

NOTES

ANNUAL REPRODUCTION, DEPENDENCY PERIOD, AND APPARENT GESTATION PERIOD IN TWO CALIFORNIAN SEA OTTERS, *ENHYDRA LUTRIS*

There are various estimates of the frequency of pupping, dependency period and gestation period for the sea otter, *Enhydra lutris*. Based upon an evaluation of female urogenital tracts taken at various times of the year and comparing observed population growth rates with theoretical growth rates, Kenyon (1969) and Schneider¹ concluded that female sea otters probably reproduced every 2 yr. Sinha et al. (1966) demonstrated that delayed implantation of the blastocyst probably occurred in sea otters. Kenyon (1969) suggested 12-13 mo total gestation period (7-8 mo unimplanted and 4.5-5.5 mo implanted) and 11-12 mo for rearing the pup, and a few months rest between weaning and the next estrus. This cycle could be shortened if the female prematurely lost a pup (Schneider footnote 1). Schneider² assumed the reproductive cycle included a 7.5 mo gestation period; Barabash-Nikiforov (1935) estimated an 8-9 mo gestation period; he later stated that sea otters breed once a year (Barabash-Nikiforov 1969). Lensink (1962) believed that females bred every year, at least when food was not limiting, and recent evidence presented by Johnson and Jameson³ indicates annual reproduction in at least some Prince William Sound sea otters. Vandever (1972) suggested that pup dependency period was less than a year, based on an annual February peak in pupping in California.

This note describes observations of two tagged female sea otters in California, one seen with a different pup for 6 consecutive yr and the other seen with four different pups in about 5 yr. We also report estimates on the apparent gestation period and pup dependency period for these two sea otters.

The first sea otter was a female [No. 34; marked with aluminum tags (Loughlin 1977)] weighing 22

kg when captured on 7 March 1976 near Monterey, Calif. It was noted at the time that this female had protruding nipples, a distended abdomen, an enlarged pelvic area, indicating that she may have been pregnant. She was subsequently seen on 13 March 1976 with a newborn pup. The female-pup pair was last sighted on 2 April 1976, although the female was sighted often in May 1976 without a pup. The pup was apparently lost after only 2 mo and probably died. On 9 May 1977, female No. 34 was seen with a second pup estimated to be 1-3 mo old near San Simeon, Calif. (approximately 140 km south of Monterey). The last sighting of this pup was on 10 August 1977 at which time it was assumed to be 4-6 mo old. [The pups were not marked, except for No. 34's third pup, and since sea otters are not known to adopt strange pups, we assumed that the pups observed were the same during any 1 yr. Estimates of age for pups were based upon a subjective appraisal of physical appearance and behavior (Lensink 1962; Kenyon 1969; Sandegren et al. 1973). The reader is cautioned that our estimates of gestation period are based upon this subjective appraisal.] A third pup, a 3.6 kg female probably not over 1.5 mo old, was captured along with No. 34 on 2 March 1978 back near Monterey. This pup was marked with a small tag in one ear and was sighted only once about a week later. It is presumed to have died. Number 34 was observed on 9 January 1979 with a fourth pup. Both were resighted on many occasions through 13 September 1979 when this pup was assumed to be slightly over 8 mo of age. This same female was seen with a fifth newborn pup on 27 March 1980. This mother-pup pair was seen on at least two subsequent occasions, the last being 8 April 1980, but by 5 May 1980 she again was without a pup and it presumably died. Number 34 was seen with her sixth pup, judged to be 1 mo old, on 9 March 1981 and it was still with the female at the time of writing (Table 1). (Identification of No. 34 is now difficult since she lost her right flipper tag and the left is loose.)

The second female sea otter (No. 41) weighed 25 kg when captured and marked on 15 August 1976 near Monterey. She was observed on 8 January 1977 with a newborn pup and both were subsequently resighted on many occasions. Eight months later, on 8 September 1977, she had a red swollen nose which is indicative of recent copulatory behavior (Kenyon 1969) and was without her

¹Schneider, K. B. 1972. Reproduction in the female sea otter. Alaska Department of Fish and Game, Sea Otter Rep. I, 36 p.

²Schneider, K. B. 1973. Reproduction in the female sea otter. Alaska Department of Fish and Game, Sea Otter Rep. II, 13 p.

³Johnson, A. M., and R. Jameson. 1979. Evidence of annual reproduction among sea otters. (Abstr.) Third Biennial Conference on the Biology of Marine Mammals, Oct. 7-11, Seattle, Wash., p. 31.

TABLE 1.—Observation data on sea otter No. 34 and her six pups.

Pup	Date pup first seen	Approximate age of pup when first seen	Date pup last seen	First date female seen without pup	Approximate dependency period	Apparent gestation period
First	13 Mar. 1976	Newborn	2 Apr. 1976	10 May 1976	Presumed dead	} No estimate About 5 mo No estimate 6 mo No estimate
Second	9 May 1977	1-3 mo	10 Aug. 1977	12 Aug. 1977	4-6 mo	
Third	2 Mar. 1978	About 1.5 mo	7 Mar. 1978	15 Mar. 1978	Presumed dead	
Fourth	9 Jan. 1979	Newborn	13 Sept. 1979	22 Sept. 1979	8.5 mo	
Fifth	27 Mar. 1980	Newborn	8 Apr. 1980	5 May 1980	Presumed dead	
Sixth	9 Mar. 1981	About 1 mo	Still with female at time of writing			

TABLE 2.—Observation data on sea otter No. 41 and her four pups.

Pup	Date pup first seen	Approximate age of pup when first seen	Date pup last seen	First date female seen without pup	Approximate dependency period	Apparent gestation period
First	8 Jan. 1977	Newborn	27 Aug. 1977	8 Sept. 1977	8 mo	} 4 mo 4 mo No estimate
Second	28 Feb. 1978	About 1.5 mo	7 Sept. 1978	27 Sept. 1978	8 mo	
Third	13 Mar. 1979	About 1.5 mo	5 May 1979	10 July 1979	3.5-5.5 mo	
Fourth	31 Dec. 1980	About 1.5 mo	Still with female at time of writing			

pup (Table 2). She was seen with a second pup judged to be about 1.5 mo old on 28 February 1978. This mother-pup pair was seen on numerous occasions through 7 September 1978. Apparently the mother and pup separated after about 8 mo. Number 41 was observed with a third pup, also judged to be approximately 1.5 mo old, on 13 March 1979. This pair was observed often through 5 May 1979. Neither was seen again until 10 July 1979 when No. 41 was seen, red nosed, with a male but without her pup. The third pup, therefore, probably was 3.5-5.5 mo old when separated from its mother. Number 41 was seen with a fourth pup, judged to be 1.5 mo old, on 31 December 1980, and was still with the female at the time of writing.

Since it is not possible to determine with certainty when conception or blastocyst implantation occurred, we can only speculate on the gestation period for the pups of No. 34 and 41. On 10 August 1977, No. 34 was seen with a second pup and on 12 and 13 August 1977 she was seen without her second pup and with a male escort. Photographs of her head region taken on 13 August 1977 showed nose damage indicating recent copulation. She was subsequently recaptured on 2 March 1978 with a third pup that weighed 3.6 kg. Assuming the pup was 1.5 mo old at capture and that conception occurred in mid-August 1977, the gestation period was about 5 mo. Number 34 and a fourth pup were last seen together on 13 September 1979. She was seen without a pup and with a male companion on 22 September 1979 and by 24 September 1979 her nose again exhibited evidence of recent copulation. We monitored No. 34 closely for the

next several months. She was last seen without a pup on 14 March 1980; then with a fifth pup on 27 March 1980. If conception took place on 22-24 September 1979, gestation was close to 6 mo.

Number 41 was separated from a pup in early September 1977, coincident with the appearance of a male companion. She had a swollen nose on 8 September 1977 and on 28 February 1978 was seen with an estimated 1.5-mo-old pup. Assuming conception occurred in early September, the gestation period was a little over 4 mo. Her second pup was "weaned" in early September 1978. A third pup, judged to be about 1.5 mo old when first observed on 13 March 1979, was also born just over 4 mo after separation of the second.

Our observations indicate that at the time of separation (weaning) three of the eight separated pups were large enough at 8-8.5 mo of age to have a good chance of survival. Two pups between about 3.5 and 6 mo, although rather small, may have survived. Some independent animals have been documented in the 9-12 kg range (Loughlin 1977; Wild and Ames⁴). The remaining three almost certainly died.

Estimates of the gestation period for captive sea otters, presumably based upon more definitive data, range from 5.5 to 8 mo (Brosseau et al. 1975; Antrim and Cornell 1980; Antrim⁵). Our esti-

⁴Wild, P. W., and J. A. Ames. 1974. A report on the sea otter, *Enhydra lutris* L., in California. Calif. Dep. Fish Game, Mar. Resour. Tech. Rep. 20, 93 p.

⁵J. Antrim, Curator of marine mammals, Sea World, Inc., 1720 South Shores Road, San Diego, CA 92109, pers. commun. June 1980.

mates of 4-6 mo gestation periods, which assume that copulation and conception do not occur until after weaning, seem reasonable if the blastocyst is implanted soon after conception, partially skipping or entirely skipping the delay period. Our field data and that from captive studies indicate that the gestation period in sea otters may be variable and depend on an external stimulus or the general well being of the female.

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MASS MORTALITY OF FEMALE DUNGENESS CRAB, *CANCER MAGISTER*, ON THE SOUTHERN WASHINGTON COAST

Studies of growth and age of Dungeness crab, *Cancer magister*, populations from California to British Columbia have amply elucidated developmental rates for this species (Clever 1949; Waldron 1958; Butler 1961; Poole 1967), but no information is contained in such reports on mortality and its causes, apart from reference to known predators and cannibalism. Natural mortality for highly mobile crustaceans is difficult to investigate because animals simply do not expire in easily observed locations or are quickly removed by scavengers once dead. Consequently, there has been no documentation of extensive crustacean mortality by causes such as disease or pollution on the Pacific coast of the United States, and therefore loss from a population throughout its life cycle due to a generalized predator category (including fishing and cannibalism for *C. magister*, Botsford and Wickham 1978) remains the traditional mortality component of the literature on many crustaceans including Dungeness crabs.

On 18 April 1979 large numbers of dead Dungeness crabs on the beach at Grayland, Wash. (Figure 1), were reported to the Westport Field Office of the Washington Department of Fisheries (WDF). Inspection of the beach between Westport and the northern end of Willapa Bay confirmed that many Dungeness crabs had been washed ashore and, contrary to our initial supposition, were not exuvia which are often mistaken for dead crabs by the public. Preceding this instance, we had reports of dead crabs in the pots of commercial fishermen in Willapa Bay in February 1979, and these findings were verified by WDF personnel.

In response to the report of 18 April, five locales on the beach from Grays Harbor to Willapa Bay (Figure 1, Table 1) were quantitatively examined for dead crabs and the shoreline between these points was inspected from a car. All crabs along the five transects were counted and sexed, if possible, and 42 Dungeness crabs at transect 3 were measured to the nearest millimeter across the carapace inside the tenth anterolateral spines.

Results

Dead crabs found on the beach between Grays Harbor and Willapa Bay were confined to the line of previous high tide in a swath about 8-10 m wide.