 1. To incorporate our phylogeny into regression analyses incorporating the effects of phylogeny, we trimmed the single best ML tree to include only lineages that occur in lakes, and a single taxon for each lake in which cichlids have diversified. Taxa included in the trimmed tree (corresponding to those in Figure 1a), as well as confidence intervals for the time-calibrated tree, are given in Supplementary Figure 2.

For lineages present in multiple lakes, we added a tip to the tree for each instance where the lineage is found in a unique lake, such that each lineage found in multiple lakes is represented as a polytomy with a tip corresponding to each lake where it is present. We set branch lengths on these added tips to have a total length that matched that expected under a pure birth model. To do this, we follow Nee<sup>11</sup> in considering the branching times of a phylogeny that includes *n* species. Each time interval  $t_i$  represents the waiting time between successive speciation events on the tree. Under a pure-birth model with birth rate *b*, these waiting times are all drawn from exponential distributions with rate parameters that depend on the number of extant species in the tree at that particular time. Total tree depth (*T*) is the sum of these intervals:

(1) 
$$T = \frac{1}{b} + \frac{1}{2b} + \dots + \frac{1}{nb}$$

The expected value for the total evolutionary history in the tree (H), then, is:

(2) 
$$H = 1\frac{1}{b} + 2\frac{1}{2b} + \ldots + n\frac{1}{nb} = \frac{n}{b}$$

Solving for b in (1) and substituting into (2) we have:

(3) 
$$H = \frac{nI}{1 + \frac{1}{2} + \dots + \frac{1}{n}} = \frac{nI}{\sum_{i=1}^{n} \frac{1}{i}}$$

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### 2. DIVERSIFICATION STATE, TRAIT AND ENVIRONMENTAL DATA

### 2.1 Data included and source information

Lake physical and environmental can be found in the Dryad data repository (http://dx.doi.org/10.5061/dryad.5g6312br). Lake surface areas that were not reported in the literature were measured using distance-calibrated Google Earth satellite images and the software ImageJ<sup>12</sup>. Net solar radiation is the difference between the influx of solar radiation and the reflectance of heat energy back into space. We used the average of monthly values from 2010, obtained from the NASA Langley Research Center Atmospheric Science Data Center.

We obtained information about the distribution of large predatory fish of the genera *Lates*, *Hydrocynus* and *Hepsetus* from FishBase<sup>13</sup>. Trait data have been deposited in the Dryad data repository (http://dx.doi.org/10.5061/dryad.5g6312br).

#### 2.2 Time for diversification

We calculated "time for diversification" for lineages using either the midpoint of geological age estimates for the lake (either most recent desiccation or basin age, if no evidence for desiccation exists) or the median stem age of the group estimated from our calibrated molecular phylogenies. If both ages were available we used the geological age of the lake, with the exception of lakes where radiating or colonizing groups differ substantially in age (e.g. Lake Tanganyika, Lake Malawi). Previous work has used similar approaches, combining geological and molecular genetic information to assess relative tempos of speciation<sup>14,15</sup>. The times for diversification that we inferred for all lineages in the dataset, and reference information for geologically-based dates, are archived in the Dryad data repository (http://dx.doi.org/10.5061/dryad.5g6312br).

Because of potential error arising from combining molecular phylogenetic estimates of clade age with geologic dates, we also did analyses using only geologically-based lake ages (see section 4 below and Supplementary Tables 3 and 4). The results of these analyses are qualitatively identical to those using time for diversification.

### 2.3 Diversification "thresholds"

We coded each lineage in each lake as one of two diversification states – "diversifying" or "nondiversifying" – using 2 different thresholds to identify diversifying lineages. At the lowest threshold, we identified any lineage that had undergone at least one intralacustrine speciation event. Under this criterion, any lineage that had at least one endemic species in a lake co-occurring with its sister taxon (either a widespread species or a lake endemic itself) would be coded as diversifying. Single endemic species not co-occurring with a sister taxon were not coded as diversifying. As an additional test for identifying multi-species radiations, we coded lineages as diversifying only if they had produced at least 5 endemic species within a given lake.

#### 2.4. Treating radiation as a binary variable

In this study, we focus on explaining the presence and absence of diversification, not the species richness of diversifying lineages. There are two major reasons we made the decision to treat the data this way: 1. We here ask if there are lineage-specific or environmental properties that promote intralacustrine diversification. This is a different question than asking what determines the species richness of diversifying lineages. 2. Because most lineages have colonized lakes and have not subsequently diversified, the species richness dataset is highly skewed towards 0-values; the response variable therefore has a strongly zero-skewed distribution. Therefore, the binary framework is more analytically appropriate for the dataset and the question we seek to answer. However, see section 5.3 below for additional analyses that treat both our primary question (binary "radiation-or-not") and species richness.

## **3. CORRELATION BETWEEN PREDICTOR VARIABLES**

We checked for collinearity between predictor variables prior to including variables together in multiple regression models. We calculated Pearson correlation coefficients ( $r^2$ ) for all pairs of continuous predictor variables (see Supplementary Figure 3). Among continuous predictor variables, lake depth and time for diversification

were strongly positively correlated ( $r^2 = 0.77$ ), and latitude and environmental energy were strongly negatively correlated ( $r^2 = -0.82$ ).

The collinearity between lake depth and time for diversification is not unexpected, as deeper lakes are generally older because they are less sensitive to climate-driven desiccation. Greater depth could influence diversification by increasing temporal lake stability, and/or through increased habitat dimensionality. To examine the relative explanatory power of depth versus time, we analyzed a large subset of the data, excluding lakes deeper than 150 meters, and thereby substantially reducing collinearity between depth and time ( $r^2 = 0.25$ ). We then compared models incorporating time, depth, and depth + time as predictors of diversification state. We find that depth alone predicts diversification better than does time alone at diversification threshold 1 (depth alone vs time alone:  $\triangle AIC$  2.996; vs depth + time:  $\triangle AIC$ 1.696) and at diversification threshold 5 (depth alone vs time alone:  $\Delta$ AIC 1.308; vs depth + time:  $\Delta$ AIC 0.541). We therefore included depth alone in multiple regression models presented in the main text. We additionally did multiple regression analyses including time and excluding depth, and as predicted for highly correlated predictor variables, time behaves qualitatively identically to depth in these models (results not shown).

Because of high collinearity between energy (measured as net radiation) and latitude ( $r^2 = -0.82$ ), we included the residuals of the linear regression of latitude as a function of net radiation, instead of raw latitude, in multiple regression models. This approach allowed us to ask whether variation in latitude influences cichlid diversification beyond the effects of available energy. The residuals of latitude were not strong predictors of diversification in any model set in multiple regression analyses, and excluding them as a predictor variable produced qualitatively identical results.

For binary predictor variables, we used the  $r^2$  equivalent suggested by Menard<sup>16</sup>,  $r^2_L$ , as an assessment of collinearity. This metric is based on the likelihood of the model with only the intercept (L<sub>0</sub>) relative to the model with the predictor variables included (L<sub>M</sub>), where

$$r_{L}^{2} = 1 - \ln(L_{O})/\ln(L_{M})$$

We removed one variable from each pair of predictor variables with  $r^2$  (or  $r^2_L$ ) of greater than 0.7 after testing models including variables with correlations higher than this value proved to cause analytical problems (inflations of standard error in parameter estimation, a diagnostic of collinearity problems in logistic regression<sup>17</sup>). Supplementary Table 2 provides  $r^2_L$  for all pairs of binary predictor variables. Mouthbrooding and polygamous mating systems were the only pair of variables with  $r^2_L$  greater than 0.6, so we removed mouthbrooding from the multiple regression models shown in the main text.

## 4. SINGLE PREDICTOR VARIABLE ANALYSES

We evaluated the relationships between single predictor variables and diversification state using phylogenetic logistic regression<sup>18</sup> (see Methods).

Because Lake Tanganyika is an outlier in terms of depth and age (it is more than twice as old and deep as any other lake in the dataset), we ran models both with and without lineages present in that lake. At both thresholds used to identify diversifying lineages, the strongest and most consistent associations with radiation were for lake depth, lake age, and time for diversification (see Supplementary Tables 3 and 4).

Ives and Garland's<sup>18</sup> method infers the parameter a, a measure of phylogenetic signal in the regression, as part of the phylogenetic logistic regression procedure, and uses this inferred measure of phylogenetic signal to modulate the strength of the phylogenetic term in the regression parameter estimation. The parameter a is defined such that values of -4 or less are considered to have negligible phylogenetic signal, and values greater than 1 indicate strong phylogenetic signal. Inferred a values for the regression of single predictor variables on radiation state are given in Supplementary Tables 6 and 7. No inferred a values exceed 0, indicating that no regressions have very strong phylogenetic signal, but strength of phylogenetic signal varies among predictor variables, and generally is higher in regressions of traits than it is in regressions of environmental variables. Note that the phylogenetic signal for the regression of these

variables on radiation state may differ substantially from phylogenetic signal in each variable alone.

At the lower diversification threshold (see Supplementary Table 3), both time for diversification and lake age are strong positive predictors of diversification both with and without Lake Tanganyika included in the dataset. Among extrinsic factors, increased lake depth and the absence of predators are significant predictors of radiation both with and without Lake Tanganyika. With taxa from Lake Tanganyika excluded, there are significant negative relationships with lake surface area and with latitude. Among intrinsic traits, sexual dichromatism is a significant predictor of radiation both with and without taxa from Lake Tanganyika included. Mouthbrooding is a significant predictor of radiation for the complete dataset, and both generalized and haplochromine-type egg dummies are significant predictors of radiation when taxa from Lake Tanganyika are excluded.

At the higher diversification threshold, (Supplementary Table 4), lake age and time for diversification are again strongly associated with radiation both with and without taxa from Lake Tanganyika included. Lake depth is also a strong predictor of radiation both with and without taxa from Lake Tanganyika. Increased energy, and decreased latitude, are significantly associated with radiation for the whole dataset, but are not significant predictors with taxa from Lake Tanganyika excluded. Mouthbrooding is a significant predictor of radiation for the complete dataset only, and the presence of egg dummies (both generalized and haplochromine-type) and sexual dichromatism are significant predictors of radiation with taxa from Lake Tanganyika excluded.

### 5. MULTIPLE REGRESSION ANALYSES

#### 5.1 Model Averaging Procedure

To assess the impact of predictor variables on the fit of multiple regression models, we used an AICc-based model averaging approach following Burnham and Anderson<sup>19</sup> and Kisel and Barraclough<sup>20</sup>. To do this, we fitted logistic regression models in RR Development Core , using the function glm(), that included all possible additive models given our set of predictor variables. We calculated the Akaike weight of each model by first calculating relative likelihoods for each model as exp(-0.5\* $\Delta$ AICc). The Akaike weight equals the relative likelihood divided by the sum of the relative likelihoods for all models. We then calculated the relative importance (RI) for each predictor variable, as the sum of relative Akaike weights for models in which they appear. RI values scale from 0 to 1, where a variable with a score of 0 is associated with very low Akaike weights and 1 is consistently associated with high weights. We also calculated model-averaged estimates of regression parameters and standard error values, calculated as the sum of the parameter estimates for each model including that predictor, multiplied by the relative Akaike weight of each of those models.

As an additional test of the robustness of our multiple regression results, we conducted a cross-validation test. We took 500 random draws of a subset of the lineages in the full dataset (75% of the total) and conducted the model averaging procedure as described above on these data subsets.

### 5.2 Multiple regression results

The full multiple regression model results, which are summarized in Figure 2 in the main text, are given in Supplementary Tables 5 and 6. Results are concordant across diversification thresholds. Relative importance values decrease for the higher diversification threshold. This is expected, as the number of instances of observed diversification decreases with increased threshold, and thus the power to observe significant across thresholds, with one exception. At threshold 5, lake area is no longer a significant predictor of diversification (for thresholds 1 it is a strong negative predictor of diversification). This indicates that the negative association between lake area and diversification is driven by very small radiations (< 5 species) in very small lakes.

One possibility for the negative association between lake area and diversification that we discuss in the main text is ascertainment bias. While data on cichlid species presence is generally present for all large lakes of Africa, data on cichlid species presence in very small lakes is rare. Small lakes included in the dataset are frequently those known for their endemic cichlids (e.g. Cameroonian crater lakes; Guinas Sink Hole). Furthermore, although our results demonstrate that the occurrence of intralacustrine speciation is not limited by lake area (see main text), species richness in cichlid radiations is limited by lake area (see Seehausen<sup>22</sup>, Wagner et al. in prep). Therefore, if the small lakes included in the dataset disproportionately represent cases of radiation (more so than larger lakes), and small lakes are constrained in species richness of their radiations (by virtue of their area), the significant negative area-diversification relationship would be expected to disappear as species richness threshold increases. This is what we observe.

The cross-validation test produced average relative importance values for all variables that are concordant with values for the full dataset (Supplementary Figure 4; compare to Figure 2a).

#### 5.3 Hurdle poisson regression analysis

As a further test of the robustness of the results of our logistic regression modeling approach, we used hurdle Poisson regression implemented in the R package MCMCglmm <sup>23,24</sup>. Hurdle Poisson regression models two latent variables associated with the response: 1) the probability that the response is zero or not, and 2) the probability of the response modeled as a Poisson distribution without the observed zero-values. Our response variable for these analyses is the number of speciation events within each colonizing lineage, instead of these data transformed to binary (e.g. "radiating-or-not") as we have treated it elsewhere in the paper. We use a hurdle Poisson model for two reasons. First, our response variable is heavily zero-inflated; and second, we were specifically interested in investigating the presence of radiation separately from the species richness of those radiations.

MCMCglmm takes a Bayesian approach to fitting general linear models that are analytically intractable using traditional likelihood approaches. An additional advantage for comparative biologists is that MCMCglmm can account for phylogeny by treating the phylogenetic variance covariance matrix as a random effect in the regression model <sup>24</sup>. To use this approach, we drew 100 trees randomly from our set of bootstrap replicate trees and replicated the analyses on each of these 100 trees. Because the method requires fully resolved trees, we randomly resolved polytomies and replaced zero-length branches with near-zero length branches (0.000001).

We fit multivariate models including variables from the reduced models also used in phylogenetic logistic regression analyses (variables surface area, depth, energy, elevation, haplochromine egg dummies, and sexual dichromatism). Fixed effects included additive terms for both binary and Poisson effects for each of these predictor variables. In addition to including phylogeny as a random effect, we included lake identity as a random effect, to account for potential autocorrelation in lake identity due to the presence of multiple lineages in the same lake.

We used priors with an inverse Wishart distribution with nu = 0.002, which is equivalent to an inverse gamma distribution with shape-scale equal to 0.001. We fixed the residual variance for the binary process portion of the model, as this variance is not estimated in the regression. Our prior specification therefore took the form:

prior = list (R = list (V=diag(2), n = 0.002, fix=2), G = list (G1 = list (
$$V = diag(2), n = 0.002$$
),(G2 = list ( $V = diag(2), n = 0.002$ ))))

Where R corresponds to the prior matrix associated with the residual variance, and G corresponds to the matrices associated with the random effects.

We assessed convergence of the model through inspection of plots of the model deviance through time, and set the burn-in after a clear plateau of deviance values. We assessed autocorrelation in parameter values through the run with plots of parameter estimates through time and optimized sampling of the MCMC chain to minimize autocorrelation. We ran the model such that effective sample sizes of all parameter estimates exceeded 100. To optimize all of the above conditions, we ran the analysis on each replicate tree for 100 million generations, with 2.5 million generations of burn-in and sampling the chain every 2000 generations. For examples of run convergence diagnostics, see Supplementary Figure 5.

Results from the binary portion of the hurdle Poisson regression analysis were concordant with the results from the logistic regression analyses for the full dataset and also with data from Lake Tanganyika excluded. Lake depth, lake surface area, and sexual dichromatism were strongly significant predictors of diversification in the reduced models we tested; these three variables are also the top-performers in logistic regression both with and without Lake Tanganyika (Supplementary Figure 6). When data from Lake Tanganyika is excluded, depth remains a strong predictor of radiation, but energy also becomes a predictor of radiation (Supplementary Figure 6b). The Poisson portion of the hurdle regression did not identify any of the tested variables as significant predictors of species richness in radiating lineages, with or without data from Lake Tanganyika. That is, this analysis showed that using this approach, our predictor variables can predict whether lineages radiate or not, but not the number of species that evolve in these radiations.

## 5.4. Interaction effects

Our main results show significant additive effects between environmental variables and lineage-specific traits in predicting cichlid radiation. We were interested in further testing whether there is evidence for non-additive interaction effects between extrinsic and intrinsic variables. We tested for this in two ways:

- 1) We tested for interactions between two pairs of variables: sexual dichromatism and lake depth, and sexual dichromatism and lake surface area, in a Poisson hurdle model including those three variables. We chose these three variables because they were the significant predictors in our prior hurdle Poisson analyses (see section 5.3 above). We estimated regression parameters for each variable alone and for the two interactions described above. estimating effects for the binary portion of the model (as our previous tests showed no evidence for significant effects in the Poisson portion of the hurdle model: Section 5.3 above). We ran the analysis on the single best ML tree, for 10 million generations with a burn-in of 500,000 generations. This model gave evidence for a significant interaction term between lake depth and sexual dichromatism (p = 0.04), but no significant effects for the interaction of dichromatism and lake surface area. As expected, the main additive terms (sexual dichromatism, lake depth, and lake surface area) were all significant predictors of radiation.
- 2) We tested for an interaction between sexual dichromatism and lake depth in a hurdle Poisson model including those two variables alone plus their interaction. We again only estimated parameters for the binary portion of the model, and used the run parameters described above. The results of this model did not provide evidence for a significant depth-sexual dichromatism interaction effect (p = 0.25), but depth and dichromatism were each significant predictors of radiation.

These analyses leave open the possibility that there is a weak interaction effect between lake depth and sexual dichromatism in addition to the clear additive effects of these variables in predicting cichlid radiation.

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Supplementary Table 1| Species used in full phylogenetic analysis, and GenBank numbers of genes associated with these species. Numbers in bold are new sequences.

Species	ND2	168	CR	CytB	Tmo-4c4	ENCI	Ptr	S7 Intron	SH3PX2
Alcolania alcalicus	G0167781	GO167970	15428641	18072278	GO168158	GO168284	GO168033	GO168095	G0168221
Aleelania mehani	GQIOIIOI	QIONNO	19072400	19072246	00100100	00100201	00100000	00100000	00100221
Alcolapia granami			18072409	180/2346					
Alcolapia latilabris			18072788	18072760					
Alcolapia ndalalani			18072780	18072748			-		
Alticornus mentale			62637864		_	_	_	_	
	4.520.5297		22521760						
Alticorpus pectinatum	AF 505287		22551769						
Altolamprologus calvus	DQ055011		509409	509407			-		
Altolamprologus compressiceps	DO055022	18182226	509408	18265830			-		
Avistochnomie chvistvi	EE585282	18182227							
Anisioeni omis eni isiyi	EF 585282	10102227							
Asprotilapia leptura	AY337772.1		313039	313037					
Astatoreochromis alluaudi	EU753923.1	7576476	7595677	18265818	U70339		-		
Astatotilania aeneocolor	JO950374					_	_		
Astatotilania blovati	10050375		220/105	220/122					
Astatoniapia bioyen	30930373		2394103	2394123					
Astatotilapia brownae				2394141		-	-		
Astatotilapia burtoni	JQ950376		30143252	313030	_		-		
Astatotilania callintera KS	EU753934-1			EU753883			_	_	
Astatatilaria anllintera IM	4. X020000	124269647	22521760	124202212	EE470867				
Astatoniapia campiera LM	A1930090	154208047	22551700	154505515	EF4/080/				
Astatotilapia calliptera LZ	JQ950377						-		
Astatotilapia desfontainii	JQ950378								
Astatotilania elegans	JO950379						_		
And the second s	10050300		47057416						
Astatotilapia flavijosepni	JQ950380		4/05/416				-	-	
Astatotilapia macropsoides	JQ950381						-		
Astatotilapia nubila	AF305241		22531723						
Astatotilania en "orange shoulder"	10050382								-
Astatomapia sp. orange snourder	30330382								
Astatotilapia paludinosa	AY930107		60550047						
Astatotilapia piceata		18182248	48773071			_	-	_	_
Astatotilapia sp. "red chest"	JO950383						_		
Astatatilania sparsidare			2394110	2304127					
Astatomapia sparsiaens			2594110	2594157			-		
Astatotilapia stappersii	AY930046.1		60549994						
Astatotilapia tweddlei	JQ950384		JQ950405						
Astatotilania velifer			7595614	2394121	_	_	_	_	
Aulanaaaaa kaanaahi		10100000	1555611	2031121					
Autonocara baenscm		18182228					-		
Aulonocranus dewindti	AY337782.1		33355534	313033			-		
Aulonocara jacobfreibergi			11602481						
Aulonocara stuarteranti	EU661720				_		_		
B-iliii-l	120001720		55275000						
Balleychromis centropomolaes	A 1 682509		552759999						
Bathybates fasciatus	AY663732		52221335	52221306			-		
Bathybates ferox	AY663736	GQ168020	52221339	313040	GQ168209	GQ168335	GQ168083	GQ168146	GQ168272
Rathyhates graueri	AY663723		52221327	52221290	·	·		·	·
Dedicite and the second	AV((2725.1		52221327	52221270					
Bathybates hornu	AY 063/35.1		52221338	52221312			-		
Bathybates leo	AY663729		52221331	52221300					
Bathybates minor	AY663721		52221323	52221284					
Bathybates vittatus	AV663727		52221320	52221296	_		_	_	
Dunyoues vinuus	A1003/2/	-	55256001	52221290	-	-	-		
Benthochromis melanoides	AY 682512.1		55276001						
Benthochromis sp.					GQ168211	GQ168337	GQ168085	GQ168148	GQ168274
Benthochromis tricoti	AF317264		18029972	18265832	_	_	_		
Poulouzouo ohuomia mionologia	EE670225	5114129	500464	500462	CO169107	CO168222	CO168071	CO169124	CO168260
Boulengerochromis microlepis	EF079255	5114128	509404	509405	GQ108197	GQ108525	GQ1080/1	GQ108154	6Q108200
Buccochromis atritaeniatus			13235053				-		
Buccochromis heterotaenia	EU661719.1								
Buccochromis lepturus	U07241				-	-	-		
Buccochi onio replinas	007211		62627867						
Buccoenromis noioidenta			0203/80/				-		
Buccochromis oculatus	AF305300		22531782						
Callochromis macrops	U07242		33355580	33356048					
Callochromis melanostigma			33355576	33355998	_		_		
Collo charania al anno anilus	AV227771 1	10102220	212055	212052					
Callochromis pieurospilus	A133///1.1	18182229	313035	313033					
Callochromis stappersii	AY337775		33355578	33356018			-		
Cardiopharynx schoutedeni	AY337791.1		33355531	313056			-		
Chalinochromis brichardi	EF679241	5114130	509739	509737	_		_		
Chaling shurming and shuri	107244	22000454	000100	000707					
Chalinochromis popeleni	007244	55090454							
Champsochromis spilorhynchus	U07245		529343			-	-		
Cheilochromis euchilus	AY930092.1		60550032	_		-	-	_	_
Chetia brevicauda	EU753924.1		58866308					_	
Chetia flaviventris	EU752026 1		58866202				_		
Chila durine durine	E0755920.1		56600505						
Cnuochromis auponti	GQ167776	GQ167965			GQ168153	GQ168279	GQ168028	GQ168090	GQ168216
Chilotilapia rhoadesii			62637872				_	_	_
Chromidotilapia guntheri	AF317270.1								
Conadichromis borlevi	AE205208		22531700						-
Copulation on is officer	AL 303308		22551790	_					
Copadichromis chrysonotus			62637869						
Copadichromis conophoros			541597				-		
Conadichromis cyclicos			541595				_		
Conadichromis auginostomus			541502						
Copadientomis electrostomus			541595				-	-	-
Copadichromis mbenjii	EF585255							-	
Copadichromis prostoma	EU661715								
Copadichromis auadrimaculatus	AF305310		22531792		_		_		
Conadiabromis things	11 505510		541602						-
Copualchromis thinos			541602						
Copadichromis virginalis	AF305281		22531764	_				-	_
Corematodus taeniatus			62637874				_	_	_
Ctenochromis horei	AY930100 1		34495295	38202260	_		_	_	
Change Incomis north	A1950100.1		34493293	36202200					
Cienochromis pectoralis	EU753938.1			2394143					
Ctenochromis polli	EU753941.1								
Ctenopharynx intermedius			62637876				_		
Ctenonhaivny nictus	EE585254								_
Comparing the formation of the	11/00/204		22255520	212040				-	
Cunningtonia longiventralis	AY682516.1		33355529	313049		-	-	-	-
Cyathochromis obliquidens			1881618						
Cyathopharynx foae									
			50262139						
Cyathopharyny furcifer			50262139 50262143	313042					
Cyathopharynx furcifer	AY337781.1		50262139 50262143	313043				-	
Cyathopharynx furcifer Cyclopharynx fwae	 AY337781.1 AY930099.1		50262139 50262143 18029958				-		
Cyathopharynx furcifer Cyclopharynx fwae Cynotilapia afra	 AY337781.1 AY930099.1 EF585264		50262139 50262143 18029958 58866394	313043 18265820					

6 | W W W. N A T U R E . C O M / N A T U R E

Cyprichromis cf. leptosoma 'yellow'			-	58379197		-	_		
Cyprichromis leptosoma	AY337786	GQ168023	58379152	18265812	GQ168212	GQ168338	GQ168086	GQ168149	GQ168275
Cyprichromis microlepidotus	AY740354.1		58379159	58379279					
Cyprichromis pavo	AY740382		58379186	58379285					
Cyprichromis sp. 'jumbo'				18265810					
Cyprichromis sp. 'zebra'				58379283				_	
Cyprichromis zonatus	AY740377.1		58379187	58379337					
Cyrtocara moorii	AY930089.1	18182230	529344	_				_	_
Dimidiochromis compressioens	FF585267	10102250	13235093	_					
Dimidiochiomis compressiveps	AE2052227		22521804						
Dimidiochiomis ktwinge	AI 303322	18182221	22551804						
Diminochromis strigatus		18182251							
Diplotaxodon aeneus			62637885						
Diplotaxodon apogon			62637887	_					
Diplotaxodon argenteus			62637889	_					_
Diplotaxodon brevimaxillaris	AF305264		22531746	_					
Diplotaxodon greenwoodi	AF305269.1	134268645	22531752	134303321	EF470868				
Diplotaxodon holochromis	AF305262.1		22531744	_				_	
Diplotarodon linnothrissa	AF305261		22531738	-			_	_	_
Diplotavodon limnothuissa blaak palvia	AI 305201		116178671						
Diplotaxodon tinnotin'issa black pervic	4.520.5266		(2(27002						
Diplotaxoaon macrops	AF505200		62657905						
Diplotaxodon macrops offshore			1161/8/08	-		-			
Diplotaxodon similis	AF305271		22531756					-	
Docimodus evelynae	EF585252								
Eclectochromis ornatus	EU661717.1							-	
Ectodus descampsii	AY337790.1	18182232	18029950	313060					
Enantiopus melanogenvs	AY682517		33355554	33356000					
Enterochromis cinctus			7595588						
Enterochromis sp. "I F."	10050385								
Fretmodus cvanostictus	AE209220	G0169010	5018040	5019022	G0169209	C0169224	G0169092	60169145	60169271
Et e mouti	CO167777	\$2100021	5910049	5916033	CO149164	CO1(9394	CO1/2022	CO1(2001	CO1(92)7
Ena ngun	GQ167777	38199021			GQ168154	GQ168280	GQ168029	GQ168091	GQ168217
Eiropius canarensis		AY662713		-	AY662816	_			
Etroplus maculatus	AP009505.1	EF095604	-		AY662818	_	-		-
Etroplus suratensis		AY263829	_		AY662817				_
Exochochromis anagenys			22531797	_			_	_	
Fossorochromis rostratus	EF585281		62637908					_	
Gaurochromis simpsoni		33090458	7595580						
Gaurochromis sp. "LE"	JO950386			_				_	_
Genvochromis sp. EE	AF305297		1881619	_					
Conhumo aluomia Innei	11 505257		62627010						
Gephyrochromis lawsi	43/(02510	10102222	5527(010	102(5024					
Gnathochromis permaxillaris	AY682519	18182233	55276010	18265834					
Gnathochromis pfefferi	EF679245		18029974	18265836					
Gobiocichla ethelwynnae		58199022							
Gobiocichla wonderi	GQ167778	GQ167967			GQ168155	GQ168281	GQ168030	GQ168092	GQ168218
Grammatotria lemairii	AY337787.1	18182234	313068	313063					
Greenwoodochromis bellcrossi	AY682523		55276012					_	
Greenwoodochromis christvi	AY682525		55276016						
Hanlochromis adolfifrederici			30143182	-	_	_		-	
Haplochromis astatodov			30143158						
Haplochromis astatoaon			30143138	220 41 20				-	
Haplochromis chala			2394106	2394129					
Haplochromis crebridens			30143181						
Haplochromis gracilior	AY930079		30143255					-	
Haplochromis graueri			30143123						
Haplochromis insidiae	AY930077.1		30143094						
Haplochromis lividus			7595585						
Hanlochromis microchrysomelas			30143162						_
Haplochromis nigroides			30143144	_					
Haplochromis nigrotites	4.V020007		60550027						
II de la contra de la	A1950097		20142122	-				-	
Haplochromis occultaens			50145155						-
Haplochromis olivaceus			30143126					-	
Haplochromis paucidens			30143108						
Haplochromis sp. "purple yellow"	JQ950387			_				_	_
Haplochromis rubescens			30143088						
Haplochromis scheffersi			30143097	_					_
Haplochromis sp. "crebridens/olivaceus"			30143113						
Havlochromis sp. "Favoum"	EU753945.1								
Hanlochromis sp. "Kanyaboli"	EU753944 1		_		_	_			_
Hanlochromis sp. "Kisapaani"	AY930062 1			-	-	-	-	~	
Hanlochromis sp. "Mhura Dlaale"	EU752046 1					-			
Haplochuomis sp. Mouro Black	EU753940.1			ELIZED022				_	
Hardenburger set Statistical and an	EU/33928			EU/338/7					_
Trapiochromis sp. "thick skin"	JQ950388								
Haplochromis vittatus			30143178						
Haplotaxodon microlepis	EF437498.1		55276018	EF679278					
Haplotaxodon trifasciatus	AY682531		55276020						_
Harpagochromis guiarti			48773073						
Harpagochromis sp. "LE"	JQ950389								
Harpagochromis squamipinnis	EU753943.1		30143214	_		_	_		_
Hemibates stenosoma	AY663719.1		52221320	52221276					
Hemichromis bimeculatus		4001004	52221520	2304111	~	_	~		
Homioluomis olongatus	AV662714.1	4091094 CO169001	112725225	2394111	C0169190	C0149215	C0169062	C0169126	C0169252
Tremenromis elonganis	A 1 005/14.1	60108001	112/35225		GQ168189	GQ108315	GQ168063	GQ168126	GQ168252
Hemichromis guttatus		58199023			AY662866				
Hemitilapia oxyrhyncha	EF585277						_		-
Heterochromis multidens	GQ167779	4321412		18265806	AF113060	GQ168282	GQ168031	GQ168093	GQ168219
Iodotropheus sprengerae			1881620					_	
Iranocichla hormuzensis	GQ167830	GQ168018	_	_	GQ168207	GQ168333	GQ168081	GQ168144	GQ168270
Julidochromis affinis			510122						
Julidochromis brichardi	EE462222		510122						
Julidochromis diebeldi	EE462220								
Julida abuomia manliani	DO055020		 510121	 510120					
Juidochromis mariteri	DQ055039		510121	510120					
Jundochromis ornatus	EF191082		47116853						
Julidochromis regani	EF462228	134268652	393079	340559	EF470870		-	-	
Julidochromis transcriptus	EF462231					_	_	-	
Konia dikume	AJ845104		55468948	1		_	_		_
Konia eisentrauti	AJ845102		55468946	1					
Labeotropheus fuelleborni	EF585259		1881622						_
Labeotropheus trewavasae	EF585283		7595685						_

T - Lida damania da	13/510303	757(170	10046020	124202220	EE 450051				
Labidochromis caeruleus	AY/40383	/5/64/8	10046829	134303329	EF470871				-
Labidochromis gigas	EF585276								_
Labidochromis vellicans			62637911						
Labrochromis ishmaeli		18182235							
Lamprologus callipterus	EF462258		47116775	510127					
Lamprologus congoensis	AY740385	-	510132	510128					-
Lamprologus cunningtoni	JQ950365			JQ950368					
Lamprologus kungweensis	EF191084								_
Lamprologus laparogramma	EF462278								
Lamprologus lemairii	EF191093	-	47116856	JQ950369					_
Lamprologus meleagris	EF191097	_	67553148						_
amprologus mocauardi	AF398225	_	510142	510141					_
amprologus ocellatus	FF191114		510112		-		_	_	
	EF191114	_			_				_
amprologus ornatipinnis	EF191110	-							
amprologus savoryi	JQ950366	-		JQ950370					
amprologus signatus	EF191086								-
amprologus speciosus	DQ055032		67553153						
amprologus teugelsi	DQ055059		67553174						
amprologus werneri	_	-	510144	510143				-	
enidiolamprologus attenuatus	AY682532.1		55276021	JO950371					_
epidiolamprologus cumpinatori	DO055053		50916249	-	_				
anidiolamprologus elamontus	DQ055035	18182227	67552142	510125					
epiaioiamproiogus eiongatus	DQ055021	18182237	07553142	510135				-	
epiaiolamprologus kendalli	DQ055042	-	67553160					-	
epidiolamprologus nkambae	DQ055046		67553165						
epidiolamprologus profundicola	DQ055025		47116841						_
epidolamprologus elongatus	EF679248			EF679280				_	
estradea perspicax	AY337765		313074	313072				_	
estradea stannersii	AY337792 1		33355527	33356028				_	
athrinons altus	11337792.1		62637018	55550020					_
enn mops unus	1107252	-	520241						
ethrinops auritus	00/252		529341						-
ethrinops furcifer	AF305316		22531798						
ethrinops gossei	AF305290		22531772						
ethrinops longipinnis	AF305295	-	22531777					-	
ethrinops microdon	AF305292		22531774						_
ethrinops mylodon		_	62637926						_
thrinons oliveri	4F305288		22531770	_	-		_	_	
theirops palli	A1 505200		62627021						
immops point	43/(02522	-	5527(022						
imnochromis abeelei	AY682533	-	55276022						
imnochromis auritus	AF398216		313071	313069					-
imnochromis staneri	AY682538	-	55276030						
imnotilapia dardennii	DQ093109		34495299	38202268					
ipochromis cryptodon	JQ950390								
ipochromis maxillaris			60550087						-
inochromis melanonterus	_	-	7595589				_	_	
inochromis abesus	_		529342		_				
ipochiomis obesus	10050201		529542						
ipochromis sp. "velvet cryptodon"	JQ950391								
obochilotes labiatus	EF679250		393083	18265844					-
laravichromis mola	EF585274								-
laylandia callainos	EF585271	-	7595682					-	_
laylandia estherae		18182238						_	
avlandia zebra	DO093114.1	33090452	60550078		EF470875				-
chenga eucinostomus	EF585268							-	
alanochromis awatus	AV020060 1		402097						
ciunochionis alastad	A 1930009.1		403987						
etanochromis etastoaema			0203/935						
elanochromis heterochromis	-		403997				-	-	
elanochromis johannii			404001						
elanochromis melanopterus			404005			_		_	
elanochromis parallelus			404006						
elanochromis simulans	-	_	404003			_		_	_
elanochromis vermivorus	EF585270	_						_	
etriaclima zebra		_		134303335				_	
ierodontochnomis notre divertualie	AV227702 1		33344441	33356100					-
crouomochromis rounaiventralis	A1557795.1		22265510	33330100					_
croaontochromis tenuidentatus	AY 357/84.1		33335549	513075					-
yaka myaka	AJ845106	-	55468950	1			-	-	-
ylochromis anaphyrmus	AF305321		22531803						-
vlochromis ericotaenia			62637938					_	_
vlochromis labidodon			13235351					_	_
vlochromis lateristriga			7595686						_
anochromis parilus		GO168003			GO168191	GO168317	GO168065	GO168128	GO16825
pochromis pulocaudalis		18182245	7505607		02100171	52100517	02100005	0.2100120	0.010025
alamma la marchifera si stra	EE4(2242	10102243	1393001						_
eolamprologus bijasciatus	EF462240							-	-
eotamprologus boulengeri	-	-	67553155					-	_
eolamprologus brevis	DQ055020		510159						-
eolamprologus brichardi	EF462245	33090455	510161	510158					
eolamprologus buescheri	DQ055033	_	67553154					_	_
eolamprologus calliurus	EF191083		510163						-
eolamprologus caudopunctatus	AV740388		108793969					_	_
eolamprologus christvi	AV740290 1		510157	510162					
laalammualaans anlindri	EE460004		510157	510102					
reoramprotogus cytinaricus	EF402224		510105						_
eolamprologus devosi	EF437476.1	_							_

Neolamprologus caudop Neolamprologus christyi Neolamprologus cylindri Neolamprologus devosi

Neolamprologus falicula

Neolamprologus fasciatus

Neolamprologus furcifer

Neolamprologus gracilis

Neolamprologus hecqui

Neolamprologus leleupi

Neolamprologus leloupi

Neolamprologus meeli

Neolamprologus modestus

Neolamprologus mondabu

Neolamprologus mustax

Neolamprologus multifasciatus

Neolamprologus helianthus

Neolamprologus longicaudata

Neolamprologus marunguensis

EF462246

EF191119

EF462249

DQ055041

DQ055013

DQ093113

EF191103.1

AY740390.1

DQ055051

DQ055012

EF462241

EF191089

EF462223

EF462250

47116843

18254012

67553139

18254007

510171

18254002

67553169

47116917

47116855

510168

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18307833

18307823

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Neolamprologus niger	AY740391.1	-						
Neolamprologus nigriventris	AY740392.1							
No lanpi ologilo nigi renin io	111710002.1		10254004	10205015				
Neolamprologus olivaceous	A1/40595.1		18254004	1850/81/				
Neolamprologus palmeri	AY740394.1							
Naolamprologus pactorolis	EE462238							
Neolumprologus pectorulis	EF402230							
Neolamprologus petricola			47116831		-			
Neolamprologus prochilus	EF462248	_	_		_			
N 1 1 1 1	EF 162216		4711(770	10207020				
Neolamprologus pulcher	EF462244		4/116//8	1830/839				
Neolamprologus savorvi	EF462247		18254001	18307807				
Naalammalaana similia	EE101100		67552151					
Neolamprologus similis	EF191100		6/555151					
Neolamprologus splendens			18254013	18307835	_			
Naclampuclogue tetucoauthue	EE462220		50016262					
Neolamprologus leiracaninus	EF402220		50910205					
Neolamprologus toae	JQ950364	-	510176	510175	-			
Naolammelogus tratocanhalus	EE462210		47116857	EE670285				
Neolamprologus trelocephalus	EF402219		4/11065/	EF0/9285				
Neolamprologus variostigma	DQ055028		67553149					
Neolamprologus ventralis	EE462233			_				
Notamprotogus remains	EFICIALS							
Neolamprologus wauthioni	EF191116							
Nimbochromis fuscotaeniatus	_	134268656	_	134303333	EF470872			
Nimberdunania linni	EE665270		E996620E					
Nimbochromis linni	EF585279		58866395					
Nimbochromis livingstonii	EU753948.1		62637942					
Nimbochromis polystigma	EE585262		13235340					
Nimboeni omis polysiiginu	L1 303202	-	13233349		_	-		-
Nimbochromis venustus	EU753947.1		11602783					
Onhthalmotilania hoons	AV337773 1		50262165	33356010				-
Opininalmontapia ooops	A1557775.1	-	50202105	55550010	_			
Ophthalmotilapia heterodonta		-	12830449		-			
Ophthalmotilapia nasuta	AY337783.1		12830454	33356070				
	11100770011		22055101	212001				
Ophthalmotilapia ventralis	AY 55///4.1		33333323	313081	-			
Opthalmotilapia heterodonta	EF679254			EF679286				
Oreochromis amphimalas	AF317220.1		15/120675	18076051				
or courronnis amprimetas	Ar51/250.1		15428075	100/0031				
Oreochromis andersonii	GQ167805	GQ167994	15428673		GQ168182	GQ168308	GQ168056	GQ168119
Oreochromis aureus	DO465029	90018769	24635221	14161580				
	100403029	20010/09	24033221	14101300				
Oreochromis esculentus	AF317232.1	58199024	15428667	18076057				
Oreochromis jipe			15428678					
On the state of th	DOMESTIC	1242000	15420070	12420222	EE 450052			
Oreochromis karongae	DQ465030	134268654	15429056	134303325	EF470873			
Oreochromis leucostictus	AF317233 1		116672807					
Quaa ahuamia maayoo - h.t	AF217226.1	-	1100/2007					
Oreochromis macrochir	Ar51/235.1							
Oreochromis malagarasi			15428649	2394115				
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Oreochromis mortimeri			15429057					
Oreochromis mossambicus	AF317234.1	33090451	15428652	4903283	_			
Orachromis muaruansis	AE317236							
Oreochromis inwertiensis	AF517250							
Oreochromis niloticus	AF317237	5114129	15429060	24635169	GQ168157	GQ168283	GQ168032	GQ168094
Oreochromis niloticus baringoensis			_	18076054				
or even onis moneus our ingoensis	1 221 2220 1			10070004				
Oreochromis schwebischi	AF317238.1							
Oreochromis tanganicae	AF317240	GO167971	313080	13224	GO168159	GO168285	GO168034	GO168096
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Oreochromis urolepis	AF51/259.1		15428655					
Oreochromis variabilis	AF317241.1							
Outho chuomis an			10050406					
Orinochromis sp.			JQ950400					
Orthochromis sp.			JQ950407					
Orthochromis kasuluansis	AV930049.1		60549997	_				
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**RESEARCH** SUPPLEMENTARY INFORMATION

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Petrochromis polyodon	JO755357		50916264	JO755399	_				
	50100001			50155555					
Petrochromsi sp. "moshi"	EF679256			EF679288					
Petrochromis trewavasae		_	47156790	38202300					
Patvotilania viava	EU661721.1								
r enomapia nigra	EU001/21.1								
Pharyngochromis acuticeps	AY930094		58866300						
Pharvngochromis sp.			JO950408						
Phanmachromis sp. DAL-2005			58866322						
I nur yngoeni onnis sp. DAG-2005	_	_	56666522		_				
Placidochromis cJ. subocularis MRI-2005			62637950						
Placidochromis johnstoni	EF585269	-			-	-			
Placidochromis milomo	EE585251		393087					_	
Plana in the last	11000201	10100010	1055007						
Platytaeniodus degeni	AY930064.1	18182249	48773064						
Plecodus elaviae	EF437504	-			-	_			
Placodus multidantatus	EE437505.1								
r lecouis multidentalus	EF457505.1	-				-			
Plecodus paradoxus	EF437499								
Plecodus straeleni	AF398221		313092	313090					
Pusanathashuomis dautau			48772070						
r rognumochromis dentex			40773070						
Prognathochromis longirostris			48773069						
Prognathochromis paraguiarti			48773072						
Prograthe chronic on "I E"	10050202								
Frognainochromis sp. LE	10920292								
Prognathochromis venator			7595599						
Protomelas annectens	EU661718.1		13235352						
Bustomalas for actuatus	41205201		7505697						
Frotometas jenestratus	AF 505501		/ 59508 /						
Protomelas insignis		_	62637951						
Protomelas similis	FU661714.1				_				
	ECOULTE								
Protomeias spilopterus	EF585255								
Protomelas taeniolatus	AF305302	_	22531784						
Pranmochromis vinovianus			7505502						
1 summocm omis riponiumus			1393392						
Pseudocrenilabrus sp. "broad head black pelvic"			JQ950409						
Pseudocrenilabrus sp. "dwarf black pelvic"			JQ950410			_			_
Pseudocrenilabrus en "fire tail"			JO950411						
D I III III	-		0,050411						_
Pseudocrenilabrus sp. "green weed picker"			JQ950412			-			
Pseudocrenilabrus sp. "grev back"			JQ950413						
Psaudoceanilabaus on "area ma			10050414		_	_	_		
r senaocrennaorus sp. grey moeruensis			JQ950414						
Pseudocrenilabrus sp. "long brown"	-		JQ950415	-		-			-
Pseudocrenilabrus sp. "long grey"			JO950416						
	EU562026.1		50066215						
Pseudocrenilabrus machadoi	EU/53936.1		58866515						
Pseudocrenilabrus multicolor	AY930070.1		18029960	18265824					
Pseudocrevilabrus multicolor victoriae	AV930070		60550018		_	_			
I sendocremitabilis manicolor vicioriae	A1930070	_	00550018		_	_			
Pseudocrenilabrus nicholsi	AY602994		47498977	47118406					
Pseudocrenilabrus sp. "pale deep"			JO950417						
De su de sus sile have subjiles des	437(02002.1		47717061	47119404					
r seudocreniiddrus philander	A 1 002995.1		4//1/201	4/118404					
Pseudocrenilabrus sp. "blue Lunzua River"	EU753951.1		47717289						
Pseudocrenilabrus sn. "orange Mwatishi River"	EU753952.1		47717269						
P d d d d d d d d d d d d d d d d d d d	10100002.1		10050400						
Pseudocrenilabrus sp. "telmatochromis-like"			JQ950418						
Pseudocrenilabrus sp. "weed picker"			JO950419						
Praudorimochromis cumifrons			18020082	19265949					
r seudosimocm omis cur vijrons		-	10029902	10203040	-	-			-
Pseudotropheus aurora	EF585266								
Pseudotropheus barlowi		_	1881627			_			
Praudotrophaus anabro	EE585256								
r senaoiropneus crabro	EF 385250								
Pseudotropheus elongatus	EF585272								
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Pseudotropheus lanisticola         Pseudotropheus livingstonii         Pseudotropheus livingstonii         Pseudotropheus iropheops         Pseudotropheus tropheops gracilior         Pseudotropheus stropheops gracilior         Pseudotromis stropheops gracilior         Pseudotromis stenograthus         Prochoromis calliurus         Rhamphochromis esca         Rhamphochromis senacrophthalmus <t< td=""><td>EF585272 AY930061.1 EF585258 AY740384.1 EF585260 GQ167807 GQ167807 AP009507.1 AP009507.1 AP009507.1 AP009507.1 AP009507.1 AY930059 JQ950394 AJ845101.1 AY682544 AF305252.1 AF305252.1 AF305254.1 AF305254.1 AF305254.1 AF305254.1 EF393682</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>GQ168225</td></t<>	EF585272 AY930061.1 EF585258 AY740384.1 EF585260 GQ167807 GQ167807 AP009507.1 AP009507.1 AP009507.1 AP009507.1 AP009507.1 AY930059 JQ950394 AJ845101.1 AY682544 AF305252.1 AF305252.1 AF305254.1 AF305254.1 AF305254.1 AF305254.1 EF393682								GQ168225
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Same almania an Machanaia?			126016722						
Sargochromis sp. "Karuensis"	-		120015/33						
Sargochromis sp. "Lisikili"	-		JQ950427						
Sargochromis sp. SK-2007	_		126015743						
Same shaanis on "Zamhasi"			AV012070 1						
Sargochromis sp. "Zambesi	-		AY9138/8.1						_
Sargochromis sp. "thin face green"			JQ950428						
Sargochromis sp. "vellow face mellandi"			JO950429						-
Saratharadan carali	A 1845113		55468056	1					
Sarotherouon curoti	AJ04J115		55408950						
Sarotherodon caudomarginatus	AF317243.1	GQ167975			GQ168163	GQ168289	GQ168038	GQ168100	GQ168226
Sarotherodon galilaeus	AF317244		15429064	14161582					
Sarotherodon galilaeus Cross		-	1	1		_	_	_	_
			1						
Sarotherodon galilaeus Ejagham			1						
Sarotherodon galilaeus Meme	-		1	1					-
Sarotherodon galilaeus multifasciatus	A 1845087 1		55468930						-
Sand and an all and a second second	A 1045005 1		55100500	1					
Sarotherodon gattaetis sanagaensis	AJ845085.1		55468929						-
Sarotherodon linnellii	AJ845114		55468958	1					
Sarotherodon lohbergeri	AJ845108		55468952	1					
Sanothanodon malanothanon	AE217245 1	CO167076	10560083	14124124	-				
Suromerouon merunomeron	AF517245.1	0010/9/0	19509085	14134134					
Sarotherodon mvogoi	GQ167811	GQ168000			GQ168188	GQ168314	GQ168062	GQ168125	GQ168251
Sarotherodon nigripinnis	AJ845084.1		19568978		GQ168164	GQ168290	GQ168039	GQ168101	GQ168227
Sarotharodon occidantalis	AE317246.1		-	-					
Sur other odon occutemants	AI 517240.1	0.01/10.00				0.01/0.001	0.01/00/0		
Sarotherodon sp. aff. galilaeus "mudteeder"		GQ16/9//			GQ168165	GQ168291	GQ168040	GQ168102	GQ168228
Sarotherodon sp. "bighead"	AJ845091.1		55468935				-		
Sarotherodon sp. "mudfeeder"	AJ845092.1		55468936				_		
Sanathana dan atainha ahi	A 1945110	10102244	55469054	1					
Sarotherodon steinbacht	AJ845110	18182244	55408954						-
Schwetzochromis neodon	EU753957.1								-
Schwetzochromis stormsi	AY930057	_	60550005						
Scigenochromis henthicola	AF205208	_	22521790						
	AF 505298		22331780						
Sciaenochromis gracilis			13235350						-
Sciaenochromis psammophilus	AF305324		22531806						-
Sciaenochromis spilostichus	_		62637040						
Commendation of the second	EE202.007.1		62037340						
Serranochromis allus	EF393697.1	-	58866372						-
Serranochromis angusticeps	EF393685		58866380			_			
Serranochromis angusticens vellow			JO950430						_
Sarranochromis of altur		_	10050421	_	_	_	_		
serranoenromis ej. anus		-	3Q950451						
Serranochromis cf. macrocephalus	-	_	JQ950432		_	_			-
Serranochromis sp. "checkerboard"		_	JO950433						
Serranachromis sp. "dark long body"	_		JO050434						
our anothromis sp. tark long body			30930434						_
Serranochromis sp. "deep red"	-	_	JQ950435				-		
Serranochromis sp. "diplotaxodon face"			JQ950436						
Serranochromis longimanus			126015680						
Serranden omis ionginanas	-		120015080				-		
Serranochromis sp. "long body"			JQ950437						-
Serranochromis sp. "long face blue"	_		JQ950438						_
Serranochromis sp. "long pelvic"	-		JO950439	-		_	_	_	_
Servinoen omis sp. Tong pervie	EE202(00		500((0))						
Serranochromis macrocephalus	EF393689		58866317						-
Serranochromis macrocephalus "deep body"			JQ950440						_
Serranochromis meridianus			58866343						
Server of the se	EE202686	\$114121	126015708						
Serranochromis robustus	EF 393080	5114151	126015/08						
Serranochromis sp. "silver long body"			JQ950441						
Serranochromis stappersi	EF393698		58866385						_
Seman e chuennie themperer	EF202702		50066200						
Serranochromis inumbergi	EF 595705		58800298						-
Simochromis babaulti	DQ093110		1110522	13504					-
Simochromis diagramma	AY930087.1		1055357	38202310					
Simochyomic manginatur	AV020088 1		1245280	10755414					
Simoenromis marginanis	A1950088.1		1243309	JQ/55414					-
Spathodus erythrodon	AF317267.1		1617160	5918217					
Spathodus marlieri	EE679260	-	1617164	5918215			-		
Spanouis marien	CO1(7790	CO1(7078	101/104	5710215	CO1(81(	CO1(8202	CO1(2041	CO1(8102	CO1(922)
Steatocranus bleheri	GQ167789	GQ16/9/8			GQ168166	GQ168292	GQ168041	GQ168103	GQ168229
Steatocranus casuarius	AF317247.1	GQ167979		2394147	GQ168167	GQ168293	GQ168042	GQ168104	GQ168230
Steatocranus gibbicens		GO167980			GO168168	GO168294	GO168043	GO168105	GO168231
Stanta manage al-han		CO169005			CO1(9102	CO1(8210	CO169067	C01(9120	CO1(925)
Steatocranus glaber		GQ108005			GQ108195	GQ108519	GQ108007	GQ108150	GQ108250
Steatocranus irvinei	GQ167792	GQ167981			GQ168169	GQ168295	GQ168044	GQ168106	GQ168232
Steatocranus sp. "bulky head"	GO167793	GO167982			GO168170	GO168296	GO168045	GO168107	GO168233
Staatoguanus on "Awart?"		CO167083			G0168171	G0168207	G0168046	G0168108	G016823
Charles and a sp. uwall		00107903			001001/1	00100297	00100040	00100108	00100234
Steatocranus sp. "redeye"	GQ167808	GQ167997			GQ168185	GQ168311	GQ168059	GQ168122	GQ168248
Steatocranus tinanti	AF317248.1	58199027			GQ168172	GQ168298	GQ168047	GQ168109	GQ168235
Steatocranus ubanquiensis	_	GO168014			GO168203	G0168320	G0168077	G0168140	G0168264
Celana de alimento moderal		02100014	(2(27002	-	52100205	52106529	521000//	52100140	52106200
sugmalochromis modestils			02037982						
Stigmatochromis woodi	AF305299	_	7595688						
Stomatepia mariae	AF317279	18182242	55468940	1	GQ168173	GQ168299	GQ168048	GQ168110	GQ168236
Stomatenia mongo	A 1845004		55468038	1					
Stamatania niudu	A TO 45000	10102242	55-00750						-
Stomatepia pindu	AJ845098	18182243	55468942	1					-
Taeniochromis holotaenia	-	_	62637987		-				-
Taeniolethrinops furcicauda	EF585263		62637984						_
Taeniolethrinons laticans	AE205205		22501707						
The state of the s	AF 303303		22031/0/						_
1 aeniolethrinops praeorbitalis	AF305318		22531800						
Tanganicodus irsacae	AF398219	_	1617161	313093					
Telmatochromis hifrenatus	D0055009		510217	510215					
Talmatashuomis bui-h-m-di	EE460006		510217	510215					
Leimaiochromis brichardi	EF462236	-							-
Telmatochromis burgeoni		_	510218	510216					
Telmatochromis dhonti	EF679266		47116792	EF679298					
Talmataaluoomis an	21017200	10103340		21077270					
reimaiochromis sp.		18182240							
Telmatochromis temporalis	EF462234	-	47116796	EF679293	-	-			_
Telmatochromis vittatus	AY740396	_	510222	510221					_
Talotramatocava presidente			52221217	\$2221274	-	-	~		
Telotrematocara macrostoma			52221317	52221274					-
Thoracochromis albolabris	EU753929.1		58866301						-
Thoracochromis avium	JQ950396	_			-	_	_		_
Thoracochromis brauschi	4 1030080	G0168007	301/12259		G0168105	G0168221	G0168060	G0168122	G0168259
The account of a state	A 1 950080	0010900/	50145238		00109195	0Q108521	3Q108009	5Q108132	3Q108238
1 horacochromis buysi	EU753933.1	_	58866305						-
Thoracochromis demeusii			58866311						-
Thoracochromis mahagiansis	10050307								
	10292029/	_							_
Inoracochromis moeruensis black		_	JQ950442						-
Thoracochromis moeruensis yellow			JQ950443						_
Thoracochromis oligacanthus	AF416779.1								
Theorem on the origination of th	10020200			-					-
1 noracocnromis petronius	JQ950398	-	-		-				-
Thoracochromis pharyngalis	JQ950399	-	JQ950404		_				
Thoracochromis sp. "pundamilia-like"		_	JQ950444						_
Thoracochromis sp. "red spotted fin"	_	_	10050445	_				_	
m i i i i i i i	TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT		10220443						_
the second second second second second	EU752042-1						_		

Thouseochyomic wingstij	10050400				-	-			
Thoracochromis wingatti	JQ950400								
Thysochromis ansorgii	AY003/13.1								-
Tilapia ap. aff. rheophila Samou		GQ168013			GQ168202	GQ168328	GQ168076	GQ168139	GQ168265
Tilapia bakossi			1	1					-
Tilapia bemini			15428684	1					_
Tilapia bilineata Lefini	GQ167775	GQ167964			GQ168152	GQ168278	GQ168027	GQ168089	GQ168215
Tilapia bilineata Salonga		GO168012			GO168201	GO168327	GO168075	GO168138	GO168264
Tilapia brevimanus	AF317249.1	GO168016			GO168205	GO168331	GO168079	GO168142	GO168268
Tilapia busumana	AF317250.1	GQ167987	-	1	GQ168175	GQ168301	GQ168049	GQ168112	GQ168238
Tilapia buttikefavi	AE217251.1	CQ167086			GQ168174	GQ168301	00100047	CQ168111	CQ169227
	AF317251.1	GQ10/980			GQ108174	6Q108500		GQ108111	GQ108237
Tilapia cabrae	AF31/252.1								_
Tilapia cessiana	AF317253.1								-
Tilapia cf. nyongana Dja		GQ168015			GQ168204	GQ168330	GQ168078	GQ168141	GQ168267
Tilapia cf. rheophila	GQ167825								
Tilapia coffea	AF317254.1								
Tilapia dageti	GO167821	GO168010			GO168198	GO168324	GO168072	GO168135	GO168261
Tilania deckerti Fia	-		1	1	-	_	-	-	- (
Tilapia discolor	AE217255 1	CO167000	15428686		CO168178	G0168304	CO168052	G0168115	G0168241
Tilapia discolor	AF317233.1	00107330	15420000		00100178	00100304	00108052	00108115	UQ106241
			1	-					
Tilapia Eja large			1	1					
Tilapia Eja littleone			1	1					
Tilapia flava			1	1					
Tilapia guineensis Cross			1	1					
Tilapia guineensis Ivoire			1	1					
Tilapia guineensis Nguti				1					
Tilanja guinasana	G0167802	GO167991			GO168170	GO168305	GO168053	G0168116	GO168242
Tilania guineensis	AF217256 1	G0168025	15428685		G0168214	GQ168340	GQ168089	G0168151	G0168277
Tilapia guttunona	Ar51/250.1	0Q108025	13420003		0Q106214	04000340	0.0109088	0010101	001002//
Thapid guintrosa			1	1					
1 llapla imbriferna			1	1					
Tilapia joka	GQ167803	GQ167992			GQ168180	GQ168306	GQ168054	GQ168117	GQ168243
Tilapia kottae			1	1				_	_
Tilapia louka	AF317257.1	GQ168011			GQ168199	GQ168325	GQ168073	GQ168136	GQ168262
Tilapia mariae	AF317258.1	GO168026	15428683	1	GO168200	GO168326	GO168074	GO168137	GO168263
Tilapia rendalli	AF317259.1		15428689	2394117	_			_	_
Tilapia ruvati	G0167799	GO167988	15428602	2071117	G0168176	G0168302	GO168050	G0168113	GO168230
Tilapia andana a	0010////	0010/200	10420092		00100170	0Q100502	00108050	00100115	00100255
Tilapia sp. aff. zillii Kisangani		GQ168017			GQ168206	GQ168332	GQ168080	GQ168143	GQ168269
Tilapia sparrmanii	AF317260.1	134268651	15428693	134303319	EF470877	GQ168303	GQ168051	GQ168114	GQ168240
Tilapia tholloni	GQ167804	GQ167993			GQ168181	GQ168307	GQ168055	GQ168118	GQ168244
Tilapia walteri	AF317261.1								_
Tilapia zillii	AF317262.1	GQ168024	15428690	1	GQ168213	GQ168339	GQ168087	GQ168150	GQ168276
Tramitichromis brevis	AF305320		22531802						
Tramitichromis intermedius			62637992						_
Tramitichromis lituris	_	_	13235348	_	_	_	_	_	
Tramitichiomis tituris	4E205210		22521801					-	-
Tramilichromis variabilis	AF 505519		22551801						
Trematocara macrostoma	AY663/15.1								
Trematocranus placodon	EF585261		62637990						-
Trematocara unimaculatum	AF317268.1		52221316	18265840					
Triglachromis otostigma	AF398217		510220	510219					_
Tristramella simonis	AF317276.1	GQ168002			GQ168190	GQ168316	GQ168064	GQ168127	GQ168253
Tropheus annectens			13736	64099					_
Tropheus brichardi	AY930086.1		13746	13742			_		_
Tropheus duboisi	AV020085.1	124268655	13757	13751	EE470878				
Tropheus autobisi	A1950085.1	154208055	13737	13751	L14/08/8				
Tropheus sp. kasabae			13779	13773					
Tropheus moorii	JQ950401	7576475	1495721	13781					-
Tropheus polli	AY930084.1		13865	13852					-
Tylochromis bangwelensis			112735228						
Tylochromis cf. variabilis MK-2006			112735226						
Tylochromis lateralis			112735227						
Tvlochromis leonensis	AF317274.1	33090449							
Tylochromis mylodon			112735229					_	_
Tylochromis polylenis	AB018973.2	5114133	112735238	18265850	U70337				
Tylochromis nulchov	110107/5.2	58100029		10203030	070557				_
Tylochuomis pucher		58199028			 CO169196	C01(9212		C01(9122	
1 yiocnromis sp.					GQ168186	GQ168312	GQ168060	GQ168123	GQ168249
Tyrannochromis nigriventer	AF305307		22531789						
Variabilichromis moorii	DQ055016	18182236	85681972	510172	GQ168187	GQ168313	GQ168061	GQ168124	GQ168250
Xenochromis hecqui	EF437514.1								
Xenotilapia bathyphila	AY337789.1		33355557	33356090					_
Xenotilapia boulengeri			33355559	33356050					
Xenotilapia caudafasciata	AY337777.1		33355565	33356034					_
Xenotilapia flavipinnis	AY337794.1		33355560	33356026					_
Xenotilania longispinis	AV337778 1		33355567	33356038	_	_	_	_	
Venotilania melanogenus	ΔV6825171		55555507	55550050		-	-	-	_
Venetilania echnogenys	A 1002017.1		212101	212000					
Aenoniapia ochrogenys	AY55//6/.1		513101	313099					
Aenotilapia ornatipinnis		18182241							
Xenotilapia papilio	AY337776.1				_	_	_	_	_
Xenotilapia sima	AY337785.1		18029953	33356008				_	-
Xenotilapia sp. "papilio sunflower"			33355574	33356022					
Xenotilapia spiloptera	AY337788.1		33355570	33356032					_
Xystichromis phytophagus	AY930076 1		51320047					_	
Vesichromis lanarogramma	10050402		7505582	-		_			
Vasiahuamia numbaaan kalua	JQ950402	10100046	AD420210						
Issichromis pyrrhocephalus	3Q950403	18182246	AB459518		-		_	_	_
Lake Saka species I (A8/0MPC18)	JQ950372								
Lake Saka Species 2 (A994MPK8)	JQ950373								_
Cumatogastan agguagata (outgroup)									
Cymaiogasier aggregaia (ouigioup)	AP009128.1	AY662711		AF370623	AY662811		_	-	_
Embiotoca jacksoni (outgroup)	AP009128.1	AY662711 AY662712		AF370623 AF159331	AY662811 AY662812				

<sup>1</sup> Sequence from Schliewen UK, Tautz D, Paabo S (1994) Sympatric Speciation Suggested By Monophyly Of Crater Lake Cichlids. Nature 368, 629-632.

**Supplementary Table 2** Correlation between binary predictor variables, measured as  $r_{r_{t}}$ , the likelihood- based equivalent of  $r^{2}$  for binary variables. Mouthbrooding and polygamous mating systems are significantly correlated.

	predators	polygamy	eggspots	haplo eggspots	sexual dichromatism	mouthbrooding
predators		0.106	0.016	0.022	0.054	0.063
polygamy	-		0.271	0.185	0.409	0.823
eggspots	-	+		0.560	0.261	0.215
haplo eggspots	-	+	+		0.165	0.164
sexual dichromatism	-	+	+	+		0.297

Supplementary Table 3| Single predictor variable phylogenetic logistic regression reveals significant associations between cichlid diversification and lake depth, predators, mouthbrooding, sexual dichromatism, time for diversification, and lake age. When Lake Tanganyika is excluded the same variables are significant, and additionally there is are significant associations between diversification and lake surface area, latitude and egg spots. N = sample size. a = phylogenetic signal estimated for the regression.

Predictor		Full Dataset					Excluding Tanganyika					
Environmental Variables	N	Estimate	SE (±)	z-value	z-value p	а	Ν	Estimate	SE (±)	z-value	z-value p	а
Lake Surface Area	166	-0.062	0.043	-1.436	0.075	-2.365	150	-0.136	0.059	-2.329	0.010	-2.491
Lake Depth	156	0.342	0.090	3.794	0.000	-2.615	140	0.317	0.120	2.641	0.004	-2.956
Energy	166	0.010	0.009	1.080	0.140	-3.324	150	0.008	0.010	0.830	0.203	-3.520
Latitude	166	-0.043	0.027	-1.610	0.054	-3.396	150	-0.052	0.031	-1.670	0.047	-4.000
Latitude (residual)	166	-0.021	0.037	-0.575	0.283	-3.286	150	-0.032	0.041	-0.774	0.220	-3.362
Elevation	166	0.000	0.000	0.767	0.222	-3.457	150	0.000	0.000	0.640	0.261	-3.613
Predators	158	-0.532	0.311	-1.708	0.044	-2.719	142	-0.921	0.400	-2.304	0.011	-2.860
Traits												
Polygamous Mating System	161	0.472	0.494	0.957	0.169	-3.200	148	0.973	0.611	1.592	0.056	-3.178
Mouthbrooding	166	1.158	0.554	2.091	0.018	-2.905	151	0.937	0.605	1.549	0.061	-3.207
Egg spots	166	0.349	0.443	0.786	0.216	-3.368	151	0.858	0.457	1.877	0.030	-4.000
Haplochromine egg spots	166	0.327	0.452	0.722	0.235	-3.456	151	1.071	0.461	2.325	0.010	-4.000
Sexual Dichromatism	161	0.744	0.427	1.744	0.041	-2.656	147	1.284	0.520	2.468	0.007	-2.937
Time												
Time for Diversification	126	0.366	0.093	3.952	0.000	-2.848	112	0.462	0.176	2.629	0.004	-2.669
Lake Age	133	0.258	0.077	3.375	0.000	-2.937	117	0.249	0.113	2.197	0.014	-2.895

Supplementary Table 4| For radiations of five or more species, single predictor variable phylogenetic logistic regression reveals significant associations between radiation and lake depth, energy, latitude, mouthbrooding, time for diversification, and lake age. When Lake Tanganyika is excluded lake depth, egg spots, haplochromine egg spots, sexual dichromatism, time for diversification and lake age are significantly associated with radiation. N = sample size. a = phylogenetic signal estimated for the regression.

Predictor		Full Dataset						Excluding 7	Fanganyika			
Environmental Variables	N	Estimate	SE (±)	z-value	z-value p	а	Ν	Estimate	SE (±)	z-value	z-value p	а
Lake Surface Area	166	0.088	0.054	1.642	0.050	-1.902	150	0.005	0.055	0.091	0.464	-2.699
Lake Depth	156	0.471	0.115	4.095	0.000	-2.451	140	0.363	0.153	2.367	0.009	-2.679
Energy	166	0.018	0.011	1.666	0.048	-2.477	150	0.014	0.014	1.070	0.142	-2.880
Latitude	166	-0.054	0.031	-1.738	0.041	-2.149	150	-0.052	0.041	-1.256	0.105	-2.786
Latitude (residual)	166	0.005	0.028	0.172	0.432	-2.065	150	0.004	0.044	0.092	0.463	-2.713
Elevation	166	0.001	0.000	1.355	0.088	-2.473	150	0.001	0.001	1.240	0.107	-2.813
Predators	158	-0.033	0.239	-0.139	0.445	-2.026	142	-0.524	0.459	-1.142	0.127	-2.697
Traits												
Polygamous Mating System	161	0.305	0.655	0.466	0.321	-2.150	148	0.975	0.851	1.146	0.126	-2.587
Mouthbrooding	166	1.923	0.905	2.125	0.017	-1.052	151	0.833	0.845	0.986	0.162	-2.645
Egg spots	166	0.428	0.780	0.548	0.292	-1.401	151	1.374	0.757	1.814	0.035	-2.667
Haplochromine egg spots	166	-0.759	0.936	-0.811	0.209	-1.414	151	1.456	0.694	2.097	0.018	-2.914
Sexual Dichromatism	161	0.187	0.432	0.433	0.332	-1.914	147	1.310	0.679	1.929	0.027	-2.537
Time												
Time for Diversification	126	0.440	0.102	4.297	0.000	-2.488	112	0.521	0.197	2.647	0.004	-2.642
Lake Age	133	0.299	0.084	3.552	0.000	-2.429	117	0.235	0.124	1.897	0.029	-2.615

Full Dataset Excluding Lake Tanganyika nonphylogenetic phylogenetic nonphylogenetic phylogenetic Relative-Relativeimportance importance  $\pm$  SE ±SE Wald Z Estimate  $\pm$  SE ±SE Wald Z Predictor value Estimate Estimate value Estimate Lake Surface Area 0.998 -0.390 0.109 -0.254 0.076 -3.351 0.000 0.999 -0.442 0.120 -0.358 0.098 -3.639 0.000 Lake Depth 1.000 0.776 0.173 0.521 0.125 4.177 0.000 0.994 0.667 0.206 0.376 0.160 2.356 0.009 0.913 0.049 0.020 0.008 0.012 0.674 0.250 0.969 0.065 0.023 0.061 0.023 2.728 0.003 Energy 0.477 -0.051 0.034 0.484 -0.056 0.037 Residual Latitude 0.692 -0.001 0.001 -0.001 0.001 -1.256 0.105 0.877 -0.002 0.001 -0.001 0.001 -1.886 0.030 Elevation 0.517 0.569 0.365 0.361 0.344 0.304 Predators 0.254 0.199 0.252 0.265 -0.1050.159 Polygamous Mating System 0.504 -0 733 0 481 0 574 0.713 Egg dummies -1.126 Haplo egg dummies 0.755 1.335 0.620 -0.924 0.806 -1.146 0.126 0.900 2.168 0.905 0.343 0.697 0.493 0.311 Sexual Dichromatism 0.977 2.070 0.685 1.291 0.566 2.282 0.011 0.977 2.631 0.879 2.437 0.805 3.029 0.001

Supplementary Table 5| Full results for multiple regression models for diversification threshold 1. For summarized results, see Figure 2 in main text. Variables with relative importance scores of 0.6 or higher were included in the reduced phylogenetic logistic regression model.

Supplementary Table 6| Full results for multiple regression models for diversification threshold 5. For summarized results, see Figure 2 in main text. Variables with relative importance scores of 0.6 or higher were included in the reduced phylogenetic logistic regression model.

	Full Dataset							Excluding Lake Tanganyika						
	nonphyloger	netic		phylogene	etic			nonphyloge	netic		phylogene	etic		
Predictor	Relative- importance value	Estimate	± SE	Estimate	±SE	Wald Z		Relative- importance value	ative- atance Ilue Estimate		Estimate	±SE	Wald Z	
Lake Surface Area	0.484	-0.089	0.057					0.483	-0.095	0.061				
Lake Depth	1.000	0.636	0.170	0.460	0.125	3.691	0.000	0.610	0.243	0.137	0.221	0.172	1.289	0.099
Energy	0.748	0.040	0.021	0.028	0.020	1.416	0.078	0.860	0.060	0.026	0.041	0.024	1.718	0.043
Residual Latitude	0.265	-0.007	0.023					0.263	-0.007	0.025				
Elevation	0.328	-0.000	0.000					0.606	-0.001	0.001	-0.002	0.001	-1.691	0.045
Predators	0.339	0.205	0.223					0.333	-0.201	0.265				
Polygamous Mating System	0.358	-0.324	0.338					0.277	0.114	0.409				
Egg dummies	0.324	0.119	0.268					0.333	0.244	0.388				
Haplo egg dummies	0.629	0.821	0.461	0.649	0.627	1.037	0.150	0.824	1.666	0.743	1.493	0.761	1.961	0.025
Sexual Dichromatism	0.708	1.049	0.536	0.919	0.594	1.546	0.061	0.708	1.421	0.764	2.158	0.975	2.213	0.013

# **SUPPLEMENTARY FIGURES**



**Supplementary Figure 1**| **Phylogeny of African cichlid fishes.** The topology here is the best maximum likelihood topology from a full RAxML search.

Numbers on nodes are bootstrap values from 100 rounds of bootstrapping.



This panel corresponds with Figure 1a and is included here to facilitate translation between that figure and the taxa included in the tree. Here, as in Figure 1a, each tip represents one lineage in a lake (lake names are shown); red dots indicate diversifying lineages with at least one intralacustrine speciation event). This is the full tree shown in Supplementary Figure 1 trimmed to represent all lineages in lakes present in our dataset. Bars on nodes represent 95% confidence intervals drawn from the distribution of branching times among ultrametric bootstrap replicate trees. **b** The distribution of lake colonizations and intralacustrine diversification across the African cichlid phylogeny. Supplementary Figure 2| Phylogenetic relationships and diversification in lacustrine African cichlids. a Phylogenetic relationships among African cichlid lineages present in lakes.



Supplementary Figure 3 Correlation between continuous predictor variables. There is strong correlation between lake depth and time for diversification (r2 = 0.77) and between energy and latitude (r2 = -0.82). Red lines in panels on the lower triangle are lowess fits.

## Relative Importance



Supplementary Figure 4| Relative importance values derived from a cross-validation test, wherein the model averaging procedure was applied to random subsets of 75% of the total dataset. Results indicate high importance values for the same subset of predictors as in the full dataset (compare to Figure 2a). Gray bars represent 25% and 75% confidence intervals.



Supplementary Figure 5| Convergence diagnostic plots for MCMCglmm analyses from two example runs. Panels a, b and c are from one of 100 replicate analyses of the full dataset; panels d, e and f are from one of 100 replicate analyses of the dataset excluding lineages from Lake Tanganyika. Panels a and d: deviance/-2 plotted over the course of the run. Panels b and e: trace of the "animal" variable, which represents the inferred influence of phylogeny, over the course of the run for the poisson portion of the hurdle regression. Panels c and f: trace of the "animal" variable over the course of the run for the binary portion of the hurdle regression.



Supplementary Figure 6| Phylogenetic hurdle poisson regression supports lake depth, lake surface area, and sexual dichromatism as significant predictors of cichlid radiation. Energy is a significant predictor in analyses excluding data from Lake Tanganyika. These results are concordant with those of logistic regression analyses (compare to Figure 2a and b). a) Results from analysis of the full dataset; b) results with lineages in Lake Tanganyika removed. In both cases, no tested variables are supported as significant predictors of the species richness of cichlid radiations under a poisson regression model. Regression parameter estimates (labeled  $\pm \beta$ ) are the means taken from analyses replicated across a set of 100 bootstrap replicate trees. Positive values indicate an increased likelihood that there is no radiation. Significance values (p-values) plotted represent the mean and 95% confidence intervals of values for the 100 replicate analyses (red line corresponds to p = 0.05). Colored dots correspond to the variable numbers shown in Figure 2.