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5 January 1976; revised 19 March 1976

## Baboon Infant Produced by Embryo Transfer

Abstract. *An embryo was recovered surgically from a naturally ovulating, naturally inseminated* Papio cynocephalus *female on day 5 of gestation and transferred surgically to a naturally synchronized, nonmated* Papio cynocephalus *female on 20 March 1975. A male baboon weighing 875 grams was delivered by cesarean section on 5 September 1975, 174 days after estimated ovulation time.*

The first nonhuman primate infant to be produced by embryo transfer was delivered 5 September 1975. The male infant, weighing 875 g, appeared entirely normal when delivered by cesarean section 174 days after estimated ovulation time (the average duration of gestation in baboon is 175 days).

The embryo had been collected surgically (*1*) from a naturally inseminated, naturally ovulating *Papio cynocephalus* female on day 5 after ovulation. The embryo, appearing very similar to the baboon embryo shown in Fig. 1, was in the morula stage of development before implantation. The embryo was recovered in tissue culture medium 199 with Hanks salts, 0.35 g of sodium bicarbonate per liter, and 100 mg of neomycin solution (Grand Island Biological) per milliliter and was maintained in a covered embryological watch glass for 20 minutes at 32°C.

The recipient female was maintained in an individual cage and was not mated. She was selected on the basis that her sex skin cycle was synchronized with that of the donor; that is, the estimated day of ovulation of the recipient was the same as that of the donor. The recipient was prepared for the surgical transfer with ketamine hydrochloride and atropine prior to anesthesia and was maintained under halothane anesthesia during the transfer procedure. The uterus was exposed via a midventral laparotomy, and a puncture hole was made in the uterine fundus with an 18-gauge Intracath (Jelco, Raritan, N.J.). The embryo was deposited into the uterine lumen, along with 1 $\mu$l of the collection medium, by means of a Micro/pettor (Scientific Manufacturing Industries, Emeryville, Calif.) via the puncture hole.

The pregnancy was diagnosed on day 20 after ovulation, by means of a monkey chorionic gonadotropin test on both urine (*2*) and plasma (*3*); it was confirmed on days 20 and 52 after ovulation on the basis of increases of progestin and estrogen in the plasma; and on day 100 by radiography and ultrasonic monitoring of the fetal heart beat. The infant (Fig. 2) was delivered by cesarean section on day 174 after ovulation and is being reared in the baboon nursery.

The fact that the offspring is a male rules out the unlikely possibility that this pregnancy was induced by parthenogenesis. The possibility that the recipient's ovum might have been fertilized by a spermatozoon transferred with the embryo is ruled out by the fact that the transfer was performed 5 days after the estimated day of ovulation, at which time the ovum of the recipient would have already degenerated. Therefore, since the recipient had not been mated, it is concluded that this offspring is the result of the continued development of the transferred embryo within the recipient uterus.

Attempts to find genetic markers that would exclude the foster mother as the genetic mother have been unsuccessful. The initial survey included red cell blood groups, electrophoretically separable blood proteins (serum and cellular), and lymphocyte antigens (RhL-A antiserums that had previously been shown to cross

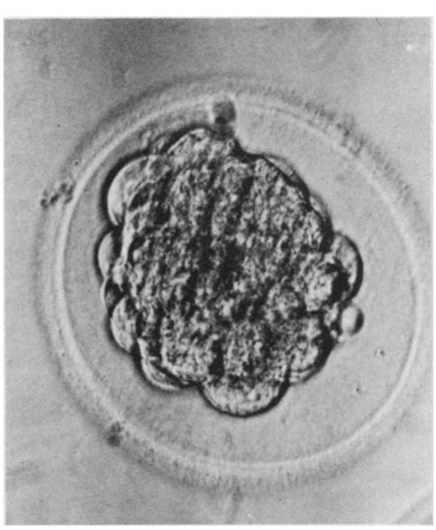

Fig. 1. A baboon embryo collected on day 5 after ovulation. It is similar in appearance to the embryo that was successfully transferred. The transferred embryo was not photographed (× 1000).

Fig. 2. The baboon infant, at 63 days of age, is shown in the center. The donor mother is to the infant's left and the recipient mother is to the infant's right.

react to some extent were used). Finding genetic markers to exclude the foster mother as the genetic mother might be possible if baboon specific lymphocyte antigens are obtained, since lymphocyte antigens have been some of the most polymorphic loci in other mammals (4).

Developmental studies that preceded this successful embryo transfer include a series in which laparotomies were performed on five mated baboon females during the preimplantation stage of pregnancy. Two of these females carried their pregnancies to term. Of 13 sham-operated control females, in which 1 $\mu$l of culture medium was transferred to their uteri, three remained pregnant to term. Ten embryo transfers between animals were performed. In each case a single embryo was transferred from the uterus of one female to the uterus of another. The infant whose birth is reported here is the result of one pregnancy that continued after transfer.

Embryo transfer procedures are being developed for application in the production of specific strains on nonhuman primates for use as animal models in biomedical research. These procedures will also be useful for studies of the relative importance of hereditary and environmental factors on prenatal development in which nonhuman primates are used as comparative models of human disease.

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# Imprinting to Chemical Cues: The Basis for Home Stream Selection in Salmon

Abstract. *Juvenile coho salmon were exposed to morpholine or phenethyl alcohol (p-alcohol) for 1½ months and then released in Lake Michigan. During the spawning migration 18 months later, morpholine and p-alcohol were metered into separate streams, and the number of morpholine- and p-alcohol–exposed fish returning to each stream was determined. Seventeen other locations were also monitored. The majority of the fish exposed to morpholine were captured in the stream scented with morpholine and most fish exposed to p-alcohol were captured at the p-alcohol-treated stream. This field study demonstrates that coho salmon imprint to and utilize chemical cues for homing.*

The odor hypothesis for salmon homing states that a juvenile salmon imprints to unique organic chemical odors of its natal stream and subsequently uses this cue to locate its stream during the spawning migration (*1*). We report here on field studies that document homing to two different organic chemicals by coho salmon [*Oncorhynchus kisutch* (Walbaum)]. The methods used were modified from previous work (*2–10*).

The basic procedure proposed by Hasler and Wisby (*1*) was to expose (imprint) young salmon to a synthetic chemical in

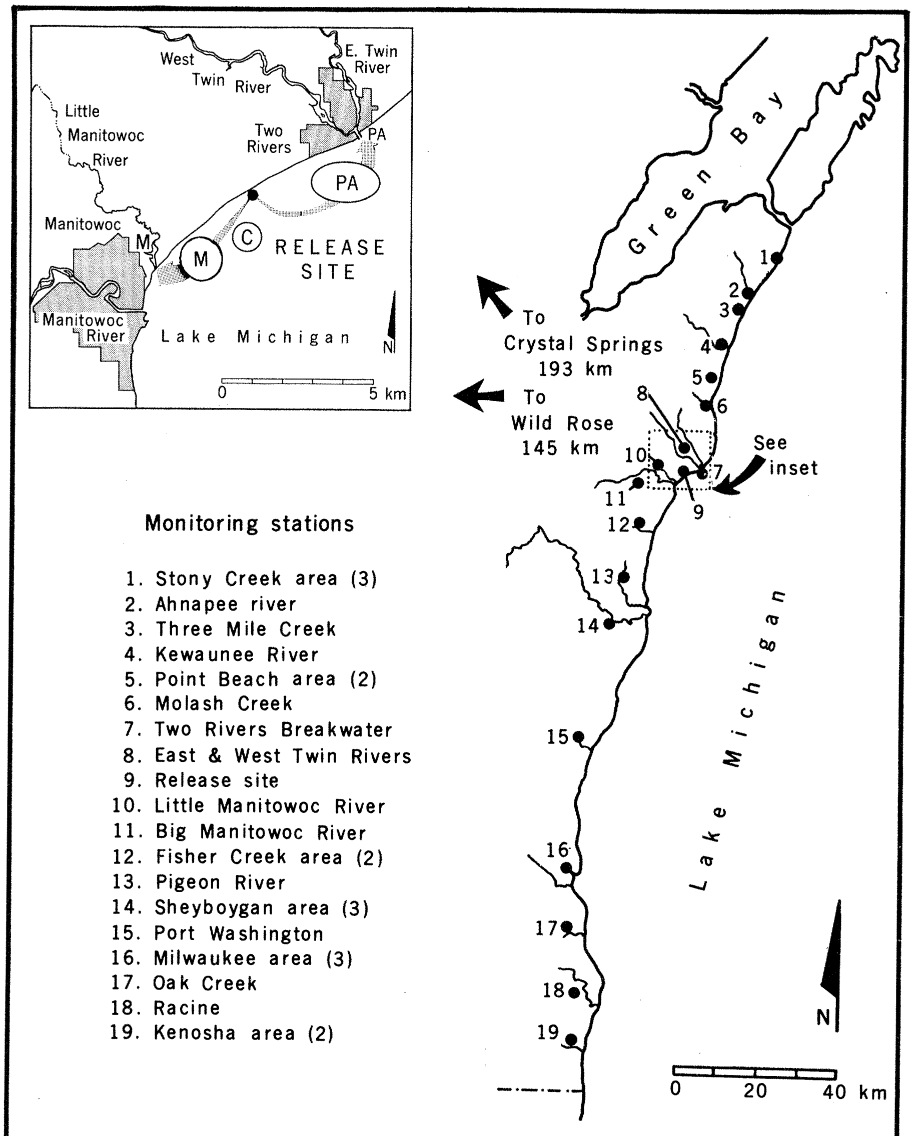


Fig. 1. Research area, Wisconsin shore, Lake Michigan. Numbers in parentheses represent the number of streams in the general area of the monitoring station that were surveyed. Inset shows detail of the release site, the morpholine-scented Little Manitowoc River (M) and the phenethyl alcohol–scented breakwater area at Two Rivers (PA).