

Supplementary Materials

Long-lived life history for onaga *Etelis coruscans* in the Hawaiian Islands

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Table S1. Data from fish specimens used in this study

Fish length was fork length (FL) and mean otolith mass included both whole sagittal otoliths for most fish.

Final age in years was the accepted age estimate from three age readings. Final age was the final count (deemed best read of three reads during the fourth reading by an experienced age reader) and using the validated reference-image otolith sections when necessary (i.e. the iterative age reading of outliers from the otolith mass-to-age relationship). n.a., otolith mass not available because the otolith was broken with missing piece

Lab number	Fish specimen number	Fish length FL (cm)	Fish mass (kg)	Gonad mass (g)	Sex	Otolith mass (g)	Final age (years)
OH-001	M12-2-5-427	86.9	9.62	104.2	F	0.289	55
OH-002	M9-1-2-321	78.6	6.54	76.0	M	0.249	43
OH-003	M14-3-5-520	85.0	8.69	101.2	F	0.240	40
OH-004	IM7-6-10-445	79.0	7.69	122.4	F	0.237	48
OH-005	M14-2-8-512	79.6	7.30	325.7	M	0.181	23
OH-006	M8-2-6-338	74.4	5.64	46.2	M	0.166	27
OH-007a	CK2-1-2-2	84.0	7.80	176.7	M	0.165	30
OH-007b	M8-2-5-320	72.5	5.72	56.8	F	0.153	14
OH-008	M8-1-2-301	70.8	5.40	24.9	M	0.146	15
OH-009	CK5-1-4-4	79.8	7.72	109.6	U	n.a.	16
OH-010	M8-1-7-311	71.0	5.34	37.0	M	0.126	16
OH-011	M14-2-7-511	72.4	5.44	48.0	M	0.122	11
OH-012	CK1-1-7-7	61.1	3.72	31.5	M	0.098	9
OH-013	M4-1-10-290	60.7	3.48	20.6	M	0.075	9
OH-014	M8-1-5-308	56.3	2.94	4.3	M	0.078	7
OH-015	LW3-1-7-57	48.7	1.68	1.9	F	0.067	6
OH-016	M7-2-8-174	53.3	2.18	3.8	M	0.088	6
OH-017	JA6-1-3-81	46.1	1.36	1.7	F	0.051	5
OH-018	JA1-1-3-2	39.7	0.98	0.9	U	0.044	4
OH-019	CK3-1-3-3	31.9	0.52	0.3	U	0.031	4
OH-020	JA9-2-7-151	28.8	0.40	0.2	U	0.028	3
OH-021	JA10-2-5-162	23.5	0.23	0.2	U	0.024	2
OH-022	JA14-3-5-297	21.9	0.18	0.1	U	0.018	1
OH-023	NT4-1-9-26	26.1	0.34	0.3	F	0.034	3
OH-024	NT4-2-3-30	28.0	0.41	0.3	F	0.034	3
OH-025	NT4-1-6-23	26.8	0.39	0.2	F	0.029	2
OH-026	NT4-1-4-21	21.5	0.18	0.1	F	0.021	2
OH-027	NT3-1-6-20	26.6	0.32	0.2	F	0.029	2
OH-028	NT3-1-2-16	23.5	0.25	0.2	F	0.026	3
OH-029	NT2-1-10-9	32.2	0.59	0.7	F	0.038	5
OH-030	M14-3-1-515	52.5	2.20	1.7	M	0.055	6
OH-031	M14-2-10-514	68.3	4.79	35.4	M	0.130	14
OH-032	M14-2-6-510	70.2	4.83	62.5	M	0.102	12
OH-033	M14-1-9-503	74.8	5.53	72.9	M	0.181	20

Lab number	Fish specimen number	Fish length FL (cm)	Fish mass (kg)	Gonad mass (g)	Sex	Otolith mass (g)	Final age (years)
OH-034	M14-1-8-502	69.5	4.81	61.7	M	0.138	15
OH-035	M14-1-5-465	74.4	5.62	83.4	M	0.131	16
OH-036	M14-1-4-457	68.7	4.85	34.3	F	0.109	12
OH-037	M14-1-1-423	60.5	3.33	7.0	M	0.090	9
OH-038	M1-2-9-257	75.2	6.60	113.7	M	n.a.	20
OH-039	M12-2-7-480	87.9	9.60	139.7	F	0.267	39
OH-040	M12-2-6-419	81.8	7.60	80.7	F	0.145	20
OH-041	M12-2-3-492	85.7	9.58	116.7	F	0.278	43
OH-042	M12-1-8-458	85.7	9.42	99.8	F	0.237	42
OH-043	M12-1-6-463	44.8	1.38	1.0	M	0.050	7
OH-044	M12-1-5-475	80.0	6.78	47.4	M	0.178	21
OH-045	M10-2-6-364	78.7	7.06	66.4	F	0.164	17
OH-046	M10-2-5-363	85.2	8.68	51.1	M	0.258	51
OH-047	M10-2-4-362	73.2	5.74	51.1	M	0.155	17
OH-048	M10-2-3-361	79.9	6.78	115.2	M	0.207	26
OH-049	M10-2-2-299	70.0	5.02	19.3	M	0.108	10
OH-050	M9-2-4-385	54.7	2.66	3.0	M	0.069	7
OH-051	M9-2-2-382	51.5	2.04	2.9	F	0.069	7
OH-052	M9-2-1-358	46.0	1.48	2.5	F	0.053	6
OH-053	M9-1-10-344	64.4	3.96	9.0	M	0.081	10
OH-054	M9-1-8-340	67.3	4.45	21.6	M	0.115	11
OH-055	M9-1-6-336	79.7	6.56	60.9	F	0.129	17
OH-056	M9-1-5-335	49.4	1.48	2.1	F	0.064	6
OH-057	M9-1-4-334	60.3	3.20	21.0	F	0.075	9
OH-058	M9-1-3-330	47.1	1.68	1.7	F	0.062	6
OH-059	M8-2-2-317	70.2	5.28	53.0	M	0.142	17
OH-060	M8-2-1-315	72.5	5.68	28.0	M	0.123	11
OH-061	M8-1-4-305	85.4	8.22	146.2	M	0.182	35
OH-062	M7-3-8-262	69.7	4.94	30.9	M	0.120	13
OH-063	M7-3-7-250	59.6	3.36	8.9	F	0.074	8
OH-064	M7-3-5-232	71.2	5.78	32.2	M	0.117	12
OH-065	M7-3-4-230	78.3	7.00	53.8	F	0.137	17
OH-066	M7-3-3-225	81.3	7.28	72.0	M	0.204	24
OH-067	M7-3-1-216	42.7	1.28	1.1	M	0.046	6
OH-068	M7-2-10-180	56.6	2.80	7.8	M	0.075	8
OH-069	M2-1-6-136	71.8	5.72	21.2	F	0.104	10
OH-070							skipped
OH-071	M2-1-2-142	79.5	6.78	61.2	M	0.211	46
OH-072	M1-2-10-287	82.3	7.20	73.6	M	0.209	25
OH-073	M1-1-1-268	76.6	7.06	45.6	M	0.118	14
OH-074	LW4-1-10-128	33.9	0.64	0.4	M	0.036	4
OH-075	LW3-1-9-59	44.0	1.38	2.1	F	0.052	6
OH-076	LW3-1-8-58	44.2	1.29	1.6	M	0.058	6
OH-077	LW2-2-5-95	43.9	1.29	1.1	F	0.055	5
OH-078	LW2-2-3-93	47.3	1.59	1.3	M	0.067	6

Lab number	Fish specimen number	Fish length FL (cm)	Fish mass (kg)	Gonad mass (g)	Sex	Otolith mass (g)	Final age (years)
OH-079	LW2-2-2-92	33.3	0.61	0.5	M	0.036	3
OH-080	LW2-2-1-91	45.0	1.36	1.8	F	0.055	4
OH-081	LW2-1-9-89	43.2	1.27	1.2	M	0.055	5
OH-082	LW2-1-8-88	34.8	0.68	0.5	F	0.042	3
OH-083	LW2-1-4-82	29.8	0.41	0.2	F	0.033	3
OH-084	JA15-1-3-283	33.2	0.64	0.5	F	0.042	3
OH-085	JA14-3-4-295	42.4	1.25	1.1	M	0.049	4
OH-086	JA14-3-3-293	35.0	0.70	0.5	F	0.037	4
OH-087	JA14-2-9-277	36.5	0.79	1.1	F	0.041	4
OH-088	JA14-2-1-268	30.2	0.43	0.3	M	0.029	2
OH-089	JA14-1-9-266	32.7	0.64	0.6	F	0.033	2
OH-090	JA14-1-7-263	25.9	0.29	0.1	U	0.023	3
OH-091	JA14-1-4-255	39.3	1.00	1.0	F	0.048	4
OH-092	JA10-2-8-178	30.0	0.45	0.4	F	0.031	3
OH-093	JA9-2-10-154	24.8	0.26	0.2	U	0.025	2
OH-094	JA9-3-4-159	23.4	0.22	0.1	U	0.022	2
OH-095	JA9-2-5-149	36.0	0.86	0.9	U	0.040	4
OH-096	JA9-2-4-148	29.9	0.42	0.2	U	0.030	2
OH-097	JA9-1-5-129	28.7	0.40	0.1	U	0.030	2
OH-098	JA8-3-8-135	36.2	0.74	0.4	U	0.040	3
OH-099	JA8-3-5-132	40.4	0.96	1.1	U	0.042	3
OH-100	JA8-3-4-131	37.7	0.88	0.84	U	0.066	6
OH-101	JA8-3-3-128	35.3	0.72	0.51	M	0.036	5
OH-102	JA8-3-2-127	39.2	0.92	0.59	M	0.036	5
OH-103	JA8-3-1-126	25.2	0.26	0.15	U	0.025	2
OH-104	JA8-2-7-121	37.3	0.86	0.64	M	0.042	3
OH-105	JA8-2-6-118	37.6	0.9	0.98	U	0.036	2
OH-106	JA8-2-4-116	35.1	0.72	0.57	M	0.036	2
OH-107	JA8-2-1-111	35.1	0.78	0.65	U	0.033	3
OH-108	JA8-1-10-107	39.1	1.02	0.59	U	0.043	2
OH-109	JA6-1-4-93	49.7	1.7	2.85	F	0.069	5
OH-110	JA6-1-2-79	53.2	2.38	4.33	M	0.077	5
OH-111	JA5-1-5-65	42.0	1.14	0.49	U	0.055	4
OH-112	JA3-1-8-7	22.6	0.16	0.08	U	0.020	1
OH-113	JA1-1-5-16	38.4	0.9	0.47	U	0.039	2
OH-114	IM3-4-8-281	62.7	3.78	45.8	M	0.103	10
OH-115	IM4-1-7-314	69.8	4.68	44.9	F	0.122	10
OH-116	HM2-1-1-4	26.3	0.3	0.10	U	0.028	2
OH-117	CK11-1-3-3	66.6	4.74	27.9	M	0.145	10
OH-118	CK8-1-10-10	63.8	4.36	16.0	M	0.128	13
OH-119	CK8-1-7-7	73.5	5.9	68.6	M	0.201	20
OH-120	CK8-1-6-6	65.0	4.32	15.2	F	0.099	11
OH-121	CK8-1-5-5	59.8	3.18	8.2	M	0.091	10
OH-122	CK8-1-2-2	60.0	3.26	4.0	M	0.083	10
OH-123	CK7-1-2-2	40.6	0.98	1.1	M	0.045	6

Lab number	Fish specimen number	Fish length FL (cm)	Fish mass (kg)	Gonad mass (g)	Sex	Otolith mass (g)	Final age (years)
OH-124	CK6-2-10-20	79.0	6.56	62.4	F	0.168	15
OH-125	CK6-2-3-13	61.1	3.32	6.5	F	0.093	8
OH-126	CK6-1-8-8	49.2	1.88	7.9	F	0.067	7
OH-127	CK6-1-7-7	68.1	4.42	31.0	M	0.127	12
OH-128	CK6-1-6-6	55.2	2.52	15.9	F	0.073	6
OH-129	CK5-1-8-8	47.0	1.54	2.0	U	0.052	5
OH-130	CK5-1-7-7	62.7	3.56	13.9	U	0.078	unreadable
OH-131	CK5-1-6-6	63.0	4.24	45.4	F	0.107	9
OH-132	CK4-1-9-9	57.1	2.92	n.a.	U	0.080	7
OH-133	CK4-1-7-7	56.4	2.84	4.9	M	0.065	6
OH-134	CK4-1-6-6	58.4	3.00	18.3	M	0.083	unreadable
OH-135	CK4-1-5-5	57.5	2.96	8.9	M	0.087	6
OH-136	CK1-1-8-8	54.5	2.52	27.6	M	0.074	6
OH-137	CK1-1-5-5	66.0	4.28	43.7	M	0.091	10
OH-138	CK1-1-4-4	62.0	3.5	11.5	M	0.082	11
OH-139	CK1-1-1-1	75.2	6.38	119.4	M	0.177	16
OH-140	AK1-1-9-9	24.6	0.25	0.16	U	0.027	2
OH-141	AK1-1-6-6	31.9	0.52	0.42	F	0.035	4
OH-142	M12-1-10-498	55.5	2.56	2.77	M	0.071	5
OH-143	CTAM1-4	22.7	0.40	n.a.	U	0.021	1
OH-144	SAITO1-3	23.6	0.22	n.a.	U	0.024	1
OH-145	CTAM1-5	24.1	0.24	n.a.	U	0.024	2
OH-146	KK3-4	24.3	0.24	n.a.	U	0.024	2
OH-147	NT4-1-5-22	24.4	0.27	0.10	F	0.027	2
OH-148	M8-1-10-314	47.8	1.84	3.12	M	0.056	4
OH-149	M12-1-2-454	48.0	1.80	1.45	M	0.060	5
OH-150	CK6-2-2-12	48.2	1.68	4.62	M	0.062	5
OH-151	ROYM9-1	51.1	2.16	17.3	F	0.065	5
OH-152	LAYNE22-2	50.7	2.06	n.a.	M	0.072	6
OH-153	M7-3-9-265	52.5	2.26	3.57	M	0.068	7
OH-154	GVI3-8	53.3	2.5.0	27.4	F	0.077	6
OH-155	M7-2-6-158	53.8	2.36	3.95	F	0.061	8
OH-156	20140831ROY-04	53.8	2.6.0	41.0	F	0.071	7
OH-157	GVI10-6	54.9	3.18	13.2	F	0.093	8
OH-158	GVI6-17	56.9	2.95	n.a.	F	0.078	8
OH-159	ROYM9-3	57.1	2.94	35.0	F	0.069	7
OH-160	ROYM9-2	58.7	3.34	68.3	F	0.080	6
OH-161	GVI10-1	59.0	3.64	34.8	F	0.088	8
OH-162	GVI3-9						no otolith
OH-163	GVI3-17	60.4	3.64	31.2	F	0.084	9
OH-164	GVI3-13	62.2	4.09	40.7	F	0.095	8
OH-165	GVI3-14	62.7	4.09	87.9	F	0.092	9
OH-166	GVI3-10	64.3	4.55	114.4	F	0.104	9
OH-167	GVI15-11	64.4	4.55	44.2	F	0.118	10
OH-168	GVI4-1	65.0	4.32	60.5	F	0.133	8

Lab number	Fish specimen number	Fish length FL (cm)	Fish mass (kg)	Gonad mass (g)	Sex	Otolith mass (g)	Final age (years)
OH-169	GVI6-5	67.8	5.00	22.9	F	0.116	9
OH-170	GVI6-5	67.8	5.00	22.9	F	n.a.	unreadable
OH-171	GVI4-6	68.1	5.23	35.6	F	0.114	10
OH-172	GVI6-22	68.3	5.68	51.1	F	0.115	9
OH-173	GVI7-5	70.8	5.45	69.5	F	0.138	13
OH-174	M11-4-5-447	72.1	5.74	48.0	F	0.111	13
OH-175	GVI18-18	73.2	6.82	75.6	F	0.168	15
OH-176	M12-1-1-417	73.3	6.14	72.5	F	0.160	15
OH-177	GVI22-1	76.5	6.4	123.2	F	0.166	22
OH-178	GVI22-3	77.5	7.48	234.1	F	0.155	17
OH-179	GVI13-2	78.3	9.55	164.4	F	0.219	24
OH-180	GVI3-7	80.1	7.73	237.8	F	0.193	28
OH-181	M14-3-4-519	80.4	7.64	144.7	M	0.194	37
OH-182	M10-2-9-367	81.7	7.48	107.7	F	0.216	28
OH-183	LAYNE13-2	82.0	7.62	n.a.	F	0.153	17
OH-184	M13-1-5-415	82.6	7.78	120.7	M	0.206	29
OH-185	CK10-1-3-3	83.6	4.56	97.0	F	0.237	31
OH-186	SE13-02-28						replicate #
OH-187	SE13-02-28	86.0	8.62	n.a.	F	0.243	37
OH-188	SE13-02-27	86.25	9.16	75.3	F	0.207	29
OH-189	M14-2-5-509	86.6	8.87	93.8	F	0.211	40
OH-190	IM4-1-9-320						no otolith
OH-191	LAYNE13-9	87.0	8.71	n.a.	F	0.150	low mass ^A
OH-192	KK2-1	87.1	9.30	313.4	F	0.160	low mass ^A
OH-193	SE13-02-22	88.0	9.43	n.a.	F	0.239	35
OH-194	GVI17-2						no otolith
OH-195	SE13-02-26	90.25	9.25	n.a.	F	0.230	36
OH-196	SE13-02-25	93.25	9.71	135.2	F	0.225	32
OH-197	LAYNE13-7	93.5	10.89	n.a.	F	0.257	44

^AOtolith mass was inordinate relative to fish length and indicated that the data for the specimen were unreliable.

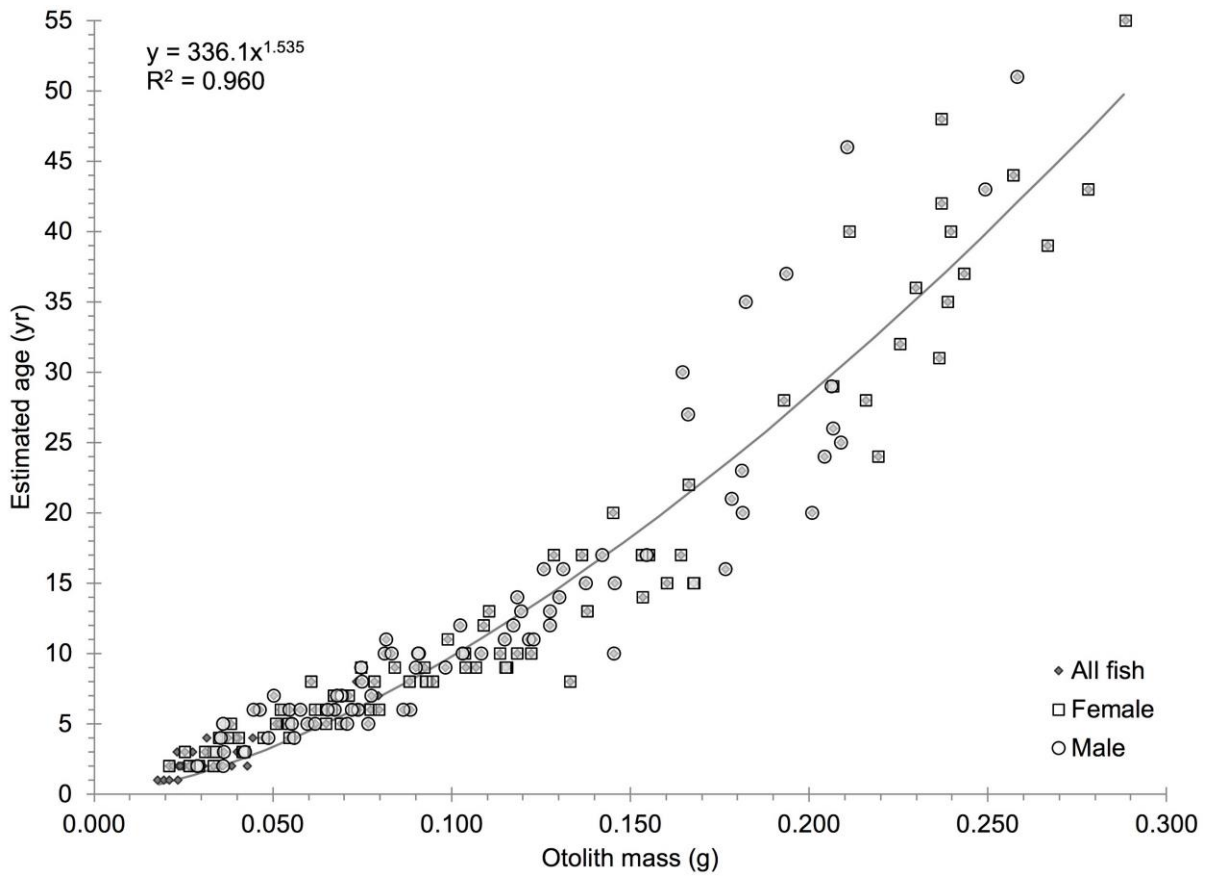


Fig. S1. Otolith mass relative to the estimated age from growth zone counting was used as a tool to refine outlying age estimates associated with the first two decades of growth, the region of the curve that is most diagnostic for age. Outlying ages that were visible as an inordinate separation from the slightly curvilinear relationship were reevaluated based on the reference-image otolith sections that had been age validated with bomb ^{14}C dating. This approach was iterative in that repeated reads were necessary to resolve the most consistent age reading estimate. This tool is often overlooked in age and growth studies and should be employed to avoid the introduction of spurious age estimates.

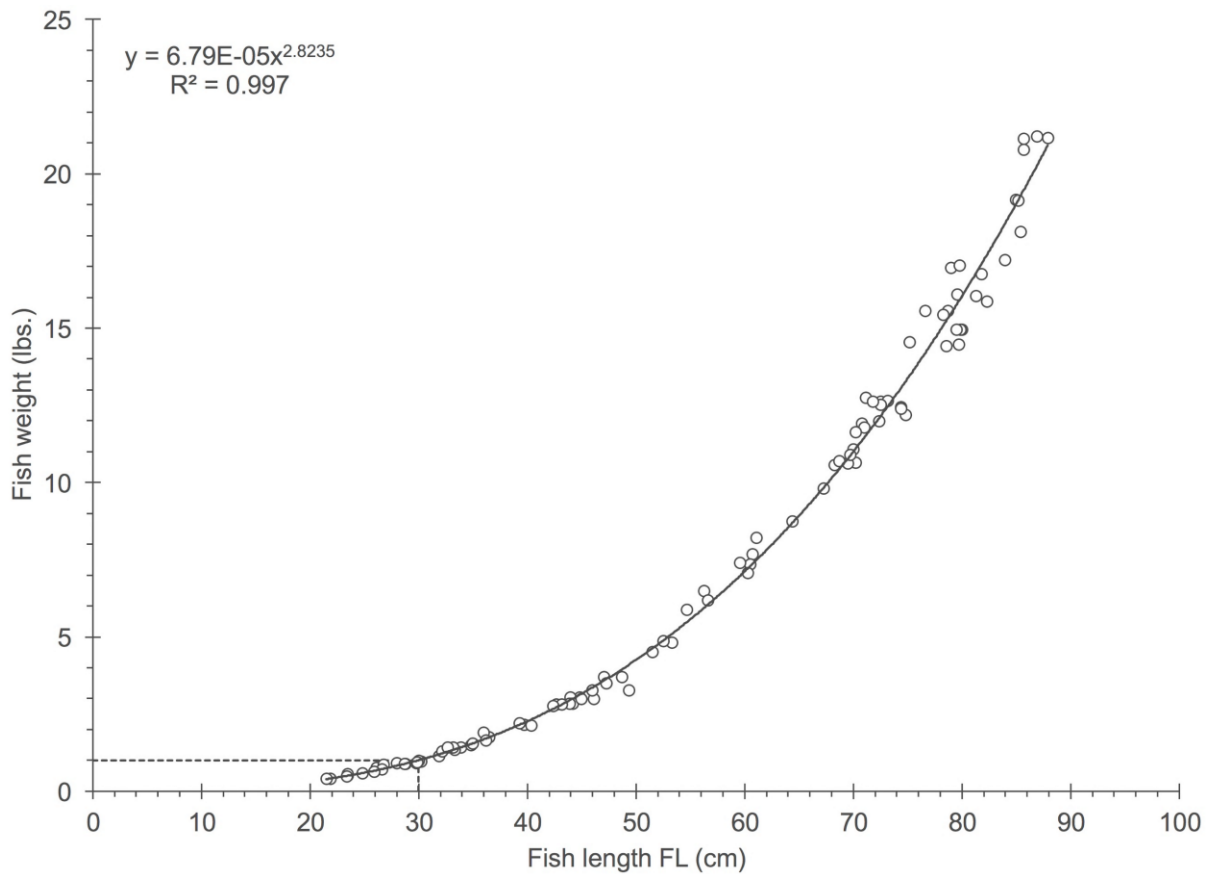


Fig. S2. The relationship between round (whole fish weight) and body length for some of the onaga (*Etelis coruscans*) specimens used in this study (Table S1). This relationship was used to provide an age estimate for fish of minimum retention size (confer intersection of the two dashed lines). Specifically, current fishing regulations in Hawaii limit retention to onaga ≥ 1 lb (~ 30 cm) and this equates to an age of 2–3 years (Fig. 4). This weight–length relationship for MHI onaga is similar to one described for onaga in the NWHI (Uchiyama and Kazama 2003).

Reference

Uchiyama, J. H., and Kazama, T. K. (2003). Updated weight-on-length relationships for pelagic fishes caught in the central North Pacific Ocean and bottomfishes from the Northwestern Hawaiian Islands. NOAA Fisheries, PIFSC Admin. Rep. H-03-01.