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Growth of baleen of a rehabilitating gray whale calf

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Abstract

The pattern and rate of growth of baleen plates in a rehabilitating gray whale calf (*Eschrichtius robustus*) was monitored by making 35-mm film and Hi-8 mm video images of each side of 'JJ's' head when she surfaced and exposed her mouth. From selected film and video images of baleen and rostral surface features, I measured the lengths of baleen plate images at three locations along the lip-line. Direct measurements of JJ's rostrum tip-to-eye distance were made routinely during periodic physical exams and used to scale baleen plate image measurements to estimate baleen plate lengths. There was no difference in the rate of growth of baleen plates on the left and right sides of the mouth, but the posterior baleen plates grew faster than the anterior ones (through at least the first 33 weeks) from 1.6 mm/week in the anterior section to 6.0 mm/week in the posterior section. JJ's baleen remained short during the first several months, presumably to allow suckling before active foraging began. Her baleen plates then grew rapidly to adult lengths by the time she was 6–7 mo old, the normal time of weaning in free-ranging gray whales.

Key words: gray whale, growth, baleen, rehabilitation.

Introduction

Gray whales (*Eschrichtius robustus*) feed principally on benthic prey (Nerini, 1984), and their relatively short and coarse baleen is assumed to be subject to more sediment abrasion and wear than experienced by other mysticetes (Rice & Wolman, 1971). That abrasion is compensated by continuous and relatively rapid growth throughout a gray whale's life. Rice and Wolman (1971) examined variations in seasonal thickness of baleen and presumed that apparent zones of growth represented one year of baleen plate growth. However, no baleen plates in their extensive collection showed more than four such growth zones, regardless of a whale's age, evidently owing to the rapid abrasion of baleen plates.

Pfeiffer (1993) described the ultrastructural morphology of baleen bristles, which constitute the terminal filtering structure of all mysticete whales. In gray whales, a row of approximately 155 baleen plates grow from a foundation layer anchored to each side of the hard palate of the upper jaw (Pivorunas, 1979). To date, baleen length in gray whales has been measured only in dead whales, usually adults, that either stranded or were harvested (Kasuya & Rice, 1970). Kasuya and Rice (1970) reported a strong bilateral asymmetry in the adults they examined, likely due to consistent feeding and consequent abrasion on a preferred side. No rates of growth based on repeated measures of baleen length in the same whale over time have been reported, nor has the pattern of post-natal baleen growth been described previously in any mysticete species. Here, I describe the pattern and rate of growth of baleen plates in a rehabilitating gray whale calf (JJ) during her first year of life.

Materials and Methods

I made opportunistic photographs (35-mm slide film and Hi-8 mm video) of each side of JJ's head when she surfaced and exposed her mouth (Fig. 1) while she rehabilitated at SeaWorld of San Diego from 18 January 1997 through February 1998. I printed digitized images using a flat-bed scanner (600 dpi) and digitized segments of video recordings using Adobe Premiere® software. Individual frames were measured, using Adobe Illustrator®, of the baleen plates. I evaluated the images of baleen and rostral surface features, degree of mouth gape, and absence of angular distortion for best resolution and selected six images of the left and seven of the right-side of her head that were suitable for measurements. Direct measurements of the distance from the tip of the rostrum (R_t) to the center of her eye (E_c) were routinely made during periodic physical exams. I used those data to scale the indirect measurements of baleen plates made from the photographs. I

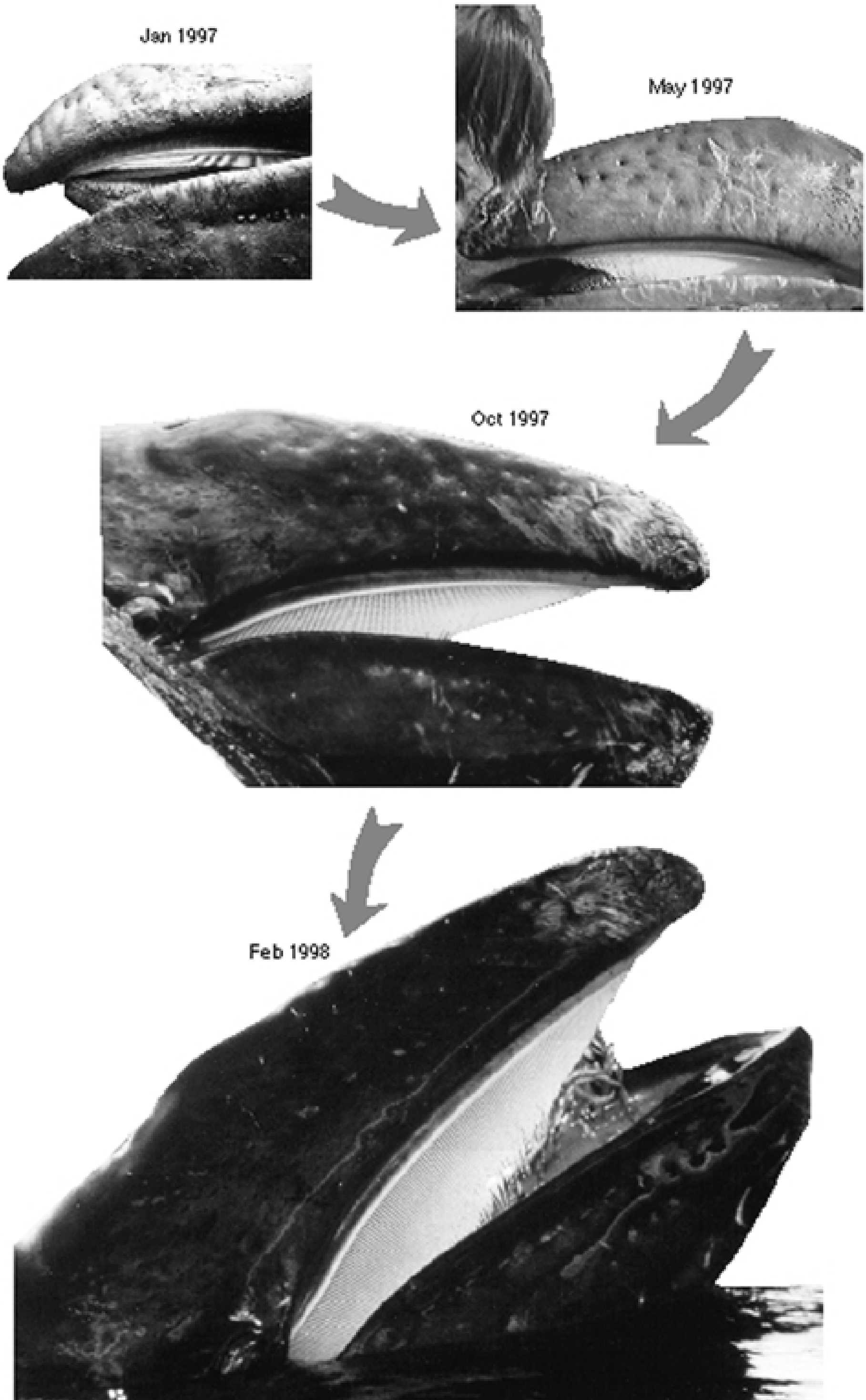

Figure 1. Lateral views of baleen of a rehabilitating gray whale calf (JJ) from January 1997 through February 1998. Each image is scaled to her body length relative to age.

Figure 2. Left and right outline views of the rostrum of a gray whale calf (JJ) showing distinct scars (linear features), rostral hair pits (small circles), the linear distances used to scale baleen length measures (dashed lines), and the three locations where baleen plate lengths were measured.

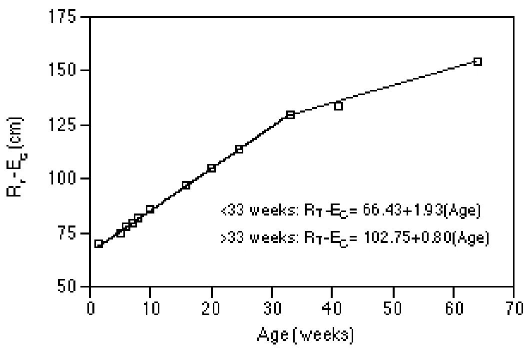

Figure 3. Increase in the distance from the tip of the rostrum (R_t) to the center of the eye (E_c) with age of a rehabilitating gray whale calf (JJ) from January 1997 through February 1998. The change in the rate of growth at 33 weeks correlates with a shift from formula feeding to foraging on solid food on the bottom of the pool.

measured the lengths (± 0.1 mm) of baleen plate images at three locations (Fig. 2), corresponding to 35% (B_1), 50% (B_2) and 65% (B_3) of the distance from the tip of the rostrum to the center of the eye (R_t–E_c), using Adobe Illustrator® software. I then converted each measurement to estimate actual baleen length by scaling to the image reference (usually R_t–E_c) versus the actual age-related reference (Fig. 3).

Results

The distance between the tip of the rostrum and the center of the eye increased steadily at about 1.9 cm/week until JJ was 33 weeks old. It then slowed to about 0.8 cm/week (Table 1). There was no difference in the rate of growth of baleen

Table 1. Measurements of baleen plate length of a rehabilitating gray whale calf (JJ) made from 35 mm film and video images.

Age (weeks)	Length (cm)	R_t–E_c (cm)	Side	Image R_t–E_c	Basis	Image lengths (mm)			Actual lengths (cm)		
						B_1	B_2	B_3	B_1	B_2	B_3
35 mm film photos											
1.5	423	70	L	50.4	a	1.7	2.2	2.6	2.37	3.07	3.62
5	450	75	R	53.9	a		2.4			3.33	
8	494	82	L	59.6	a	2.6				3.58	
33	781	130	L	91.8	a	5.9	11	16	8.33	15.53	22.6
41	805	134	R	98	a	5.9	12		8.05	16.36	
64	930	154	R	112	a	8.5	15.7		11.72	21.64	
Digitized video images											
6	470	78	R	256.8	c	9.8	13		2.98	3.95	
7	482	80	R	254.4	0.64xa	8.9	17.1	21.3	2.8	5.38	6.7
10	517	86	R	203.4	a	6.8	13.9	17	2.87	5.86	7.17
16	586	97	L	124.6	c	7.4	10.6	13.3	2.78	8.27	10.38
20	632	105	R	80	a	5.1	7.2	9.7	6.69	9.44	12.72
20.5	638	106	L	80	a	4.2	6		5.56	7.94	
24.5	684	114	L	224.7	b	14.5	16.9		7.32	8.54	

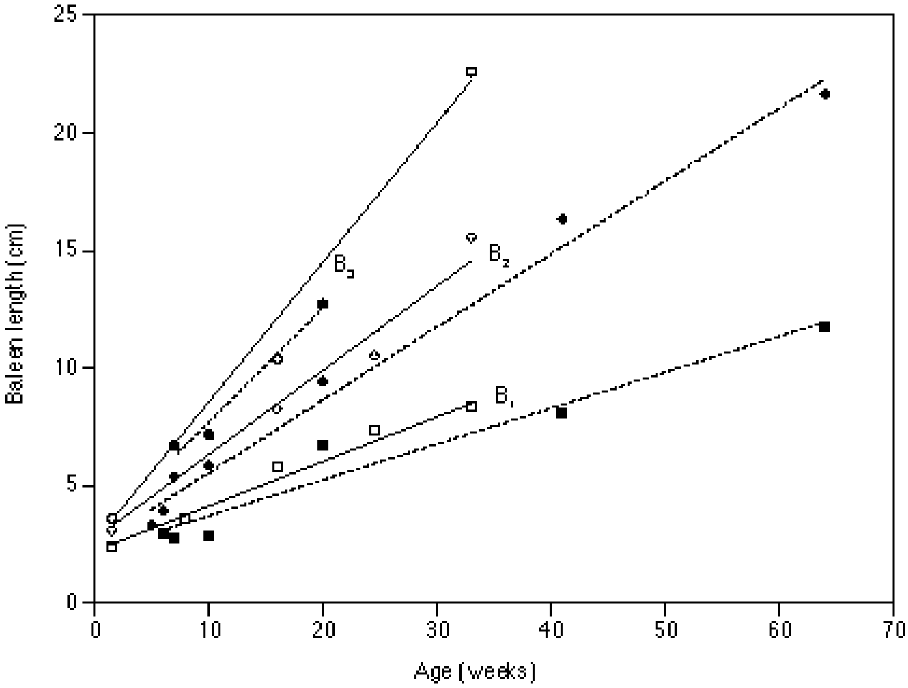

Figure 4. Baleen plate length versus age of a rehabilitating gray whale calf (JJ). Measurements on the left side are solid lines, those on the right are dashed lines. All r^2 values >0.95.

plates on the left and right sides of the mouth, but the posterior baleen plates grew faster than the anterior plates, at least through the first 33 weeks; after that the tips of the posterior plates were not visible in the photographs. The baleen plates grew by 1.6 m/week in the front section (B_1), 3.2 mm/week in the middle section (B_2), and 6.0 mm/week in the back section (B_3; Fig. 4). That amounted to 1.9 (B_1), 2.2 (B_2), and 3.9 (B_3) times the relative increase in total body length and in the change of the distance from the tip of the rostrum to the center of the eye. Though the increase in R_t–E_c slowed considerably after week 33, baleen growth remained constant in the front and middle sections.

I summarized the overall pattern of baleen growth by estimating plate lengths at roughly 10-week intervals (Fig. 5). I conservatively assumed that baleen was longest in section B_3, and then decreased farther back, where it grew at the same rate as the change in R_t–E_c after week 33. Those assumptions are consistent with measurements of baleen plates in adult gray whales (*cf.*, Kasuya & Rice, 1970 Figure 2 indicates that the longest baleen plate was 2.9% of the body length of an adult female (roughly 17% of R_t–E_c).

Discussion

JJ's baleen basket was short enough during the first several months to allow suckling. The baleen plates then increased rapidly to adult lengths by the time she was 6–7 mo old, which corresponds with the time of weaning in free-ranging gray whales (Rice & Wolman, 1971). The baleen plates were bilaterally symmetrical during that period. This is consistent with Rice and Wolman's (1971) suggestion that the asymmetrical pattern of baleen plate length in adult gray whales results from preferential feeding on the substrate and consequent abrasion of the plates on one side (usually the right side), rather than from differential growth of baleen plates between the sides.

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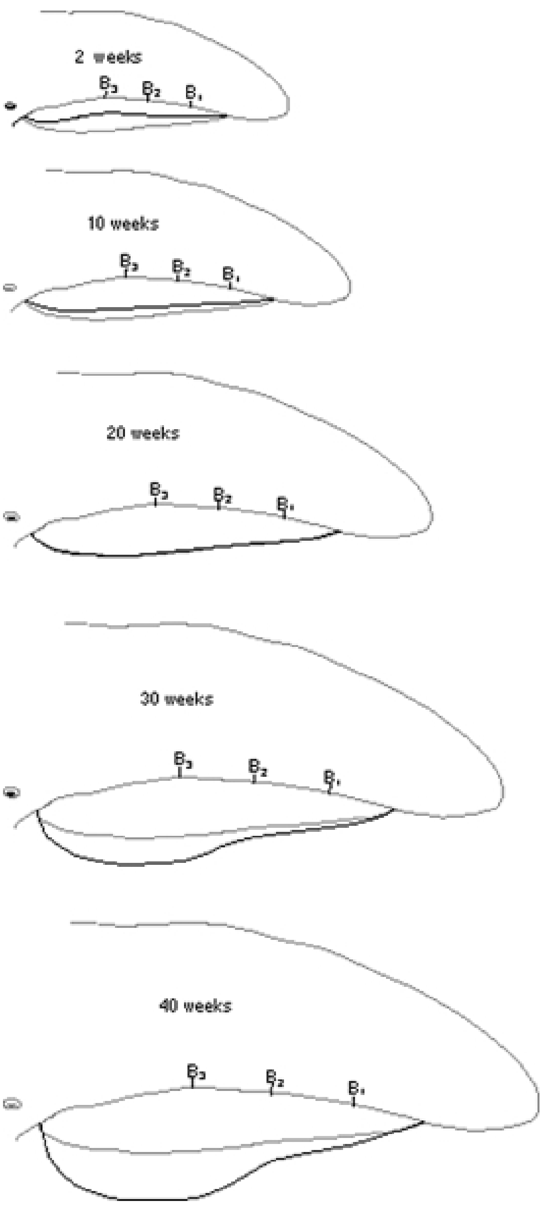

Figure 5. Summary of gray whale baleen plate growth (thick lines) from measurements made at ten week intervals. The baleen outline for 20 weeks is super-imposed on the other outlines to illustrate the rapid growth of the posterior plates.

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