Cal/Ecotox
Exposure Factors for Long-toed Salamander (Ambystoma macrodactylum)*

Endpoint Type	Endpoint Value	Error	Range	Units	Sex	Life Stage	Location	Note	Reference
Age at Sexual Maturity	3			yrs	B	Adult	Alpine; Calaveras; CA	a	1
Age at Sexual Maturity	2			yr	B	Adult	Santa Cruz; CA	b	1
Age at Sexual Maturity	2			yrs	NR	Adult	CANADA	c	2
Body Weight - Mean	6.02	0.04 SE		g	F	Adult	ID	d	3
Body Weight - Mean	4.63	0.07 SE		g	M	Adult	ID	e	3
Body Weight - Mean	15.4	0.3 SE		mg	NR	Juvenile	Lab	f	4
Clutch or Litter Size	307		215-411	eggs/clutch	F	Adult	Santa Cruz; CA	g	1
Clutch or Litter Size			191 - 315	eggs/female	F	Adult	WA	h	5
Clutch or Litter Size	90.1	48.87 SD		eggs/female	F	Adult	OR	i	6
Clutch or Litter Size	105.3	31.03 SD		eggs/female	F	Adult	OR	j	6
Clutch or Litter Size	166.5	59.7 SD		eggs/female	F	Adult	ID	k	6
Dietary Composition	Cast skin (2.1%); Isopoda (0.7%); Araneida (10.4%); Collembola (10.4%); Diptera (57.0%); Orthoptera (3.5%); Coleoptera (11.9%); Unidentified (4.2%)			%	NR	Adult	Alpine; CA	l	7
Dietary Composition	Cast skin (10.4%); Annelida (6.5%); Mollusca (7.8%); Chilopoda (3.9%); Isopoda (46.8%); Araneida (1.3%); Collembola (2.6%); Lepidoptera (2.6%); Diptera (2.6%); Orthoptera (6.5%); Coleoptera (14.2%); Unidentified (1.3%)			%	NR	Adult	Santa Cruz; CA	m	7
Dietary Composition	Cladocera (1.12%); Copepoda (0.22%); Ostracoda (12.64%); Chironomidae (23.79%); Corixidae (1.56%); Snails (5.58%); Leeches (4.46%); Oligochaeta (22.30%) and Tadpoles (27.88%)			%	NR	Juvenile	Santa Cruz; CA	n	7
Dietary Composition	Mollusca (2.7%); Cladocera (36.7%); Copepoda (20.8%); Ostracoda (11.5%); Hydracarina (0.4%); Chironomidae (17.9%); Mosquitoes (5.1%); Coleoptera (2.1); Trichoptera (0.3) and Unidentified (0.14%)			%	NR	Juvenile	Alpine; CA	o	7
Dietary Composition	Benthic macroinvertebrates (75%): Diptera (66.7); Chironomidae (41.7%); Coleoptera (58.3%); Trichoptera (50%); Ephemeroptera (25%); Amphipoda (16.7%); Plecoptera (8.3%); Pelecypoda (8.3%); Crustacean zooplankton (41.7%): Cladocerans (41.7%); Unidentified (41.7%); Imm. Daphnids (25.0%); Daphnia rosea (25%); Ceriodaphnia quadrangula			%	NR	Juvenile	WA	p	8

Endpoint Type	Endpoint Value	Error	Range	Units	Sex	Life Stage	Location	Note	Reference
Dietary Composition	(16.7%); Chydorus spaericus (8.3%); Copepods (16.7%); Cylopoids (16.7%); Calanoids (8.3%); Harpactacoids (8.3%)								
Growth Rate	see citation				B	Juvenile	Alpine; Calaveras; CA	q	1
Growth Rate	see citation				B	Juvenile	Santa Cruz; CA	r	1
Growth Rate			0.32 - 0.39	mm/d	B	Juvenile	OR	s	6
Growth Rate			0.12 - 0.17	mm/d	B	Juvenile	ID	t	6
Inhalation Rate	see citation				NR	NR	Lab	u	9
Longevity	10			yr	NR	Adult	CANADA	v	2
Metabolic Rate	see citation			ul O2/g/hr	NR	NR	Lab	w	9
Metabolic Rate	281.0	19.5 SE		ul O2/g/hr	NR	NR	Lab	x	10
Population Density			0 - 383	larvae/100 m shoreline	B	Juvenile	WA	y	8
Time of Mating/ Laying	May - June				B	Adult	Alpine; Calaveras; CA	z	1
Time of Mating/ Laying	Jan. - Feb.				B	Adult	Santa Cruz; CA	aa	1
Time of Mating/ Laying	June - July				B	Adult	OR	ab	6
Time of Mating/ Laying	Feb. - Apr.				B	Adult	ID	ac	6
Time of Mating/ Laying	Apr.-May				B	Adult	OR	ad	6
Time of Mating/ Laying	May - July				F	Adult	OR	ae	11

Notes

a N=NR; Big Meadow (elev., 1980m) and Mosquito Lakes (elev., 2450 m)
b N=NR; Valencia Lagoon, Rio Del Mar
c N=170; Bow Valley (elev., 1290-1375m), [lat.,51^o05'N; long., 115^o4'W]
d N=134; Feb.-Apr.; Moscow, Latah County
e N=134; Feb.-Apr.; Moscow, Latah County
f N=3; Age=2 d post-hatch
g N=5; Valencia Lagoon, Rio Del Mar
h N=11; Palouse grasslands, Pullman
i N=7; Wallowa County (elev., 2470m)
j eggs/cluster averaged 14.8; N=16; Bear Wallow, Baker County (elev., 1140m)
k eggs/cluster averaged 16.7; N=25; Lindsey Creek, Perce County (elev., 420m)
l % of total number of items in stomach contents; N=20; May-June; Mosquito Lakes (elev., 8050 ft); 50.7% of diet was mosquito pupae
m % of total number of items in stomach contents; N=38; Mar.-Nov.; Ellicott Pond
n % by weight of food item in stomach contents; N=20; Age=larvae; Mar.-May; Ellicott Pond
o % of total number of items in stomach contents; N=60; Age=larvae; May-June; Mosquito Lakes (elev., 8050 ft)
p % larvae stomachs that contained prey item; N=13; June - Sept.; North Cascades National Park Service Complex
q figure of seasonal changes in total length; N=NR; Big Meadow (elev., 1980m) and Mosquito Lakes (elev., 2450 m)
r figure of seasonal changes in total length; N=NR; Valencia Lagoon, Rio Del Mar
s increase in snout-vent length; N=NR; June - Aug.; Bear Wallow, Baker County (elev., 1140m)
t increase in snout-vent length; N=223; Feb.-Sept.; Lindsey Creek, Perce County (elev., 420m)
u tidal volume and breathing rate data; N=NR
v maximum lifespan; N=170; Bow Valley (elev., 1290-1375m), [lat.,51^o05'N; long., 115^o4'W]
w figure of pulmonary and cutaneous oxygen consumption; N=NR
x mean oxygen consumption following activity, measured at 25C; N=6; average body weight, 2.44 g
y range of larval density estimates in 8 fishless lakes utilizing 3 survey methodologies during day and night; N=NR; June - Sept.; North Cascades National Park Service Complex

z	time of breeding; N=NR; Big Meadow (elev., 1980m) and Mosquito Lakes (elev., 2450 m)
aa	time of breeding; N=NR; Valencia Lagoon, Rio Del Mar
ab	time of breeding; N=NR; Wallowa County (elev., 2470m)
ac	time of breeding; N=NR; Lindsey Creek, Perce County (elev., 420m)
ad	time of breeding; N=NR; Bear Wallow, Baker County (elev., 1140m)
ae	time of laying; N=NR; Crater Lake, Munson Oxbow Pond, Aant Point Pond, Whitehorse Bluff ponds and Lake West

References

1 Anderson, James D. 1967. A comparison of the life histories of coastal and montane populations of Ambystoma macrodactylum in California. Am. Midl. Nat. 77(2):323-355.

2 Russell, Anthony P., G. Lawrence Powell and Dean R. Hall. 1996. Growth and age of Alberta long-toed salamanders (Ambystoma macrodactylum krausei): a comparison of two methods of estimation. Can. J. Zool. 74:397-412.

3 Beneski Jr., John T., Zalisko, Edward J. and John H. Larsen, Jr. 1986. Demography and migratory patterns of the eastern long-toed salamander, Ambystoma macrodactylum columbianum. Copeia. 1986:398-408.

4 Ingermann, R.L., D.C. Bencic and V.P. Eroschenko. 1997. Methoxychlor alters hatching and larval startle response in the salamander Ambystoma macrodactylum. Bull. Environ. Contam. Toxicol. 59:815-821.

5 Verrel, Paul and Janet Pelton. 1996. The sexual strategy of the central long-toed salamander, Ambystoma macrodactylum columbianum, in south-eastern Washington. J. Zool. 240:37-50.

6 Howard, James H. and Richard L. Wallace. 1985. Life history characteristics of populations of the long-toed salamander (Ambystoma macrodactylum) from different altitudes. Am. Midl. Nat. 113:361-373.

7 Anderson, James D. 1968. A comparison of the food habits of Ambystoma macrodactylum sigillaturm, Ambystoma macrodactylum croceum and Ambystoma tigrinum californiense. Herpetologica. 24:273-284.

8 Tyler, Torrey, William J. Liss, Lisa M. Ganio, Gary L. Larson, Robert Hoffman, Elisabeth Deimling and Gregg Lomnicky. 1998. Interaction between introduced trout and larval salamanders (Ambystoma macrodactylum) in high-elevation lakes. Conserv. Biol. 12:94-105.

9 Whitford, Walter G. and Victor H. Hutchison. 1966. Cutaneous and pulmonary gas exchange in ambystomatid salamanders. Copeia. 1966:573-577.

10 Feder, Martin E. 1977. Oxygen consumption and activity in salamanders: Effect of body size and lunglessness. J. Exp. Zool. 202:403-414.

11 Kezer, James and Donald S. Farner. 1955. Life history patterns of the salamander Ambystoma macrodactylum in the high Cascade mountains of southern Oregon. Copeia. 1955:127-131.

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