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MOVEMENTS AND HAULOUT BEHAVIOR OF RADIO-TAGGED HARBOR SEAIS

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Abstract: Movements, haulout area fidelity and haulout frequency of harbor seals (*Phoca vitulina*) were studied in the Kodiak Island area, Alaska by relocating radio-tagged animals captured on a large hauling area. Eight of 35 radio-tagged seals were found on hauling areas other than the capture site. The longest movement was 194 km. One seal crossed 74 km of open ocean. Movement rates up to 27 km/day were recorded. There appeared to be considerable fidelity to one or two specific haulout locations by individual radio-tagged animals. "Resident," radio-tagged seals of a large hauling area were hauled out during 50% of the daily radio checks in June and 41% from 1 August to 5 September. On an individual basis, frequency of haulout ranged from 16% to 80% of the days.

Key words: *Phoca vitulina*, harbor seals, Gulf of Alaska, radio-tagged, movements, haulout behavior.

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We studied movements, haulout area fidelity and frequency of haulout of radio-tagged harbor seals in the Gulf of Alaska. The research was conducted to aid in evaluating potential impacts on harbor seal populations of activities associated with proposed offshore oil and gas development in the area.

Harbor seals have been considered sedentary animals with local movements associated with tides, food, reproduction and season (Havinga 1933; Scheffer and Slipp 1944; Fisher 1952; Bigg 1969). These impressions were the results of general observations rather than records of individual movements. The only scientific information of which we are aware on movements of individual seals is from recoveries of animals tagged as pups (Vania et *al.* 1969; Divinyi 1973; Bonner and Witthames 1974; Boulva and McLaren 1979).

In common with other pinnipeds, harbor seals spend much of their lives in the ocean. At times they "haulout" of the water onto reefs, beaches, ice or other suitable substratum where they rest, give birth and suckle their young. It is at this time when harbor seals can be most easily and accurately counted. Several workers have attempted to census harbor seal populations by counting hauled-out animals (Rosenthal 1968; Pearson and Verts 1970; Calambokidis et al. in press). However, because of insufficient information regarding haulout patterns and proportion of the population visible (Chapman et al. 1977) such counts are only valuable as minimum estimates.

Little is known regarding fidelity of individual harbor seals to a particular haulout location. It is difficult to assess impacts of localized development or disturbance without insight into this area.

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METHODS

The research was conducted in the Kodiak Island area of the Gulf of Alaska (Fig. 1). The primary study site was the southwestern hauling area on Tugidak Island (56° 27'N, 154° 47'W) where up to 9,000 harbor seals have been counted on a 3.2 km stretch of gravel beach. Field work was conducted between 8 May and 9 September 1978. Thirty-five seals (Table 1) were captured on the southwestern hauling area, immobilized with ketamine hydrochloride and fitted with radio transmitters attached with a bracelet around the base of a hind flipper. The first 21 seals were captured between 8 May and 2 June. Capture operations were then

suspended to avoid disturbance during pupping. Fourteen more seals were fitted with transmitters from 3 to 9 July. The transmitters, fabricated by Cedar Creek Bioelectronics Laboratory of the University of Minnesota, operated on separate frequencies in the 164-165 MHz range and signals could be received only when the seals were hauled out. Maximum range of the transmitters was about 8 km. Individually recognizable color combinations of cattle ear tags placed in hind flippers and vinyl flagging attached to the transmitters were used as backup identifiers to detect transmitter failure or loss.

Both numbers of radio-tagged seals and total numbers of seals hauled out on the southwestern hauling area were monitored on a near daily basis during June and from 1 August to 5 September. Additional observations of radio-tagged harbor seals ashore were made from 9-31 May but behavior of the animals may have been affected by the disturbance of ongoing capture operations. Radio checks and counts of seals on the southwestern hauling area were made from the top of 30 m bluffs abutting the beach. A portable radio-tracking receiver with a hand held yagi antenna was used for the onsite radio checks. counts were made visually from the bluffs or from polaroid prints taken from the bluffs. Hauled-out seals were examined with 10X binoculars to locate radio-tagged individuals and the results compared with radio checks to detect radio failures ‘or losses. Radio checks and counts were timed to coincide with daytime low tides when maximum numbers were usually hauled out.

Aerial, radio-tracking surveys, using a scanning receiver, were flown in a Bellanca Scout fixed-wing aircraft and Bell 206 helicopter.

Twenty-seven surveys, totaling 53.6 hours, were flown to locate radio-tagged seals which moved from southwestern Tugidak to other hauling areas. Coverage of the surveys included most of the shoreline and all of the known, major haulouts in the Kodiak Island group. Chirikof Island and the Semidi Islands were surveyed twice. The coast between Wide Bay and Amalik Bay on the Alaska Peninsula was surveyed once. Surveys were flown during lower stages of the tide when the most seals were usually hauled out.

RESULTS AND DISCUSSION

Movements - Eight radio-tagged seals (6 females and 2 males) were relocated 17 times at hauling areas other than the capture site. The longest movement was a minimum of 194 km to Ugak Island (Fig. 1). Another animal crossed 74 km of open ocean to Chirikof Island and then returned to southwestern Tugidak. The other movements ranged between 26 and 74 km. The general pattern for these animals seemed to be for them to remain at the new site for some period of time rather than using many locations. Twelve of 17 relocations of radio-tagged seals on haulouts other than southwestern Tugidak were clustered in the northern Tugidak, Sitkinak, southern Kodiak area (Fig. 1) which are the nearest hauling areas to southwestern Tugidak. Several different "types" of movements occurred. One seal (TR-12) made a long move to another hauling area which it appeared to use for the remainder of the study period. Another (TR-5) made a long move to a hauling area, then returned to southwestern Tugidak where it appeared to stay for the remainder of the summer. Two radio-tagged seals (TR-4, 13) alternated between 2 haulouts. Three

seals (TR-8, 15, 22) were found at hauling areas other than southwestern Tugidak only one time. No correlation between sex and age of the radio-tagged seals and extent or type of movement was apparent, however, sample sizes of all groups except adult females were very small (Table 1).

It was probable that additional movements of radio-tagged seals occurred. Many of the other transmitter equipped seals were absent from southwestern Tudigak for extended periods (Fig. 2). Only occasional radio tracking surveys were flown and radio-tagged animals which were not hauled out at the time or in the area of the survey would not have been found.

Information on movement rates was derived by dividing minimum distances between consecutive sighting by elapsed time. Rates for 4 animals were 24 km/day, 19 km/day, 27 km/day and 26 km/day. These rates were minimums because actual routes traveled were unknown and actual travel times were no doubt less than observed in most cases.

Information previously available on movements of individual harbor seals was from the recoveries of animals which had been tagged within several weeks of their birth (Vania et al. 1969; Bonner and Witthames 1974; Boulva and McLaren 1979). They documented dispersal of juveniles up to 250 km from large pupping areas. Mansfield (1967) and Knudtson (1974) remarked on the wandering or dispersal of young harbor seals, referring to them as "rangers!". Additional insight into the range of harbor seal movements comes from offshore sightings. Spalding (1964) reported observations of harbor seals 50-65 km offshore in the Gulf of Alaska and Wahl (1977) saw a seal 80 km off the coast of Washington State.

Haulout Area Fidelity

There appeared to be considerable fidelity to specific haulout areas by individual radio-tagged seals. Twenty-three of 31 (74%) seals which were relocated after capture were found only at the capture site. Of the 8 animals which were found on haulouts other than southwestern Tugidak, 3 were found on the same haulout more than once. Only 1 seal was found on more than 2 sites and it was found on only 3. Additional use of haulouts other than southwestern Tugidak may have gone undetected but the consistency of these data leads to the conclusion that few sites are generally used.

Calambokidis et al. (1978) suggested that both year-round site loyalty and long distance movements occurred in harbor seal populations in Puget Sound. They based this on repetitive observations of uniquely marked individuals and fluctuations of counts of seals on hauling areas. Knudtson (1974) and Reijnders (1976) reported observations of the same animals returning repeatedly to the same hauling area. Divinyi (1973) collected a tagged harbor seal on the southwestern Tugidak haulout where it had been tagged as a pup 3 years earlier. Boulva and McLaren (1979) saw recognizable individuals hauled out in the same area day after day during summer.

Frequency of Haulout and Proportion Hauled Out

Insight into what proportion of the population was represented by counts of hauled out seals was gained by examining haulout histories of radio-

tagged seals (Fig. 2). More than 1 hauling area may have been used and since only southwestern Tugidak was regularly monitored, it was impossible to quantify precisely the haulout frequency of all radio-tagged seals. To alleviate this problem we classified aposteriori certain radio-tagged seals as southwestern Tugidak "residents" by excluding those found hauled out at other locations and those which were absent from southwestern Tugidak for extended periods. We then examined the haulout data from these animals during 2 periods with frequent monitoring and minimal disturbance (1-30 June and 1 August-5 September).

In June, "resident" radio-tagged seals were found hauled out during daily radio checks on an *average* of 50% of the days (Table 2) and between 1 August and 5 September they were found hauled out on 40% of the days (Table 3). On an individual basis, frequency of haulout ranged from 16% (TR-20 during June and TR-24 during August-Sept.) to 80% (TR-19 during June) of the days. If the "resident" radio-tagged animals were representative of the populations the average number of seals hauled out during the daily radio checks probably represented about one half of the total population.

Our finding agree quite well with the results of certain, other studies of harbor seals. Sullivan (1979) found that harbor seals spent an *average* of 44% of their daily activity budgets hauled out. Summers and Mountford's (1975) estimate of harbor seals in the Wash, Great Britian based on mark-recapture studies was considerably higher than numbers seen hauled out. Finley (1979) speculated that midday counts of ringed seals (*Phoca hispada*) represented about 70% of the population based on a recognizable individual which was observed 71% of the time.

The effects of capture, handling and attachment of the transmitter package on the behavior of radio-tagged was largely unknown but cannot be entirely ignored. Some seals developed abrasions where the bracelet encircled the ankle, apparently because of excess rigidity of the bracelet. In one instance, both the health and choice of haulout location of a radio-tagged seal appeared to be influenced by the abrasion resulting from the transmitter attachment. TR-22 was relocated 56 days after capture on a beach not normally used as a haulout by harbor seals. She appeared thin and her hind flipper at the point of transmitter attachment was badly abraided and infected. We recaptured her and removed the transmitter. However our subjective impression *was* that haulout behavior *was "normal"* for the *radio-tagged* seals observed on southwestern Tugidak.

Four radio-tagged seals were never relocated after release. They may have moved beyond the range of the aerial surveys or not have been hauled out during any of the surveys. If the transmitters failed or were lost they would not have been relocated during aerial *surveys,* but would have been seen on southwestern Tugidak where visual searches were routinely made. Mortality, either related or unrelated to capture and transmitter attachment, could explain lack of contracts. Hammond and Elsner (1977) reported delayed deaths of seals several hours after they appeared to be recovered from immobilization with ketamine hydrochloride.

The significance of our findings *in* regard to potential impacts of offshore oil development are not clearcut. The range of movements we recorded (up to 194 km) in combination with the highly variable individual haulout

patterns and average haulout frequency of 40%-50% of the days suggest it would be unlikely that all members of a "resident" population would be hauled out at a given time thereby subjecting them to the effects of an event such as an oil spill. Also, given the extent of movements found in this study plus the dispersal of juveniles reported by others (Vania et *al.* *1969;* Bonner and Witthames 1974; Boulva and McLaren 1979) it seems likely that animals would move *into* areas which had been depleted. Conversely, the high degree of fidelity to 1 or 2 specific hauling areas would appear to make harbor seals susceptible to localized disturbance, development and catastrophic events.

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Fig. 1. Gulf of Alaska study area showing locations of radio-tagged harbor seals found at haulouts other than the capture site on southwestern Tugidak Island.

Fig. 2. Haulout patterns of radio-tagged harbor seals on southwestern Tugidak Island showing the presence or absence of each individual during daily radio checks. Open box, present; dark box, found on other haulout; capture operation caused some disturbance between 8 May and 2 June; 25 valid radio checks between 1 and 30 June; no onsite radio checks 2-31 July; 31 valid radio checks between 1 August and 5 September.

Fig 1

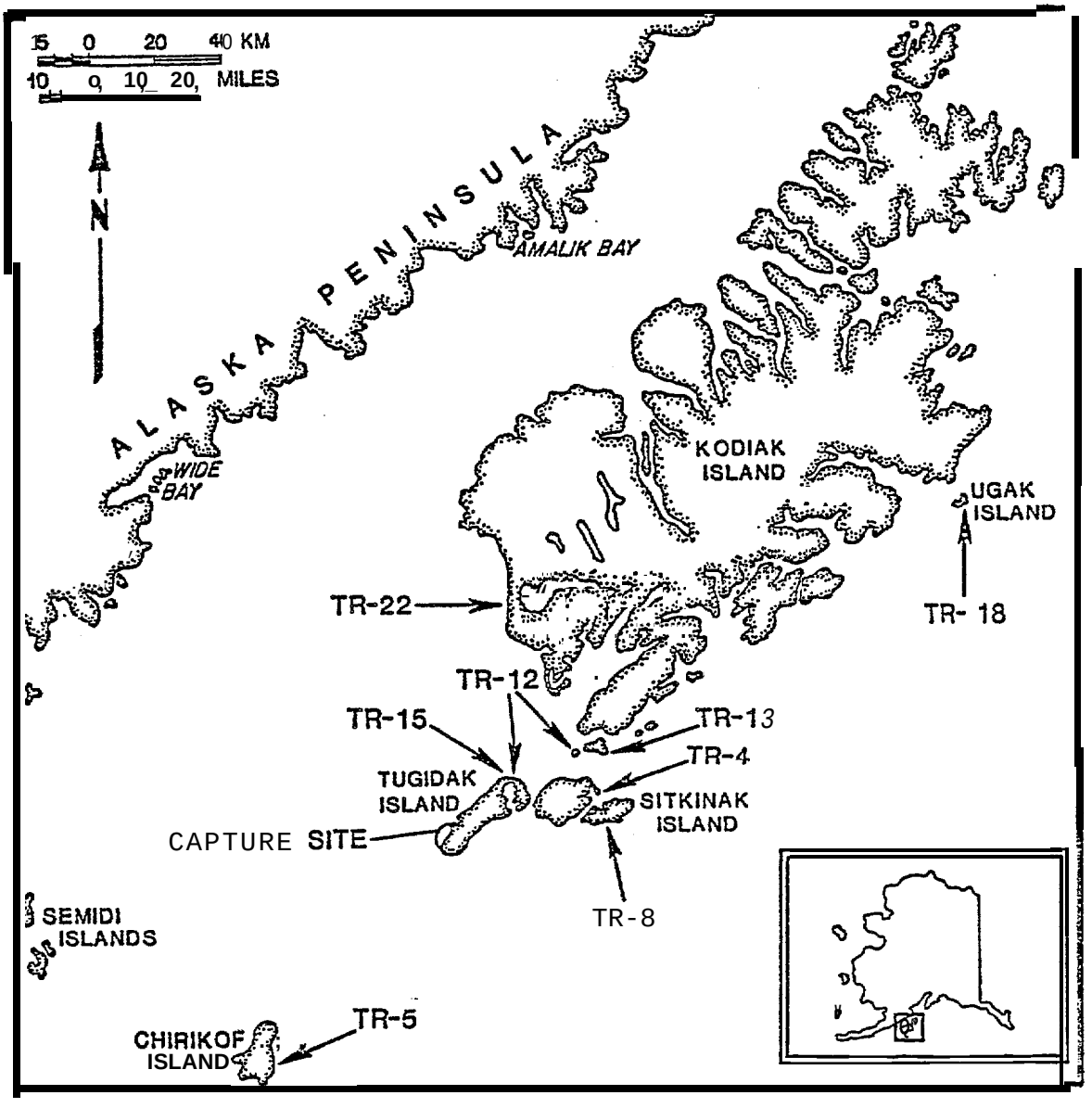
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fig. 2

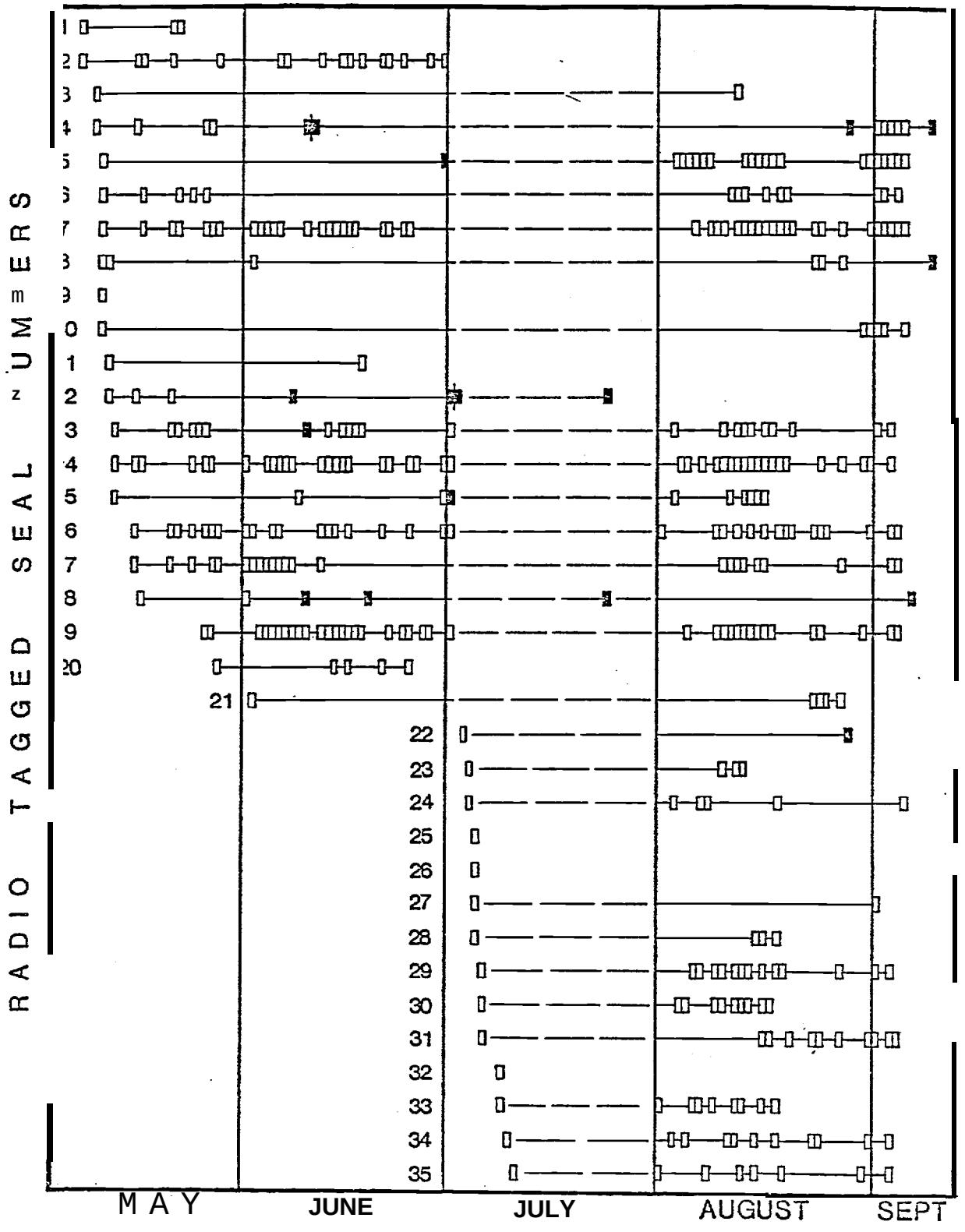
RADIO TAGGED SEAL SUMMERS
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Table 1. Sex and age composition of 35 radio-tagged harbor seals captured on the southwestern hauling area of Tugidak Island.

Sex and *age* classification	Number of seals
Mature females	24
Immature females	5
Mature males	5
Immature males	1
Total	35

Table 2. Haulout frequency of 7 "resident" radio-tagged harbor seals on southwestern Tugidak Island from 1-30 June 1978. Column at far right shows the proportion of days during this period on which each seal hauled out.

Resident seal #	(Days) June 1	2	3	4	5	6	7	8	9	10	12	13	14	15	16	17	18	21	22	24	25	26	27	28	30	Days hauled out	Proportion days hauled out
z						x	x				x			x	x		x	x	x	x				x	x	11	0.44
7		x	x	x	x	x				x	x	x	x	x	x	x		x	x	x	x					16	0„6,$
14	x			x	x	x	x	x			x	x	x	x	x			x	x		x	x			x	16	0.64
16	x	x			x	x					x	x	x		x			x			x				X	11	0.44
17	x	x	x		x	x	x	x	x		x															9	0.36
19			x	x	x	x	x	x	x	x	x	x	x	x	xx		xx		x	x	x		x	x		20	0„80
20													x		x			x			x					4	0.16
																										87	0„50

Table 3. Haulout frequency of 12 "resident" radio-tagged harbor seals on southwestern Tugidak Is and from 1 August-5 September 1978. Column at far right shows the proportion of days hauled out by each seal.

Resident seal #	(Days) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	23	24	25	27	30	31	1	2	3	4	5	Days hauled out	Proportion days hauled out
													August																September				
5			x	x	X	X	X	X					X	X	X	X	X	X							X	X	X	X	X	X	X	19	0.61
6											X	X	X			X		X	X								X	X		X		9	0.29
7						X		X	X	X		X	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X	X	x	22	0.71
13			X							X		X	X	X		X	X			X							X		X			10	0.32
14				X	X		X		X	X	X	X	X	X	X	X	X	X	X			X		X	XX				X			19	0.61
16	X								X	X		X		X		X		X	X	X	X	X	X		X				X	X		15	0.48
17										X	X	X	X		X	X								X						X	X		9	0.29
19					X				X	X	X	X	X	X	X	X	X				X	X			X				X	X		15	0.48
24			X				X	X										X													X	5	0.16
29						X	X		X	X		X	X	X		X		X	X					X			X		X			13	0.42
34			X		X						X	X			X			X			X	X				X			X			10	0.32
35	X							X					X		X				X						X				X			7	0.23
																																153	0.41