

Proposal C - Example

Dam and Infant Proximity and Directional Locomotion
as Measures of Quality of Maternal Care
in Long-Tailed Macaques on Tinjil Island, Indonesia.

INTRODUCTION

Trivers (1972) described parental investment as “any investment by the parent in an offspring that increases the offspring’s chance of surviving (and hence reproductive success) at the cost of the parent’s ability to invest in other offspring” (p. 139). The primate order, characterized by k-selected reproductive strategy, particularly illustrates this central concept of sociobiological theory. Primate dams, in comparison to similarly sized mammals, have a long gestation, followed by an extended period of maternal care of the infant. Dams expend energy and time carrying their infant and protecting the infant from predation and conspecific social aggression, but the greatest cost to the dam is lactation.

Lactation is the mobilization of maternal reserves for the nutritional needs of an active offspring no longer constrained by the natal environment. Infant growth and maturation increases the caloric demands placed on the dam and consequently the dams must spend more time foraging, which in turn requires greater amounts of energy. Additionally, lactation is associated with ovulation suppression; preventing conception and delaying future reproduction (Lee 1996).

All females are not identical and variables such as weight, age, gravidity, family dynamics, environment, health, and social status affect pregnancy outcome and quality of maternal care post-natally. The mother-infant bond has been a central question in primate studies since the days of Harlow and hundreds of studies have attempted to address the reproductive strategies employed by dams of differential reproductive condition.

Maternal age, weight, and social status have consistently been the focus variables associated with reproductive outcome and mothering strategy in longitudinal non-human primate research. Among feral yellow baboons (*Papio cynocephalus*) maternal social status predicted the mothering strategy. High ranking dams were “laissez-faire,” less restrictive of their infant’s

behavior and allowed greater distances between themselves and their infant, and weaned their infants at younger ages without reduced infant survivorship, resuming estrus more quickly. Low ranking dams, however, were restrictive, maintaining close proximity to their infants, vigilant against infant-snatching and socially dominant con-specifics weaned infants later in order to insure infant survivorship, and had longer inter-birth intervals (Luft and Altmann 1998).

Fairbanks and MacGuire (1995) found interesting differences in the quality of maternal care in captive vervet monkeys (*Cercopithecus aethiops*). Mothering strategy of prime condition dams, as defined by high status, normal weight, fully mature adults, were similar to the pattern observed in high ranking yellow baboons. Marginal vervet dams, however, defined as low status, low weight, and either immature or aged females, were very "laissez-faire," to the point of neglect. These dams habitually rejected ventral contact with the infant, maintained greater distances from the infant, and limited nipple access. These behaviors were associated with increased infant mortality during the first 6 months of life, but the marginal dams did not enjoy a shortened inter-birth interval. The researchers argued that these females were maximizing their lifetime reproductive potential by restricting maternal resources away from a current low-quality reproductive attempt for future reproduction under more favorable conditions (Fairbanks and MacGuire 1995).

The purpose of this study is to address the relationship of maternal social status and, to a lesser extent, maternal health condition, and quality of maternal care in feral long-tailed macaques (*Macaca fascicularis*). Maternal health has been mostly overlooked in research assessing variables of maternal reproductive condition, most likely because gradations of health are so hard to address in the feral situation (monkeys aren't receptive to blood draws for CBC and chemistry analysis). Given the short study period, data collection will be restricted to

infant/dam proximity and locomotion in reference to each other, and general measures of maternal submissive and dominance behaviors. The null hypotheses which are the framework of this study are:

Hypothesis 1. Maternal social status/health condition will not be associated with infant/dam proximity and directional locomotion.

Hypothesis 2. Infants of high status/good health condition dams will show no differences in responsibility in maintaining ventral contact with their dam than infants of middle and low ranking dams.

METHODS

Field Site:

Observational data will be collected in Indonesia, southwest of Java, at the Pulau Tinjil Natural Habitat Breeding Facility (NHBF) dedicated to breeding specific pathogen-free long-tailed macaques, *Macaca fascicularis* (See Appendix A). This island facility is supported by the Washington Regional Primate Research Center and the Institut Pertanian Bogor and provides a natural habitat for approximately 1500 free-ranging long-tailed macaques. Tinjil Island has been extensively described in previous publications (Kyes et al 1998, Crockett et al 1996, Kyes 1993).

Subjects:

In order to address variation of maternal behavior, 6 dam/infant dyads will be selected for observational data collection. Selection of subjects will be based on observer reliability of individual animal identification, animal receptivity to observer follow, and all dams must be lactating. Ideally infants will be under 3 months of age and dependent on their lactating dam for the majority of their nutritional and caloric needs. Subjects will be selected from the two most habituated groups on Tinjil Island, M26 and "One-eye." These groups' home ranges are ideally located near Turtle Beach camp and food distribution cages and provide maximal opportunity for observation compared to less habituated groups more distally located from human settlement.

Materials:

Binoculars will be used to optimize animal identification and observational data collection

Procedure:

Behavioral data collection will be conducted from July 2 through July 20, 2001. Initially, a libitum notes of individual physical and behavioral characteristics, including observable health condition as indicated by maternal coat, body fat, and stool, will be taken as the observer

identifies potential subjects and concurrently habituates animals to observers' presence. Once subjects have been selected and reliably identified, focal animal sampling, focal dyad sampling, and instantaneous scan sampling of all infant/dam dyads will be conducted.

To better understand maternal social status, fifteen minute focal animal sampling of each dam will be conducted three times during the study period. All observed occurrences of behavior associated with dominance and submission occurring between the focal animal and another female will be recorded on a data collection sheet (See Appendix B). Data collection is restricted to female interactions in order to better understand the female hierarchy. Dominant and submissive behaviors to be recorded are listed in the ethogram (See Appendix C) and are a modified list of events and states described by Kaufman and Rosenblum (1966). This list is not intended to be exhaustive of dominant and submissive behaviors and does not attempt to address the many dynamics of social behavior, but rather give a simplified picture of an animal's position in the social hierarchy.

Additionally, the quality of the dam/infant relationship will be addressed using two methods of sampling. One measure of the quality of maternal care is maternal rejection. The method of evaluating the relative contribution of the dam or the infant to maintaining ventral contact was developed by Hinde (1974) and involves a simple calculation:

$$\text{Contact Index} = \frac{\text{Infant Makes Contact}}{\text{Infant MC} + \text{Dam MC}} - \frac{\text{Infant Breaks Contact} * 100}{\text{Infant BC} + \text{Dam BC}}$$

A higher score in this index indicates that the infant is more responsible for maintaining ventral contact than the dam. Ten minute focal sampling of each dyad will be conducted ten times during

the study period and will consist of simple recording of each occurrence of ventral contact between the dam and the infant, who initiated, and who broke the contact (See Appendix D). A more complex method of addressing quality of infant/dam relationship will be attempted using expanded categories of dam/infant proximity and directional locomotion. Instantaneous scan sampling of all six dyads will be conducted daily for 1-3 hours; weather, monkeys, and observer attitude permitting. Data will be collected using a two digit code, the first digit indicating infant/dam proximity and the second digit indicating infant and dam locomotion in reference to each other. These codes are detailed on the data collection sheet (See Appendix E).

Data Analysis: Each dam's social behavior data will be calculated simply, total number of occurrences of dominant behaviors divided by total number of occurrences of behaviors (dominant and submissive) observed. Ideally the females will be distributed across the social hierarchy, higher percentages of dominant behavior should reflect high social status, lower percentages of dominant behavior should indicate lower social status. Infant or dam maintenance or ventral contact will be analyzed using the Hinde Index (1974) described in the procedures section. Infant/dam proximity and directional locomotion will be analyzed using ANOVA.

SUMMARY

This project, while structured within the framework of a central question of animal behavior, does not attempt to address the many variables of maternal condition affecting quality of infant care. Rather, the goal of this project is to look at the infant/dam relationship and the role of social status, well studied in both captive and feral settings, and to a lesser extent, maternal health condition, which has been mostly overlooked in non-human primate studies. The short duration of the study period, the dense foliage of the natural environment, the uncertain habituation of the

animals, and the large population of observers are anticipated limitations to this study; however, the opportunity to observe feral animals using multiple data collection techniques and to potentially learn anything about their social behavior is the unparalleled worth of the entire adventure.

LITERATURE CITED

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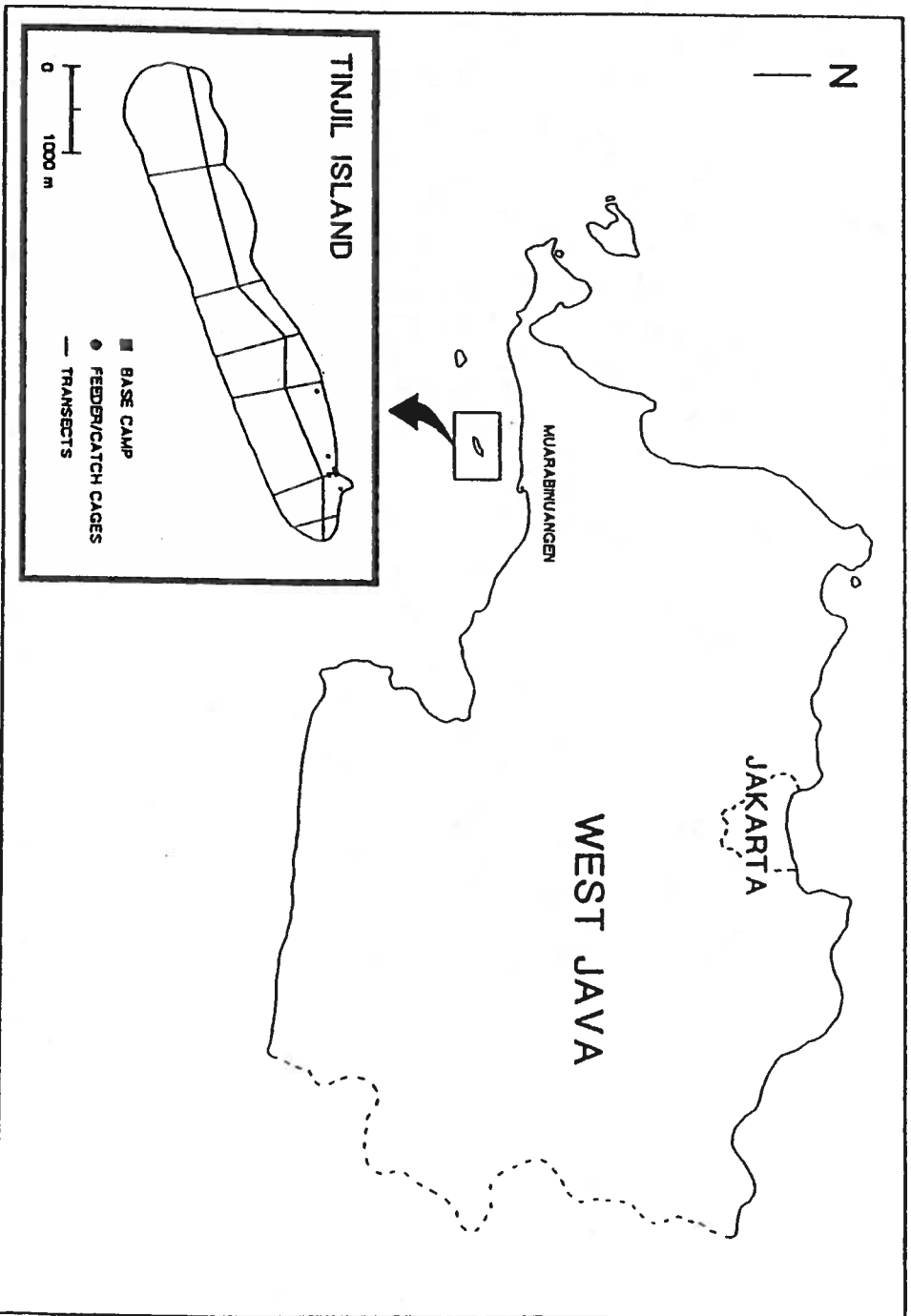


Fig. 1. Location of Tinjil Island.

Kyes, R. (1993). Survey of Long-Tailed Macaques Introduced Onto Tinjil Island, Indonesia. *American Journal of Primatology*. 33: 77-83.

APPENDIX B

MATERNAL SOCIAL STATUS BEHAVIORAL OBSERVATION DATA COLLECTION SHEET
15 MINUTE FOCAL ANIMAL SAMPLE

DATE: TIME:

DAM:

DOMINANT BEHAVIORS

- ATTACK
- PURSUIT
- THREAT
- STARE
- DISPLACEMENT
- TAKE AWAY

TOTAL

SUBMISSIVE BEHAVIORS

- DEFENSE AGGRESSION
- RIGID RESPONSE TO GROOMING
- DISPLACED/WITHDRAWAL
- FLIGHT
- GRIMACE
- LIP SMACKING
- CROUCH

#EVENTS

TOTAL

COMMENTS:

DATE: TIME:

DAM:

DOMINANT BEHAVIORS

- ATTACK
- PURSUIT
- THREAT
- STARE
- DISPLACEMENT
- TAKE AWAY

TOTAL

SUBMISSIVE BEHAVIORS

- DEFENSE AGGRESSION
- RIGID RESPONSE TO GROOMING
- DISPLACED/WITHDRAWAL
- FLIGHT
- GRIMACE
- LIP SMACKING
- CROUCH

#EVENTS

TOTAL

COMMENTS:

APPENDIX C

ETHOGRAM OF DOMINANT AND SUBMISSIVE BEHAVIORS

Modified from Kaufman, I.C. and L. A. Rosenblum (1966). A Behavioral Taxonomy for *Macaca nemestrina* and *Macaca radiata*: Based on Longitudinal Observation of Family Groups in the Laboratory. *Primates*. 7: 205-258.

Dominance Behaviors:

- A. Attack: Any act which causes physical insult to another animal including bite and manual grabbing.
- B. Pursuit: Vigorous chasing of another animal while threatening or attacking.
- C. Threat: Physical posturing that may include open mouth, teeth exposure, aggressive, stiffed legged stance LEN (synchronized movement of the lips, ears, neck), threat shake of environmental prop or pilo-erected fur.
- D. Stare: Intense visual fixation of another animal, gaze holding, not accompanied by any other threat behavior.
- E. Displacement: Take over another animal's position.
- F. Take Away: Taking an object or infant from another animal.

Submissive Behaviors:

- A. Defense Aggression: Hesitant, tentative retaliatory attacks while under attack.
- B. Rigid Response to Grooming
- C. Displacement/ Withdrawal: Social withdrawal from an initiator/displacer
- D. Flight: Rapid retreat from another animal
- E. Fear Grimace: Wide open mouth, closed teeth face
- F. Lip-smacking: rapid opening and closing of mouth, smacking lips together making a small sound.
- G. Crouch: Lowering of whole body, or chest and head, or back end.

APPENDIX D

MATERNAL REJECTION OF INFANT DATA COLLECTION SHEET
10 MINUTE FOCAL DYAD SAMPLE

DATE: TIME:

FOCAL INFANT/DAM DYAD:
CONTACT BEHAVIOR:

IMC

IBC

DMC

DBC

I=INFANT
D=DAM
MC=MAKES CONTACT
BC=BREAKS CONTACT

TOTAL:

COMMENTS:

DATE: TIME:

FOCAL INFANT/DAM DYAD:
CONTACT BEHAVIOR:

IMC

IBC

DMC

DBC

I=INFANT
D=DAM
MC=MAKES CONTACT
BC=BREAKS CONTACT

TOTAL:

COMMENTS:

APPENDIX E

INFANT AND DAM PROXIMITY AND LOCOMOTION DATA COLLECTION SHEET

DYAD

INSTANTANEOUS SCANS

COMMENTS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A																				
B																				
C																				
D																				
E																				
F																				
G*																				
H*																				

DATE:

TIME:

WEATHER

GENERAL GROUP ACTIVITY AND OTHER COMMENTS:

PROXIMITY CODES

- 1 INFANT-DAM IN CONTACT
- 2 < 1 METER APART
- 3 > 1, < 3 METERS APART
- 4 > 3 METERS APART
- 5 PROXIMITY UNKNOWN

LOCOMOTION CODES:

- 1 IS, DS
- 2 DS, ILTD
- 3 DS, ILAD
- 4 IS, DLTl
- 5 IS, DLAI
- 6 ILTD, DLAI
- 7 ILTD, DLTl
- 8 ILAD, DLTl
- 9 ILAD, DLAI
- 10 RELATIONSHIP UNKNOWN

- D=DAM
- I=INFANT
- S=STATIONARY
- L=LOCOMOTING
- T=TOWARD
- A=AWAY FROM