SUPPLEMENTARY INFORMATION

Study system

The classification of fast- and slow-living species was based on presence/absence of long-term diapause in the egg stage of each species, following Furness et al. (2015). All study subjects were raised from the egg stage in our lab (with the exception of 7 individuals of the slow species *Chromaphyosemion splendopleure*, which were bought as young adults). Two fast-living species were not originally included in the phylogeny by Furness et al. (2015) and were subsequently added based on other published assessments (*Ophtalmolebias constanciae* within the *Simpsonichthys* genus (Pohl et al. 2015), and *Nothobranchius kadleci*, a sister species of *Nothobranchius furzeri* (Dorn et al. 2014)). Eggs were obtained from dedicated hobbyists, or from our own laboratory stock populations. Fast- and slow-living species vary similarly in regard to how long they have been kept in captive conditions, but when available, we have included the collection locale, and the time kept in aquaria since collection from the wild in Table S1.

After hatching, fry were kept in groups (four to six individuals) in 13L plastic tanks until sexed, and then kept as pairs (female and male, also in 13L tanks). However, due to perceived male aggression, some species ($N = 2$ slow, $N = 5$ fast, see Table S2-S5) were kept as trios (one male and two females), to minimise harassment of females.

Maintenance

All tanks were furnished with gravel, and environmental enrichment in the form of a small terracotta pot, and one or two floating acrylic yarn mops. Snails (*Planorbarius*

corneus) and small pieces of plants (java moss (*Taxiphyllum barbieri*) and/or süsswassertang (*Lomariopsis* sp.)) were added to the tanks to maintain good water quality. White plastic sheets were placed behind and between all home tanks to eliminate interaction between individuals of different tanks. The tanks of the fast-living species were also provided with 0.75L containers filled with coconut peat as a breeding substrate. All fish were kept at a 12:12 light:dark cycle at a water temperature of 23-25 °C. Juveniles were fed *Artemi*a nauplii, with red midge larvae added to the adult diet, ad libitum, three times a day (once a day on weekends). All experiments were conducted on fish that had reached sexual maturity. For all tanks we used tap water that had been aerated for a minimum of 24 hours, and treated with Sera Aquatan to remove any potentially harmful substances. Water for the home tanks and experimental tanks of *Nothobranchius guentheri* and *Nothobranchius kadleci* were treated with extra NaCl (1.16 mg/L) to reduce the risk of *Oodinium* parasite infection.

Residuals and priors for linear models

Count data (number of attacks) were fit with Poisson-distributed residuals (log-link), while the other traits were fit with Gaussian errors (confirmed by visual inspections of the residuals). Flat priors were used on the fixed effects, and random effects were fit with parameter-expanded locally non-informative priors (Murphy 2007). The Bayesian models were run with a burnin of 5000 iterations, after which every 1000nd iteration was saved so as to produce 1000 posterior samples. The autocorrelations between parameter estimates were assessed to ensure they were within the interval of -0.1 and 0.1.

Standard Metabolic Rate

Fish with a mass less than ~0.65 g, were placed in 21.8mL resting glass chambers, while larger fish (>0.65g) were placed in 120.8mL resting acrylic chambers. The trials were run overnight for approximately 17h. Over this time, oxygen consumption was measured during 30-minute periods. These periods included a 7-minute flush phase, when water from the outside bath was circulated through the chambers. Then a 3-minute wait phase, when the water circulation to the outside bath was discontinued, but measurements were not taken, to eliminate the non-linear starting phase. Then a 20-minute measurement phase was initiated, where the slope of the oxygen concentration decrease over time was estimated. To reduce the effects of handling stress and spontaneous activity on the measurements, only data from 00:00 to 05:00 was used to estimate oxygen consumption. Resting chambers were air-dried daily before respirometry trials. The whole system was cleaned weekly with a bleach solution and partial water changes.

Timing of behavioural experiments

Experiments were conducted (30^{tht} of January 2016 - 9th of June 2017) in bouts: the first half (starting in January 2016) of 2016 and the first half (starting December 2016) of 2017. Both fast- and slow-living species were tested during these periods. Measurements of SMR and mirror tests overlapped (randomised among species), with a minimum period of 22 hours between tests.

Figure S1. Relationship between the time kept in aquaria for each species, and the pace of life-history. PC1 of life-history was obtained by extracting the first principal component of a PCA on the species means of log10-transformed time until sexual maturity in males (days), log10-transformed growth rate (cm/day), and reproductive rate (eggs/female/month). Year collected was obtained from the collection ID of each species for which it was available. There was no significant association between year collected and PC1 of life-history (Spearman's rho = 0.038, P = 0.89).

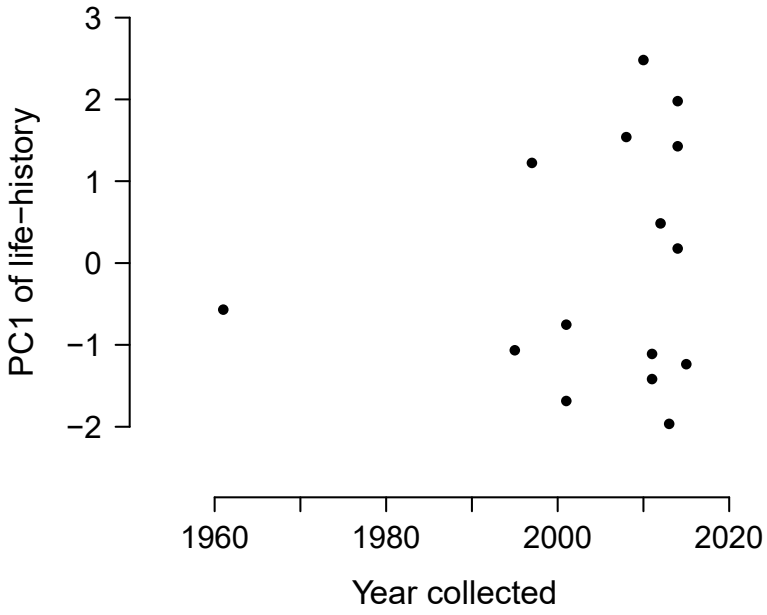

Table S1. Collection IDs for a subset of the species used in the experiments.

Species	Collection ID	Year collected
Aphyosemion striatum	"GEBL CG 1961"	1961
Austrolebias nigripinnis	"La Peregrina 2011"	2011
Austrolebias wolterstorffi	"Velasquez 2008"	2008
Callopanchax toddi	"Takhori GM 1997"	1997
Chromamphyosemion splendoplure	"Bimbia Camp 2013"	2013
Fundulopanchax cinnamomeus	"Dakoni Bafor" 2001	2001
Fundulopanchax filamentosus	"Ikeja"	
Fundulopanchax scheeli	Data not available	
Gnatholebias zonatus	"Finca Palmas COL 2014" or "Las Mecedes VEN 2014"	2014
Nematolebias whitei	"Buzios"	
Nothobranchius guentheri	"ZAN 2014"	2014
Nothobranchius kadleci	"Save River MZCS 2008" or "Nhamatanda MZCS 2011" or "Pungwe MZCS 2012"	2008/2011/2012
Notholebias minimus	"Campo Grande 2012"	2012
Ophtalmolebias constanciae	"Barra de Sao Joao 1995"	1995
Pachypanchax playfairii	Data not available	
Pterolebias longipinnis	"Rio San Pablo II BPB 2014"	2014
Anablepsoides amphoreus	"Tafelberg 2001"	2001
Anablepsoides iridescens	"Peru CI 2015"	2015

Cynodonichthys fuscolineatus	"Senderos Oasis, Cano Negro 2011"	2011
Scriptaphyosemion cauveti	"Kindia"	

Table S2. Sample sizes for the open field test. * Indicates that the individuals were reared in groups, two females and one male. The total number of individuals was 315.

Species	Females	Males	Total
Aphyosemion striatum	9	10	19
Austrolebias nigripinnis*	6	3	9
Austrolebias wolterstorffi	4	4	8
Callopanchax toddi	7	6	13
Chromaphyosemion splendopleure*	3	5	8
Fundulopanchax cinnamomeus	8	8	16
Fundulopanchax filamentosus	8	8	16
Fundulopanchax scheeli	9	9	18
Gnatholebias zonatus	9	9	18
Nematolebias whitei*	16	10	26
Nothobranchius guentheri*	18	8	26
Nothobranchius kadleci*	7	5	12
Notholebias minimus*	6	4	10
Ophtalmolebias constanciae	11	11	22
Pachypanchax playfairii	8	8	16
Pterolebias longipinnis	5	4	9
Anablepsoides amphoreus	9	9	18
Anablepsoides iridescens	8	7	15
Cynodonichthys fuscolineatus*	3	2	5
Scriptaphyosemion cauveti	16	15	31

Table S3. Sample sizes for the emergence test. * Indicates that the individuals were reared in groups, two females and one male. The total number of individuals was 267.

Species	Females	Males	Total
Aphyosemion striatum	9	10	19
Austrolebias nigripinnis*	6	2	8
Austrolebias wolterstorffi	4	4	8
Callopanchax toddi	7	6	13
Chromaphyosemion splendopleure*	1	6	7
Fundulopanchax cinnamomeus	7	7	14
Fundulopanchax filamentosus	7	7	14
Fundulopanchax scheeli	5	9	14
Gnatholebias zonatus	8	8	16
Nematolebias whitei*	6	10	16
Nothobranchius guentheri*	10	8	18
Nothobranchius kadleci*	7	4	11
Notholebias minimus*	7	3	10
Ophtalmolebias constanciae	4	5	9
Pachypanchax playfairii	8	8	16
Pterolebias longipinnis	4	3	7
Anablepsoides amphoreus	9	8	17
Anablepsoides iridescens	8	8	16
Cynodonichthys fuscolineatus*	3	2	5
Scriptaphyosemion cauveti	14	15	29

Table S4. Sample sizes for the mirror test. * Indicates that the individuals were reared in groups, two females and one male. The total number of individuals was 121.

Species	Males
Aphyosemion striatum	10
Austrolebias wolterstorffi	2
Callopanchax toddi	6
Chromaphyosemion splendopleure*	5
Fundulopanchax cinnamomeus	7
Fundulopanchax filamentosus	6
Fundulopanchax scheeli	8
Gnatholebias zonatus	8
Nematolebias whitei*	7
Nothobranchius guentheri*	8
Nothobranchius kadleci*	4
Notholebias minimus*	3
Ophtalmolebias constanciae	9
Pachypanchax playfairii	8
Pterolebias longipinnis	3
Anablepsoides amphoreus	7
Anablepsoides iridescens	7
Cynodonichthys fuscolineatus*	2
Scriptaphyosemion cauveti	11

Table S5. Sample sizes for the metabolic rate test. * Indicates that the individuals were reared in groups, two females and one male. The total number of individuals was 233.

Species	Females	Males	Total
Aphyosemion striatum	6	10	16
Austrolebias wolterstorffi	3	2	5
Callopanchax toddi	7	6	13
Chromaphyosemion splendopleure*	3	2	5
Fundulopanchax cinnamomeus	7	7	14
Fundulopanchax filamentosus	8	6	14
Fundulopanchax scheeli	8	9	17
Gnatholebias zonatus	8	7	15
Nematolebias whitei*	4	9	13
Nothobranchius guentheri*	8	7	15
Nothobranchius kadleci*	2	4	6
Notholebias minimus*	2	2	4
Ophtalmolebias constanciae	9	9	18
Pachypanchax playfairii	3	4	7
Pterolebias longipinnis	4	2	6
Anablepsoides amphoreus	7	8	15
Anablepsoides iridescens	5	7	12
Cynodonichthys fuscolineatus*	4	6	10
Scriptaphyosemion cauveti	14	14	28

Table S6. Results of the probabilistic principal component analysis (PPCA) on life-history, represented by log10-transformed maturation time (days), log10-transformed reproductive rate (eggs/female/month), and log10-transformed growth rate (cm/day). The PPCA was performed on the correlation matrix of the species means, with imputation of missing values.

	PC1	PC2	PC3
Variance explained			
R2	0.754	0.147	0.0995
Cumulative R2	0.754	0.900	1.00
Loadings			
Log10-transformed maturation time (days)	-0.633	0.704	0.321
Log10-transformed reproductive rate (eggs/female/month)	0.466	0.0161	0.885
Log10-transformed growth rate (cm/day)	0.618	0.710	-0.339

Table S7. Intraclass correlations (ICCs) from Bayesian phylogenetic mixed model, estimated as the fraction of variance explained by phylogenetic effects and species effects, divided by the total variance (phylogenetic effects, species effects, and residuals). Activity is represented by log_{10}-transformed mean speed (cm/s), boldness is represented by log_{10}-transformed, mean centred and inverted latency to emerge +1 (s), metabolic rate is represented by log_{10}-transformed standard metabolic rate (mg O_2/kg/h), and aggression is represented by the number of attacks.

Parameter	Posterior mode	Lower CI	Upper CI
Activity	0.545	0.365	0.755
Boldness	0.447	0.278	0.651
Metabolic rate	0.257	0.143	0.509
Aggression	0.198	0.0224	0.464

Table S8. Bayesian phylogenetic mixed model on activity, boldness, metabolic rate, and aggression, as response variables. This table contains the fixed predictor variables of the model; PC1 of life-history and sex (for the random effects, see table S8). Activity is represented by log_{10}-transformed mean speed (cm/s), boldness is represented by log_{10}-transformed, mean centred and inverted latency to emerge +1 (s), metabolic rate is represented by log_{10}-transformed standard metabolic rate (mg O_2/kg/h), and aggression is represented by the number of attacks.

Response variable	Coefficient	Posterior mode	Lower CI	Upper CI	PMC MC
Activity	Intercept	0.172	-0.0712	0.468	0.154
	Sex (males)	-0.0363	-0.0906	0.0512	0.512
	PC1 life-history	0.0165	-0.0779	0.150	0.646
Boldness	Intercept	-0.0732	-0.681	0.461	0.756
	Sex (males)	-0.0528	-0.185	0.186	0.992
	PC1 life-history	0.0132	-0.214	0.263	0.854
Metabolic rate	Intercept	34.6	30.1	41.3	0.001
	Sex (males)	-2.11	-4.49	0.830	0.158
	PC1 life-history	1.37	-1.27	3.55	0.342

Aggression	Intercept	-0.537	-1.63	0.228	0.130
	PC1 life-history	0.680	0.133	1.110	0.0240

Table S9. Bayesian phylogenetic mixed model on activity, boldness, metabolic rate, and aggression, as response variables. This table contains the random effects of the model; phylogeny, species and residuals (for the fixed effects, see table S7). Activity is represented by log_{10}-transformed mean speed (cm/s), boldness is represented by log_{10}-transformed, mean centred and inverted latency to emerge +1 (s), metabolic rate is represented by log_{10}-transformed standard metabolic rate (mg O_2/kg/h), and aggression is represented by the number of attacks.

Response variable	Coefficient	Posterior mode	Lower CI	Upper CI
Activity	Phylogeny	0.00193	$2.94x10^{-8}$	0.226
	Species	0.00103	$3.06x10^{-8}$	0.178
	Residuals	0.0974	0.0872	0.121
Boldness	Phylogeny	0.00387	$1.06x10^{-5}$	0.950
	Species	0.00464	$2.09x10^{-6}$	0.622
	Residuals	0.619	0.512	0.721
Metabolic rate	Phylogeny	0.746	$8.28x10^{-5}$	84.3
	Species	0.336	0.00198	65.0
	Residuals	104	84.9	124
Aggression	Phylogeny	0.0195	$1.18x10^{-6}$	2.21
	Species	0.0107	$7.32x10^{-7}$	1.82
	Residuals	4.36	2.63	7.10

Table S10. Among species correlations from Bayesian phylogenetic mixed model on activity, boldness, metabolic rate, and aggression, as response variables, no fixed effects, and with species as random effect. The model was run on the individual level, while only species level correlations were extracted. Activity is represented by log_{10}-transformed mean speed (cm/s), boldness is represented by log_{10}-transformed, mean centred and inverted latency to emerge +1 (s), metabolic rate is represented by log_{10}-transformed standard metabolic rate (mg O_2/kg/h), and aggression is represented by the number of attacks.

	Posterior mode	Lower CI	Upper CI
Metabolic rate - boldness	0.478	-0.0205	0.768
Activity - boldness	0.404	0.0323	0.744
Activity - metabolic rate	0.177	-0.211	0.708
Aggression - metabolic rate	0.515	-0.108	0.900
Aggression - activity	-0.132	-0.539	0.605
Aggression - boldness	0.276	-0.369	0.745

Table S11. Log_{10}-transformed mean speed (cm/s) in the open field test. * Indicates that the individuals were reared in groups, two females and one male. The total number of individuals was 315.

Species	Mean	SD
Aphyosemion striatum	-0.635	0.578
Austrolebias nigripinnis*	-0.531	0.464
Austrolebias wolterstorffi	-1.08	0.156
Callopanchax toddi	-0.884	0.409
Chromaphyosemion splendopleure*	-1.38	0.155
Fundulopanchax cinnamomeus	-1.10	0.344
Fundulopanchax filamentosus	-0.691	0.340
Fundulopanchax scheeli	-0.468	0.442
Gnatholebias zonatus	-0.873	0.434
Nematolebias whitei*	-0.977	0.376
Nothobranchius guentheri*	-1.37	0.330
Nothobranchius kadleci*	-1.32	0.216
Notholebias minimus*	-1.16	0.318
Ophtalmolebias constanciae	-0.958	0.293
Pachypanchax playfairii	-1.71	0.348
Pterolebias longipinnis	-1.07	0.166
Anablepsoides amphoreus	-1.68	0.216
Anablepsoides iridescens	-1.55	0.492
Cynodonichthys fuscolineatus*	-1.23	0.447
Scriptaphyosemion cauveti	-1.14	0.275

Table S12. Log_{10}-transformed, mean centred and inverted latency to emerge +1 (s) in the emergence test. * Indicates that the individuals were reared in groups, two females and one male. The total number of individuals was 267.

Species	Mean	SD
Aphyosemion striatum	2.14	1.35
Austrolebias nigripinnis*	2.51	0.509
Austrolebias wolterstorffi	1.74	0.487
Callopanchax toddi	1.54	0.871
Chromaphyosemion splendopleure*	2.36	0.558
Fundulopanchax cinnamomeus	1.55	1.01
Fundulopanchax filamentosus	1.74	0.452
Fundulopanchax scheeli	1.85	0.748
Gnatholebias zonatus	2.18	0.421
Nematolebias whitei*	2.86	0.532
Nothobranchius guentheri*	1.29	0.869
Nothobranchius kadleci*	1.10	0.808
Notholebias minimus*	2.63	0.426
Ophtalmolebias constanciae	2.92	0.528
Pachypanchax playfairii	1.05	0.850
Pterolebias longipinnis	3.04	0.206
Anablepsoides amphoreus	2.25	0.628
Anablepsoides iridescens	0.773	1.05
Cynodonichthys fuscolineatus*	2.49	0.511
Scriptaphyosemion cauveti	0.980	0.687

Table S13. Log_{10}-transformed number of attacks +1 in the mirror test. * Indicates that the individuals were reared in groups, two females and one male. The total number of individuals was 121.

Species	Mean	SD
Aphyosemion striatum	0.276	0.384
Austrolebias wolterstorffi	0.151	0.213
Callopanchax toddi	0.447	0.615
Chromaphyosemion splendopleure*	0.0602	0.135
Fundulopanchax cinnamomeus	0.0999	0.264
Fundulopanchax filamentosus	0.639	0.471
Fundulopanchax scheeli	0.496	0.354
Gnatholebias zonatus	0.884	0.678
Nematolebias whitei*	0.389	0.584
Nothobranchius guentheri*	0.379	0.409
Nothobranchius kadleci*	0.783	0.756
Notholebias minimus*	0	0
Ophtalmolebias constanciae	0.106	0.318
Pachypanchax playfairii	0.540	0.616
Pterolebias longipinnis	0.100	0.174
Anablepsoides amphoreus	0.129	0.161
Anablepsoides iridescens	0.129	0.161
Cynodonichthys fuscolineatus*	0.801	0.707
Scriptaphyosemion cauveti	0.189	0.319

Table S14. Log_{10}-transformed standard metabolic rate (mg O_2/kg/h) in the metabolic rate test. * Indicates that the individuals were reared in groups, two females and one male. The total number of individuals was 233.

Species	Mean	SD
Aphyosemion striatum	1.45	0.124
Austrolebias wolterstorffi	1.60	0.064
Callopanchax toddi	1.53	0.129
Chromaphyosemion splendopleure*	1.50	0.0688
Fundulopanchax cinnamomeus	1.50	0.101
Fundulopanchax filamentosus	1.52	0.110
Fundulopanchax scheeli	1.67	0.0989
Gnatholebias zonatus	1.57	0.140
Nematolebias whitei*	1.39	0.153
Nothobranchius guentheri*	1.52	0.115
Nothobranchius kadleci*	1.62	0.180
Notholebias minimus*	1.37	0.117
Ophtalmolebias constanciae	1.51	0.103
Pachypanchax playfairii	1.62	0.111
Pterolebias longipinnis	1.37	0.136
Anablepsoides amphoreus	1.53	0.127
Anablepsoides iridescens	1.37	0.130
Cynodonichthys fuscolineatus*	1.33	0.155
Scriptaphyosemion cauveti	1.54	0.124

SUPPLEMENTARY REFERENCES

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