ASSOCIATIONS AND SOCIAL BEHAVIORS AMONG KILLER WHALES (ORCINUS ORCA) IN THE JOHNSTONE STRAIT, BRITISH COLUMBIA, 1979-1986

by

Jeff K. Jacobsen

A Thesis

Presented to

The Faculty of Humboldt State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

May, 1990

and an Addendum Containing Data and Analyses of

Associations Among Pods of Killer Whales (Orcinus orca)

in the Johnstone Strait, 1987 and 1988

PREFACE

This document contains the data and analyses submitted to and approved by the faculty of the Department of Biological Sciences, Humboldt State University as a thesis for the degree of Masters of Arts. The traditional format of the thesis has been changed, but not the contents (except for page numbers and one typo), to reduce the number of pages and associated production costs. Data and analyses from 1987 and 1988, my last two years of field work in the Johnstone Strait, are also included. These data were presented at the Eighth Biennial Conference on the Biology of Marine Mammals, December 1989, and at the Third International Orca Symposium, March 1990.

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We certify that we have read this study and that it conforms to acceptable standards of scholarly presentation and is fully acceptable, in scope and quality, as a thesis for the degree of Master of Arts.

Daniel Brant Major Professor

W J Houck

R. L. Rasmussen

David W. Fletcher

Michael Biggs

Approved by the Graduate Dean

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This thesis is dedicated, with a young boy's awe and respect, to Einar A. Jacobsen.

ACKNOWLEDGEMENTS

I have come to know many wonderful people during the past dozen years of migration to and from the Johnstone Strait, and they all have been as important and essential to the project as the orcas. I realize the near impossibility of acknowedging all of them, but I am determined to be as thorough as possible, for this may be my last opportunity to do so. This is, after all, a thesis about social associations!

First thanks go again to Peter Jepsen, for suggesting this adventure in the first place. The following people worked with me in the field from 1980 to 1986, sharing both the burdens and joys of camp life and endless hours in a small open boat: Maris Sidenstecker, Mary Cunningham, Harold Powel, Mark Deutschmann, Kathy Turco, Linda Campbell, Patty Gallagher, Karen Cunha, Patty Smith, and Hiroya Minakuchi. Kristen Warnock helped with a couple odd projects in the lab, so has a seat waiting aboard whenever she wants.

I gratefully thank Michael Bigg, Graeme Ellis, and John Ford for sharing their photo-identification system, which made this entire study feasable. Much of my understanding of the orcas has come from conversations with them. Many others came to observe the orcas during my tenure in the Johnstone Strait, and we formed an odd society rich in reciprocal altruisms, shared thoughts, and campfire follies. These fellow "orcateers" included David Bain, Sue Kruse, Janice Waite, Naomi Rose, David Arcese, and their many assistants. Many others were involved in this community, and helped in many ways: Richard Osborne, Ken Balcomb, Sara and Jim Hiemlich-Boran, Nancy Haenel, Fred Felleman, Deborah Duffield, Marilyn Dahlheim, Barbara Kirkevold, Joan Lockard, Steve Landino, Yan Ostman, and Randy Wells.

Many people that resided near the study area generously opened their homes and hearts, so much so that I feel I have another home town. Paul Spong, along with Linda Spong and Helena Simmonds, helped in too many ways to mention, and will always be a source of inspiration. Chris, Taegen, and Liz Whiting, Michael Berry, Maureen Wright, Guy Windebank, Jim and Anne Borrowman, Bill and Donna MacKay, Claude and Stacia and Morgan and Travis and Katie and Fiona Kennedy all provided parking places, warm beds, hot showers, and lasting friendships.

The course of this study and thesis has taken some odd twists and turns, and I'll always be grateful to those who were there to support, prod, or just sigh patiently as I muddled through it all. Prominant among them were Mary Claire Wellman, Leslie Myers, Harry Wellman, Elsa Jacobsen, and Linda Miller. I thank the members of my committee for their enduring patience and efforts on my behalf through both versions of this thesis. Ralph Holtzinger helped me build many fine pieces of research equipment, and kept my cameras working right. I thank Bill Rossiter of the Connecticut Cetacean Society for his confidence and support.

Tom Read and all my fellow students at the Northcoast School of Aikido deserve endless thanks for the example of their dedication, which helped me in ways words are futile to describe.

The ones to whom I must express my most heartfelt gratitude are the ones that seem the most distant to the ways of Master's theses, the orcas. Their patient, innocent acceptance of my persistant observation of their daily affairs deserves special acknowledgement and respect.

INTRODUCTION

Killer whales (Orcinus orca), or orcas, are an odontocete species placed in the family Delphinidae (Hershkovitz 1966). The orca is a relatively modern form, evolved in the mid to late Miocene (Gaskin 1982). Analyses of karyotype revealed an unusually high rate of chromosomal evolution, which may be related to the breeding system (Duffield 1986). Orcas have many morphological similarities with Globicephala, Feresa, and Pseudorca (Nishiwaki 1963). Orcas, however, have proportionately greater sexual dimorphism than these other genera, with maximum recorded lengths of 8.53 m for females and 9.75 m for males (Perrin and Reilly 1984), and males weighing twice as much as females (Matkin and Leatherwood 1986).

Orcas are distributed world-wide but their populations are concentrated in coastal and polar regions (Slijper 1962; Gaskin 1982; Mikhalev et al. 1981; Matkin and Leatherwood 1986; Heyning and Dahlheim 1988). Many geographically and socially isolated populations exhibit regional variations in pigmentation patterns (Evans et. al. 1982) and morphology, prompting some researchers to propose a new Antarctic species, Orcinus glacialis (Berzin and Vladimirov 1983).

Killer whales are top-level carnviores and opportunistic feeders, with an extensive list of prey species (cetacean species of all sizes, pinnipeds, fish, squid, and birds), and use a variety of foraging behaviors in capturing these prey (Martinez and Klinghammer 1970; Hoyt 1981; Perrin 1982; Lopez and Lopez 1985). In some areas orca sightings increased during seasons of prey abundance (Jonsgard and Lyshoel 1970; Condy et al. 1978; Heimlich-Boran 1986a).

The most extensive studies on the biology and behavior of wild orcas have been conducted along Vancouver Island, British Columbia. Beginning in 1973, Bigg and co-workers (1976, 1982, 1987) developed a photographic technique to identify individuals by their natural markings and dorsal fin shape. After several years and thousands of photographs no new orcas were observed, and they concluded that the British Columbia population was stable, the only changes due to deaths and births. This population (261 orcas in 1981 (Bigg 1982)) was composed of many stable family groups which Bigg called pods.

Bigg (1982) defined a pod as a social grouping consisting "... of the same individuals which travel together throughout the year and over a period of at least seven years". In addition, "... pods generally do not split for more than a few hours or days. Thus recognition of a single individual will generally indicate that the remaining members of its pod are nearby." Pod size ranged from 1 to 50 individuals, but typically contained 5-20 whales. Pod compositions ranged from one female with seven males (B pod), to one bull with several females (A5 pod), to I11 pod with only females and calves (Bigg 1982). Bigg also noticed

that "Maternal associations tend to form distinct subgroups within pods." No dispersal by either sex was observed, and it appeared that calves remained with their mothers into adulthood. Based on these observations, Bigg et al. (1987) plotted known and estimated lineage relationships within subgroups, or "subpods", of all individuals.

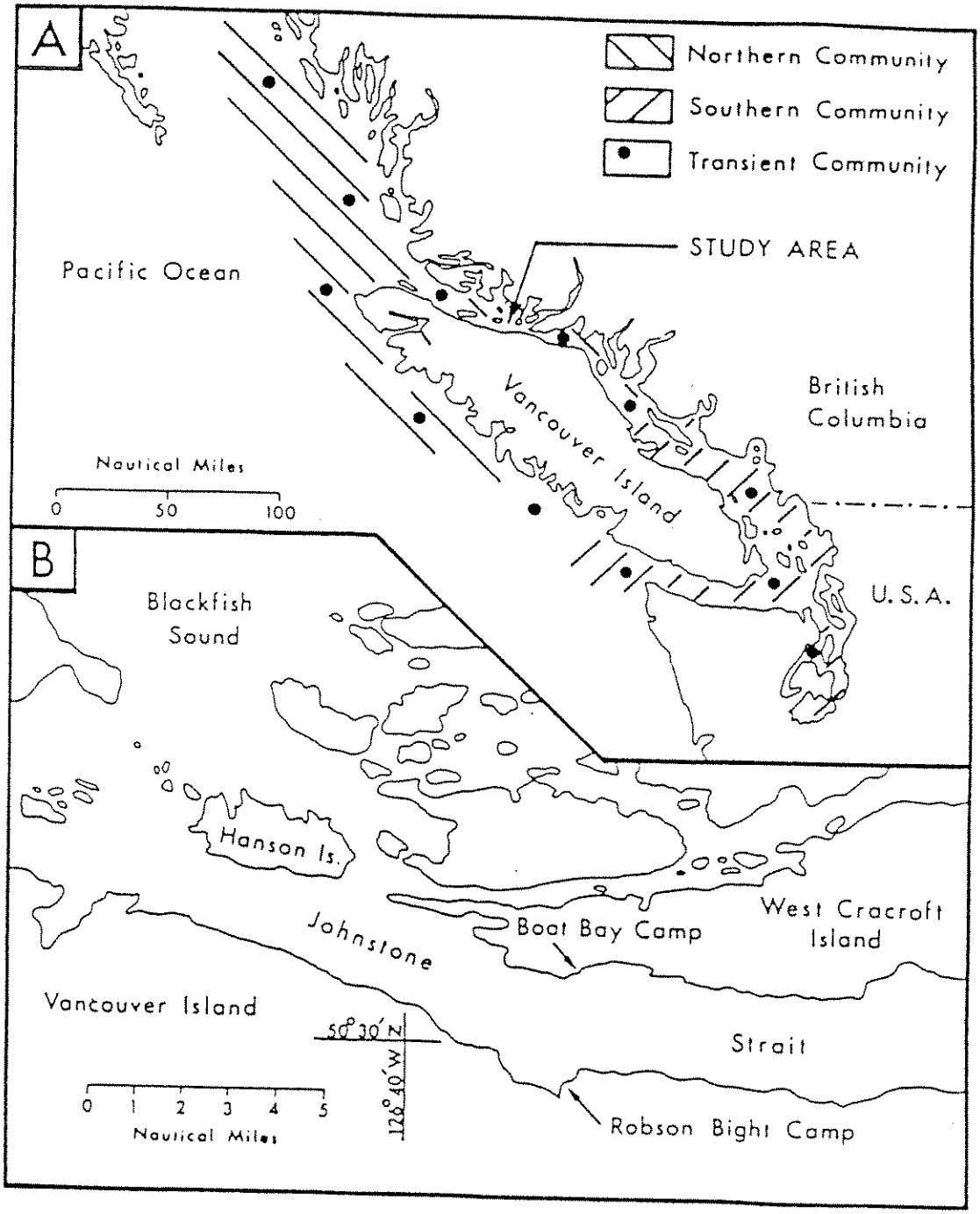

Figure 1. A) Distribution of Northern and Southern Resident Community and Transient Community (redrawn from Bigg 1982); location of study area. B) Study area.

The pods also formed three socially isolated communities: southern resident (N=79, 3 pods); northern resident (N=135, 12 pods); and transient (N=47, 15 pods; Bigg 1982; Figure 1). Resident pods were sighted only in their respective areas, primarily from spring through summer months, and occasionally during winter. Transient pods, however, were sighted throughout the range of resident pods at all times of year but were never observed to interact with resident pods (Bigg et al. 1987). Resident pods were observed feeding only on fish, whereas transient pods fed on both fish and marine mammals (Bigg et al. 1987). Morphological differences in pigmentation and dorsal fin shape between resident and transient pods were detected. Bigg et al. (1987) proposed that residents and transients, although sympatric, were different races socially isolated from one another.

By following individual life histories, Bigg (1982) observed many population parameters. The breeding rate was lower than its predicted biotic potential, averaging about 10% per year. Minimum calving interval was three years if the calf survived, but, since only a few females produced calves, the average calving interval for the population was closer to eight years. Net population change was estimated to be 2.52%. Age of sexual maturity for females was estimated to be 6.7 years, and for males 12 years. A similar estimate was reached by Heimlich-Boran (1986b). However, social maturity is likely to occur even later than these estimates (Wasser and Barash 1983). Female longevity was estimated at up to 80 years, whereas male longevity was estimated at less than 60 years (Bigg, et al. 1987).

Historically, orcas off British Columbia were not hunted for their meat and oil, but a live-capture fishery did exist from 1961 to 1976 (Bigg and Wolman 1975; Asper and Cornell 1977). During this period a total of 75 whales were removed from the population, including 10 that died during capture operations. Fourteen of these orcas were taken from 3-4 pods in the northern community for use in various oceanaria, including 12 animals removed from A5 pod, eight of them immature (Bigg 1982). Several behavioral and acoustic studies have been conducted with some of these captive whales (Dahlheim and Awbrey 1982; Morton et al. 1986; Bain 1986; Ray et al. 1986).

Ford and Fisher (1982, 1983) examined the relationships among pods by analyzing their acoustic behavior. They demonstrated that each pod produced 7 to 17 discrete pulsed vocalizations that were stable for periods of at least 18 years. Some calls were shared among some pods, and some were unique to each pod. Based on the degree of call sharing among pods, the resident population was divided into four dialect groups called clans. Each clan had a unique set of vocalizations. The southern community (Figure 1) was one clan, and the northern community was composed of three clans.

Several behavioral studies have been conducted on the pods within the southern community (Osborne 1986, Haenel 1986, Heimlich-Boran 1986a, Balcomb et al. 1980, 1982) including an analysis of associations among individuals (Heimlich-Boran 1986c), similar studies had not been initiated on the northern community. The primary objective of my study was to conduct a long term study of daily associations among individuals within pods and how these associations varied with behavior, and associations among resident pods within the northern community. A secondary objective was to describe social behaviors that occurred in particular types of associations (i.e.: intersexual, and male-male).

METHODS

Study Area and Time Period of Observations

The study area is located at the northern end of Vancouver Island, British Columbia and includes the northern portion of Johnstone Strait and part of Blackfish Sound (Figure 1). The waters are semiprotected, generally calm, and easily navigable in a small open boat. The study area is within the range of the northern resident community (Bigg 1982).

Two main campsites were established, on Vancouver Island at Robson Bight (1979-1981) and on West Cracroft Island at Boat Bay (1982-1985) (Figure 1). Both campsites offered elevated (8-15 meters) views of Johnstone Strait and the opposite shoreline. The Orcalab facility overlooking Blackfish Sound on Hanson Island was utilized for a portion of the 1981 field season.

Data for this study were collected over an eight year period, from 1979 to 1986, during the months of July through September. Dates of my field season for each year and number of hours of recorded observations are listed in Table 1. Additional pod sighting data were obtained in 1984, 1985 and 1986 from Bain (pers. comm.) and co-workers who were working in the study area before my field season began (Table 1). An "observer day" was defined as one in which at least one reliable researcher was on duty scanning the Strait for orca for at least 75% of daylight hours. Since events such as severe storms, supply trips to town, and malfunctioning outboard engines occasionally made it impossible to meet these criteria, some days were not included in the analyses.

Table 1. Observation effort by year: extension of field season for pod sightings from other researchers (see text); dates of field season; number of days in field season including extension; number of observer days (see text); and number of hours of recorded observations.

Year	Extension of Season	Dates of Field Season	Days	Observer Days	Hours
1979	x	July 1 - Aug. 28	59	52	136
1980	x	July 12 - Oct. 1	82	75	143
1981	x	July 3 - Oct. 1	92	67	166
1982	x	July 5 - Sept. 11	69	65	351
1983	x	July 7 - Sept. 16	72	63	214
1984	July 1	July 10 - Sept. 15	77	66	239
1985	June 24	Aug. 6 - Sept. 15	84	83	205
1986	June 27	July 2 - Sept. 15	81	79	312
		TOTALS:	610	536	1766

Study Animals and Definition of Terms.

A "maternal subgroup" refers to a cow and her known offspring born since 1973, during the period of photographic documentation. Bigg (pers. comm.) provided lineage information for calves born between 1973 and 1979. A "subgroup" refers to one or more maternal subgroups plus other closely associated individuals of unknown lineage. A "pod" consists of any individuals that were always sighted together throughout the eight year study period. A pod may consist of one or more subgroups.

In Bigg's (1982) identification system, each pod was assigned a letter and each individual within a pod was assigned a number. Bigg divided the northern community into twelve pods and named them A1, A4, A5, B, C, D, G, H, I1, I11, R, and W. In the course of this study subgroups of seven of these pods traveled independently for periods greater than one day. For this paper, when a subgroup split from the rest of the pod it was subsequently identified as a new pod. Each new pod was named after what appeared to be the eldest female in the group. Pod divisions were as follows: A1 pod became A2, A12, and A36 pods; C pod became C5 and C6 pods; D pod became D3 and D7 pods; G pod became G4 and G2 pods; I1 pod became I1 and I2 pods; and I11 pod became I11 and I15 pods (see Appendix 2 for a complete comparison of IDs used in this paper with IDs used by Bigg et al. 1987). In order to maintain consistency in sample size, the resulting 20 pods were used throughout all analyses, with one partial exception. In 1986 the two pairs of maternal subgroups within A5 pod began traveling independently, and were designated the A9 and A14 pods. The A5 pod was split only for the 1986 and 1979-1986

association analyses. An annual census of the 20 resident pods from data compiled by Bigg (pers. comm.) is presented in Table 2.

Age classes were defined as follows. Calves were between one and three years old, identified by their small size, orange tint in white areas, and mottled grey of black areas), and close surfacing proximity to their mothers. Juveniles were 4-10 years old. Subadult females were large juveniles known to be greater than ten years old. Subadult males were large juveniles whose dorsal fins had begun secondary growth. Adult males and females were mature individuals whose body length and dorsal fin size had reached a maximum. Postreproductive females were cows not seen with calves in at least eight years. Sexes were determined by ventral pigmentation patterns (Matkin 1986; Bigg et al. 1987), or male dorsal fin dimorphism (Bigg 1982, Heimlich-Boran 1986b), and/or penile displays.

The five A-pods (A2, A12, A36, A4, and A5), the most frequently sighted pods in the study area, were chosen as the focal group for the analysis of associations among individuals. The annual composition of the A-pods, individual identity code (ID), age class, sex (when known), and known lineage relationships (Bigg 1987, pers. comm.) are listed in Table 3.

Table 2: Annual Census of the Resident Pods Sighted in the Johnstone Strait. Parentheses denote estimates. Data compiled by Bigg (pers. comm.).

POD	1979	1980	1981	1982	1983	1984	1985	1986
A2	5	6	6	6	6	6	6	6
A12	4	4	4	4	4	4	4	4
A36	4	4	4	5	5	5	5	5
A4	6	6	6	6	9	7	7	7
A5	11	12	12	12	12	12	12	13
B	8	8	8	8	7	7	7	7
C5	(3)	3	(3)	3	(3)	3	4	4
C6	(7)	7	(7)	7	(7)	6	6	6
D3	(5)	5	(5)	4	(4)	3	3	3
D7	(5)	5	(5)	6	(6)	7	7	6
G4	3	3	3	3	3	3	3	3
G2	(24)	(24)	24	24	(24)	(24)	26	(26)
H	6	6	7	7	7	6	6	7
I1	4	5	(5)	(5)	(5)	(5)	(5)	7
I2	13	16	16	18	(18)	(18)	17	19
I11	(4)	4	4	4	5	(5)	6	6
I15	(5)	5	5	5	6	(6)	7	8
I31	(5)	(5)	5	5	5	5	7	7
R	(17)	(17)	(17)	17	(17)	(18)	19	(19)
W	(4)	(4)	4	4	4	4	3	3
Total:	143	149	150	153	157	154	160	166

Table 3: Composition of Focal Pods. Individual identity code (ID), known sex (F=female, M=male), and age class (see text; A=adult, P=postreproductive female, S=subadult, J=juvenile, C=calf, X=absent). Cow's known offspring are indented and listed from youngest to oldest. Data from Bigg et al. (1987, pers. comm.); pod ID in parentheses was that used by Bigg (1982).

Pod	ID	Sex	Age Class							
			'79	'80	'81	'82	'83	'84	'85	'86
A2	A2	F	A	A	A	P	P	P	P	P
(A1)	A30	F	A	A	A	A	A	A	A	A
	A50	F	X	X	X	X	X	C	C	C
	A40	?	X	C	C	C	J	X	X	X
	A39	M	J	J	J	J	J	J	J	S
	A38	M	J	J	J	S	S	S	S	S
	A6	M	S	S	S	S	S	A	A	A
A36	A36	F	A	A	A	A	A	A	A	A
(A1)	A46	?	X	X	X	C	C	C	J	J
	A37	M	C	J	J	J	J	J	J	J
	A32	M	S	S	S	S	S	A	A	A
	A20	M	A	A	A	A	A	A	A	A
A12	A12	F	A	A	A	A	A	A	A	A
(A1)	A34	F	J	J	J	J	J	J	J	S
	A33	M	J	J	J	S	S	S	S	S
	A31	M	A	A	A	A	A	A	A	A
A4	A11	F	A	A	A	A	A	A	A	A
	A48	?	X	X	X	X	C	C	C	J
	A13	M	C	C	J	J	J	J	J	J
	A35	F	J	J	J	J	J	J	S	S
	A24	F	S	S	S	S	S	A	A	A
	A49	?	X	X	X	X	X	X	C	C
	A45	?	X	X	X	C	C	C	J	J
	A41	?	X	C	X	X	X	X	X	X
	A10	F	A	A	A	A	A	X	X	X
	A47	?	X	X	X	X	C	X	X	X
	A4	M	A	A	A	A	A	A	X	X
A5	A9	F	A	A	A	P	P	P	P	P
	A26	M	J	J	J	J	S	S	S	S
	A5	M	A	A	A	A	A	A	A	A
	A8	F	A	A	A	A	A	A	A	A
	A42	?	X	C	C	C	J	J	J	J
	A28	F	J	J	J	J	J	J	S	S
	A14	F	A	A	A	A	A	A	A	A
	A15	M	C	C	C	J	J	J	J	J
	A25	F	J	J	J	J	S	S	S	S
	A51	?	X	X	X	X	X	X	X	C
	A23	F	A	A	A	A	A	A	A	A
	A43	?	X	X	C	C	C	J	J	J
	A29	?	C	J	X	X	X	X	X	X
	A27	M	J	J	J	J	S	S	S	S

Data Collection and Analysis.

Observations were made primarily from a 4.2 m Zodiac inflatable boat, powered by a 25 hp outboard motor. Additional observations were made from shore using a 45X spotting scope. The whales' vocal activity was recorded using a Sony TC-D5M tape recorder and various hydrophones. Individuals were identified by their natural markings: shape of the dorsal fin, shape of the saddle patch (area of grey pigmentation posterior to the dorsal fin), and nicks and scratches. The identification codes established by Bigg (1982) were used and were updated annually. If the identity of an individual was uncertain or unknown, full-frame 35 mm photographs of the dorsal fin and saddle patch were taken. Approximately 11,000 photographs were taken and analyzed over the entire study period.

Associations were analyzed at two levels: among individuals and among pods. During the first year of the study I was still learning how to recognize individuals and assign them their correct identification code. Consequently, the 1979 data are not as reliable or complete as in subsequent years, and are presented only at the pod level.

Associations Among Individuals

Individuals were considered to be associated if they were either 1) surfacing within a few meters of one another in a coordinated manner, or 2) surfacing within 100 m of one another, engaged in a common activity (such as foraging), and moving as a group. Any isolated individual was recorded as solitary.

Associations among individuals were scan sampled (Altmann, 1974) throughout each day in the following manner. Scan sampling was used instead of time sampling due to the difficulty in maintaining visual contact consistently with all the whales for long periods of time. A group of orcas were approached from the side, each individual identified and associations recorded. If another group was sighted, it was subsequently approached and identified. This procedure was repeated until all groups in the study area were identified and all associations were recorded.

If an association was observed for at least 10 minutes, the activity was assigned to one of four behavior categories: traveling, resting, foraging, and socializing (Jacobsen 1986). Detailed field notes were taken of social interactions, especially if orientations toward urogenital areas and penis displays were observed. The orcas were not sampled again unless they changed activity state and/or associations for at least 10 minutes.

At the end of each field season association and behavioral observations of individuals within the five A-pods were transcribed from field notes onto standardized data sheets. Each entry consisted of date and time of the observation, animals in

association, and corresponding behavior code. Rapidly changing associations that occurred during play bouts were clumped into one record. Association data without sufficient behavioral notes were recorded without a behavior code. The standardized data were then entered into dBase II on an Osborne 1 personal computer.

The database was searched to calculate an annual index of association for each possible pair combination of individuals. The index, based on Dice's (1945) coincidence index, is:

1) $1000\ (2\ Nij\ /\ Ni + Nj)$,

where Ni and Nj are the number of times individuals i and j were sighted, and Nij is the number of times i and j were associated. In the case of solitary individuals, Ni = Nj, and the equation becomes:

2) $1000\ (Ns\ /\ Ni)$,

where Ns is the number of times that individual was encountered alone. The result will be referred to as a solo index. The factor of 1000 was used as a formatting convenience.

The index of association ranges from zero (no association between a pair) to 1000 (complete association). For the solo index, zero equates to an individual never sighted alone, and 1000 to always being sighted as solitary. Various forms of this index have been used for lions (Schaller 1972) and chimpanzees (Morgan et.al. 1976). This index was chosen for its simplicity, and to facilitate comparison with other studies on wild dolphins (Heimlich-Boran 1986c, 1988; Wells 1986) where it also was used to quantify associations.

Two searches of the database were conducted based on behavioral criteria. First, all associations occurring during active behaviors (traveling, foraging, and socializing), and unassigned associations were selected for calculation of association indices. For the second search only foraging associations were selected, hence it was a subset of the first search. There were insufficient data to analyze traveling or socializing as separate categories or as a lumped category. A percentage distribution, by behavior category, of all individual association records in the database (n=1,698) was: 40.9% foraging; 14.9% socializing; 4.9% travel; and 39.3% unassigned.

Associations among resting individuals were excluded from index calculations for two reasons. First, resting whales associated almost exclusively with members of their own subgroups, so these data biased the results towards subgroup associations. Secondly, a resting subgroup often aligned side by side with one or more other resting subgroups, and all subgroups established a routine and coordinated diving pattern (Jacobsen 1985, 1986). Although an individual was mostly coordinated with members of its own subgroup, it may also be alongside an

individual from another subgroup. Consequently, three different associations were occurring simultaneously: individual with its own subgroup; individual with another subgroup; and individual with the entire assembledge of subgroups.

The association indices calculated for each year were arranged into triangular matrices with solo indices placed along the diagonal. While triangular matrices provided the most detail, overall relationships among groups of individuals were difficult to interpret visually. Single-linkage cluster-analysis (SLCA) (Morgan et. al. 1976; Lehner 1979) therefore was used to display indices as dendrograms. This analysis consisted simply of sorting indices in descending order of magnitude and then plotting clusters by adding each new pair as they were encountered in the list. To simplify subgroup identification clusters were built from left to right, placing cow IDs at the left of each subgroup cluster whenever possible. The non-zero solo indices were plotted as points.

Because the number of redundant pairs increased as clusters grew, a great deal of information was lost in SLCA representations - only 17 out of a possible 153 association indices were used to generate a dendrogram of 18 individuals. Consequently, the ID of the individual responsible for each higher level linkage also was displayed in the dendrogams.

To examine the variations in associations among subgroups according to age class and lineage relationships the following analyses of association indices were performed. For each year from 1980 to 1986, individuals were selected from Table 3 and grouped by age class and lineage relationship. The resulting seven categories were: calves, juveniles and subadults of known descent (indented IDs in Table 3); juveniles, subadults and adults (excluding cows) of unknown descent; and cows. For each category, association indices corresponding to an individuals first link to its subgroup were selected from the matrices. To compare the above intra-subgroup linkages with inter-subgroup linkages, indices that linked subgroups in the dendrograms were selected. The above procedure was repeated for foraging indices and all solo indices, but with age classes of known and unknown lineages combined. Ranges, means and standard deviations were calculated for each set of indices.

Pod Sightings and Associations

A daily record of resident and transient pods sighted in the study area was maintained throughout each field season. The four transient pods sighted in this study (M, O, P, Q) will be identified collectively as transients in the following analyses. Sightings made by other observers working in the study area and familiar with the identification system were included, and verified whenever possible. Observers working in boats included Michael Bigg, Graeme Ellis, John Ford, Paul Spong, Jim Borrowman, Bill McKay, and David Bain and co-workers. In 1983, a shore

station overlooking Johnstone Strait was established by Kruse (1985, and in press) on a 50 meter cliff on Cracroft Island 1.2 nautical miles west of Boat Bay Camp, and was utilized throught the remainder of the study period (Bain 1985). Frequent radio communication with all observers was maintained starting in 1983.

To examine annual variations in the number of resident pods sighted in the study area, frequency distributions of the number of resident pods sighted per day were compiled for each year. The number of pods sighted per year was averaged over the number of observer days. The sightings of A-pods were also averaged over the number of observer days. Census data from Table 2 were combined with daily pod sighting records to calculate the number of whales sighted per day. A frequency distribution was then made of the number of orcas sighted per day. The average number of orca sightings per observer day was calculated for each year.

To examine the annual variations in occurrence of each pod in the study area, the number of individual pod sightings per year was tallied. To eliminate the effect of varying observation effort, these data were normalized by calculating an annual percentage of daily sightings, equal to the number of sightings for each pod per year divided by the number of observer days per year, multiplied by 100. The number of days when no orca were sighted per year also was normalized. Percent daily pod sightings also were calculated for all years combined.

The daily resident pod sighting data were entered into dBase II software on an Osborne I personal computer. Each record contained the date and pods observed in association. A pair of pods was considered in association if they were observed within the study area for at least one hour during the day. If this criterion was not met an additional record was added for each association observed on that date.

The annual degree of mixing among pods was measured by counting the number of pod pairs observed in association for each year. The number of pairs observed was then expressed as a percentage of the number of pairs possible (190 pairs among 20 pods). The number of new pairs observed cumulatively over the eight year period also was tallied and converted into a percentage.

Indices of association (see above) were calculated for all pairs of pods for each year and for all years combined. Solo indices were calculated for sightings of solitary pods. Indices were placed in triangular matrices, and single link cluster analysis dendrograms were drawn for each matrix, with solo indices greater than zero represented as points.

RESULTS

Associations Among Individuals

The orcas predominantly associated with members of their own subgroup during all active behaviors. The resulting high within-subgroup association indices were a prominent feature of all individual association matrices (Table 4; Appendix 1). Because the IDs were arranged as subgroups along the axes of the matrices, the within-subgroup indices were located in small triangular sub-matrices along the diagonal. The highest indices within a matrix were typically found within these sub-matrices. The lower indices of any matrix tended to be found outside these sub-matrices, corresponding to between-subgroup associations, or solo indices along the diagonal.

Table 4. Triangular matrix of 1980 association indices among A-pod individuals (pods A2, A36, and A12 were omitted due to only one sighting), and solo indices (underlined, along diagonal).

Pod A4						Pod A5												
A11	A35	A13	A24	A10	A4	A9	A26	A5	A8	A42	A28	A14	A15	A25	A23	A29	A27	
0	785	880	740	560	285	0	0	0	0	0	0	0	0	0	0	0	0	A11
	0	720	518	400	428	0	0	0	0	0	0	46	88	76	0	0	0	A35
		0	750	545	320	0	0	0	0	0	0	0	47	40	0	0	0	A13
			153	666	370	0	0	0	0	0	0	0	0	0	0	0	0	A24
				181	400	0	0	41	0	0	0	0	0	0	0	0	0	A10
					357	0	0	39	0	0	0	46	44	38	54	52	90	A4
						0	964	676	36	35	35	70	67	90	0	0	0	A9
							0	676	36	35	35	70	67	90	0	0	34	A26
								189	31	30	60	60	88	160	33	32	149	A5
									37	945	857	107	137	153	0	0	35	A8
										0	877	105	169	151	0	0	34	A42
											0	103	133	238	38	37	101	A28
												68	900	776	76	75	67	A14
													0	811	74	72	65	A15
														0	163	161	205	A25
															0	978	830	A23
																0	851	A29
																	0	A27

The high degree of within-subgroup associations was also a prominent feature of all SLCA dendrograms (Figures 2-8). Within each dendrogram the order of individuals along the horizontal axis was a result of SLCA, based on the highest association index for each individual. All individuals clustered first within their subgroups, with only two exceptions: A25 in 1985 (Figure 7), and A20 in 1986 (Figure 8).

For example, the dendrogram in Figure 2 was generated from the triangular matrix in Table 4. The A23 subgroup begins with A23 as the seventh ID from the left. A23's index of association with her calf A29 was 978, represented in the dendrogram by a horizontal line to the right linking A23 and A29. A23's oldest calf, A27, links next to the right with an index of 851. Solo indices greater than zero were represented as squares (i.e. A5 at 189, and A10 at 181). The IDs responsible for higher level linkages were displayed next to horizontal lines (i.e. an index of 90 linked A27 with A4, hence A5 pod with A4 pod).

The highest within-subgroup association indices were between cows and their youngest calves (Figure 9). As calves aged their associations with their mothers tended to decrease (Figure 9) as they increased their associations with other individuals. For example, A40's index with its mother A30 decreased from 1000 in 1981 (Figure 3) to 709 in 1983 (Figure 5). When a calf was born, it occupied the position of the previous calf in the dendrograms: A46 in 1982 (Figure 4); A48 in 1983 (Figure 5); and A49 in 1985 (Figure 7).

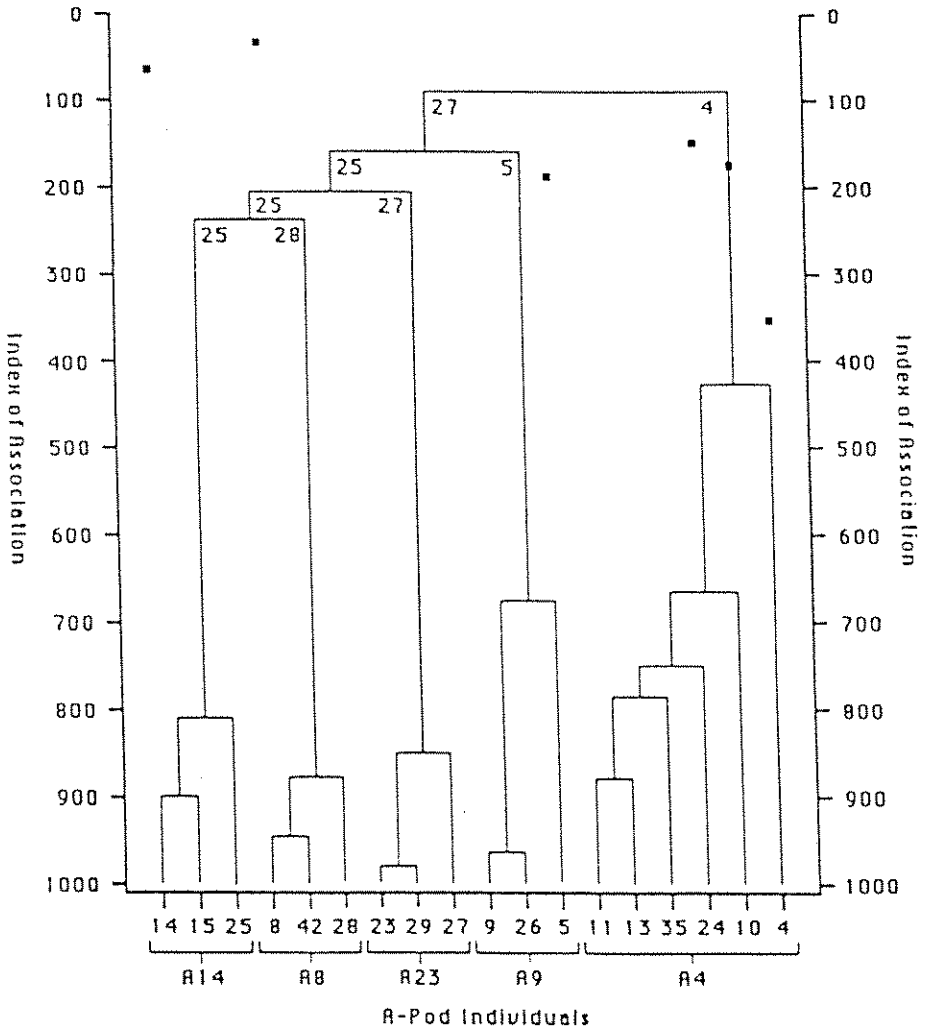

Figure 2. Cluster-analysis dendrogram of 1980 associations among A-pod individuals (pods A2, A12, and A36 omitted due to only one sighting), and solo indices (squares). Identity numbers of individuals linking clusters are shown.

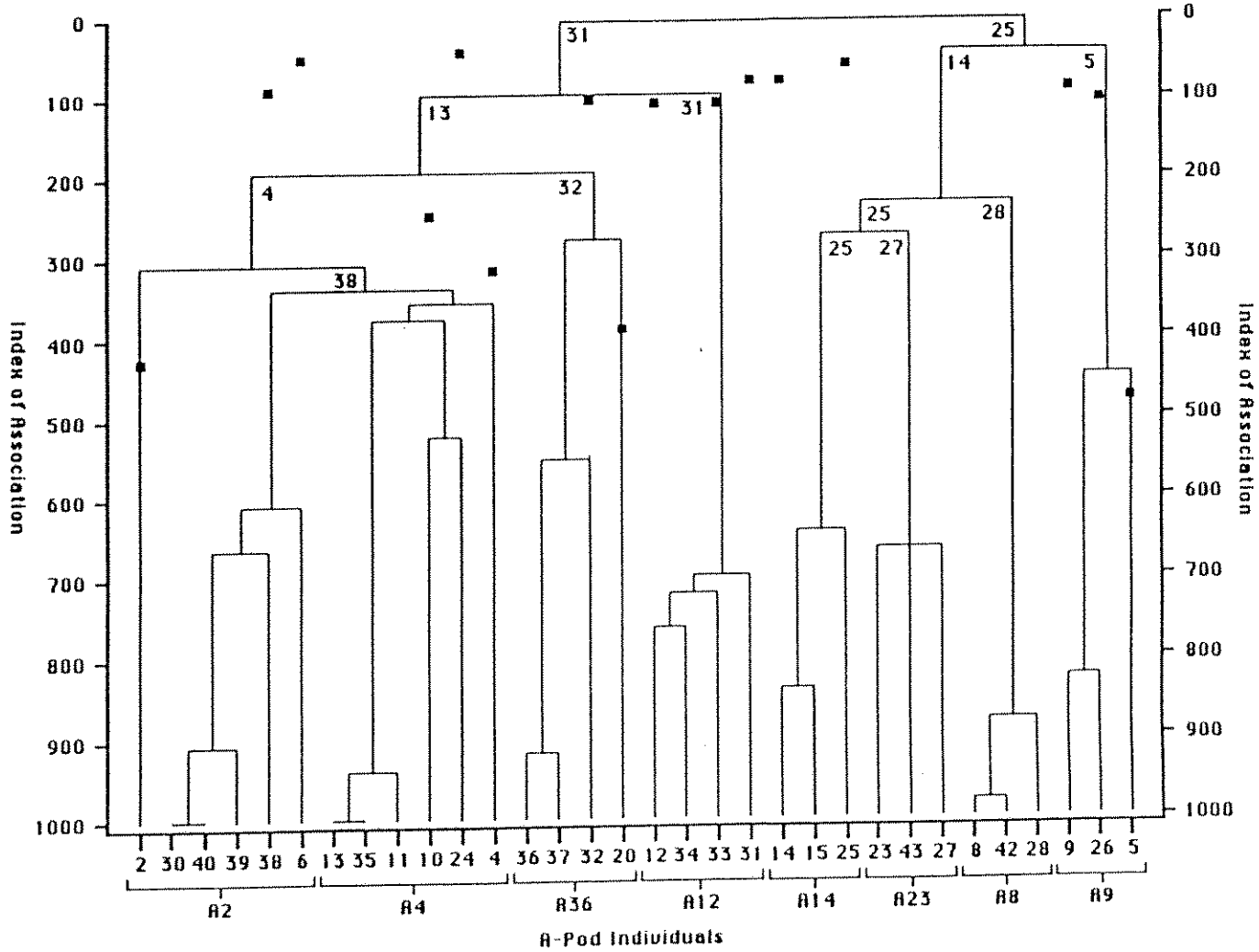

Figure 3. Cluster-analysis dendrogram of 1981 associations among A-pod individuals and solo indices (squares). Identity numbers of individuals linking clusters are shown.

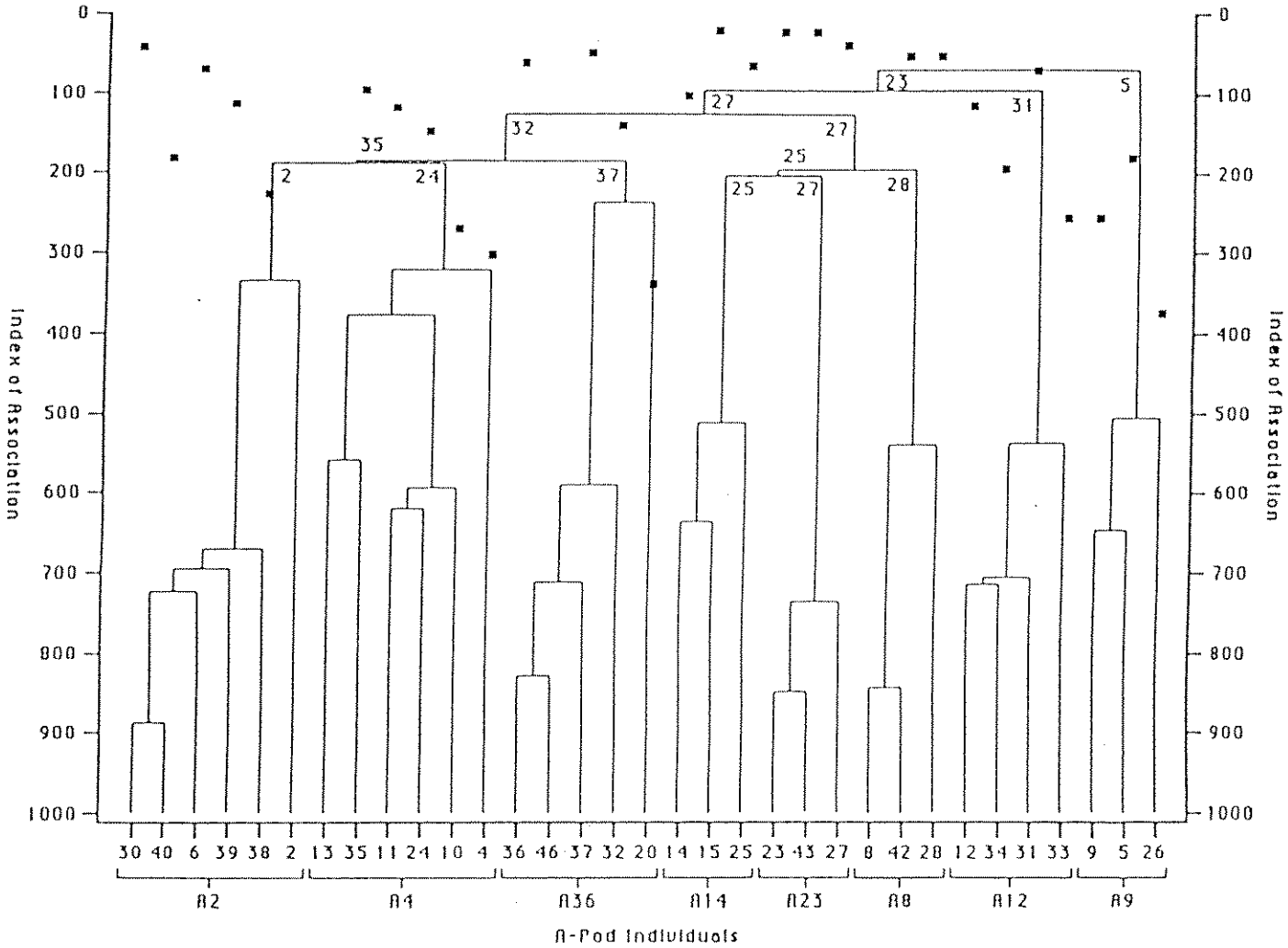

Figure 4. Cluster-analysis dendrogram of 1982 associations among A-pod individuals and solo indices (squares). Identity numbers of individuals linking clusters are shown.

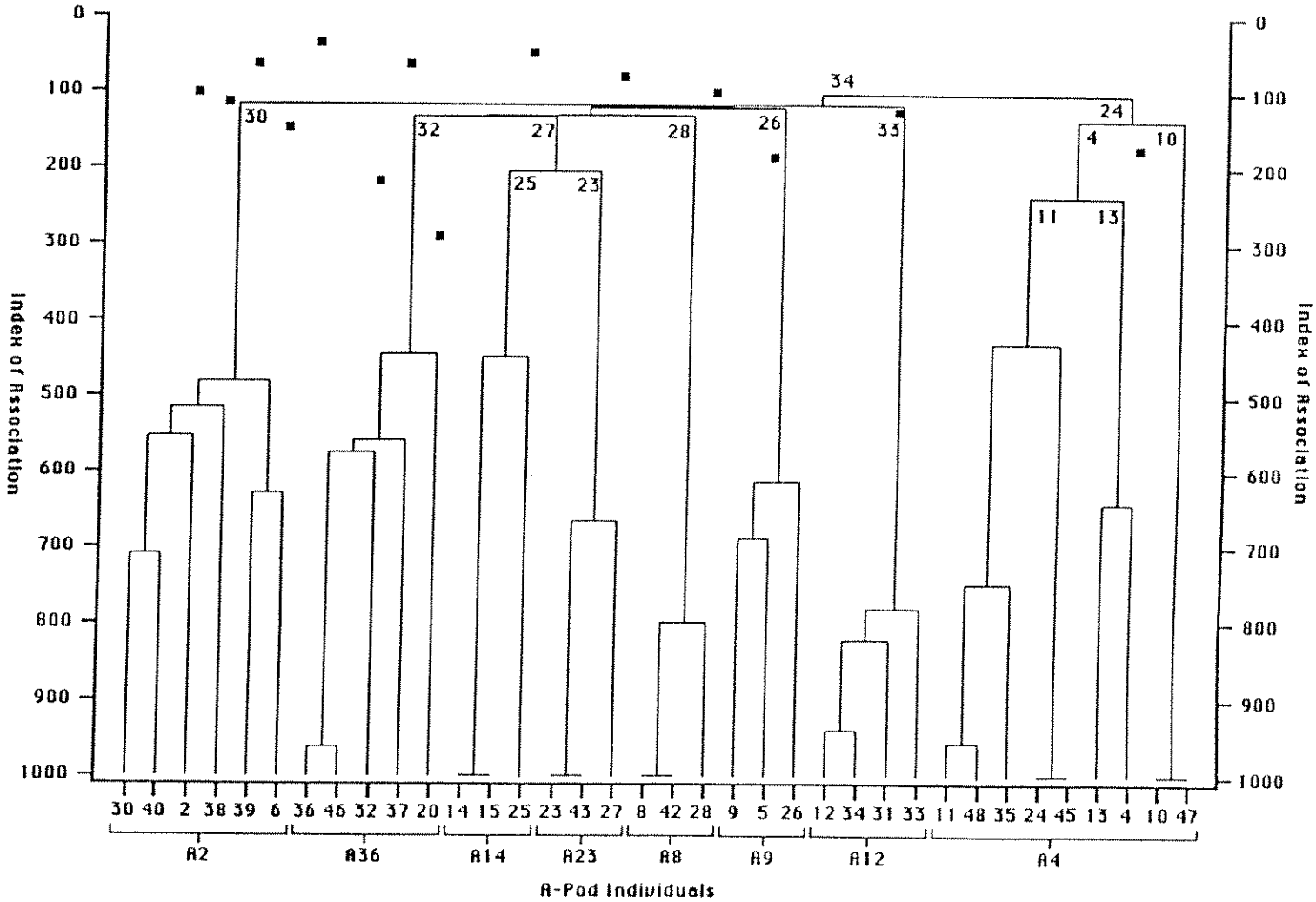

Figure 5. Cluster-analysis dendrogram of 1983 associations among A-pod individuals and solo indices (squares). Identity numbers of individuals linking clusters are shown.

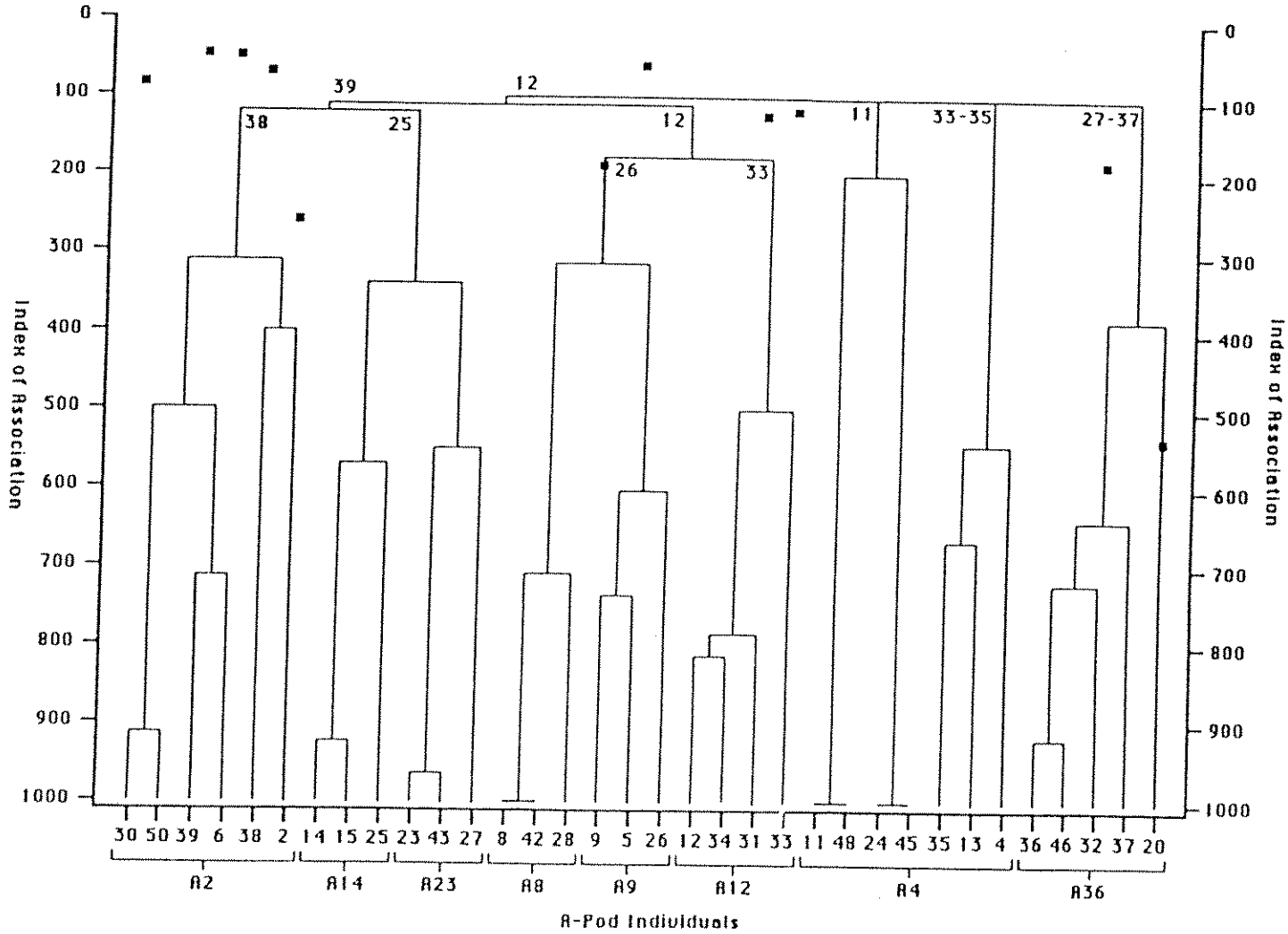

Figure 6. Cluster-analysis dendrogram of 1984 associations among A-pod individuals and solo indices (squares). Identity numbers of individuals linking clusters are shown.

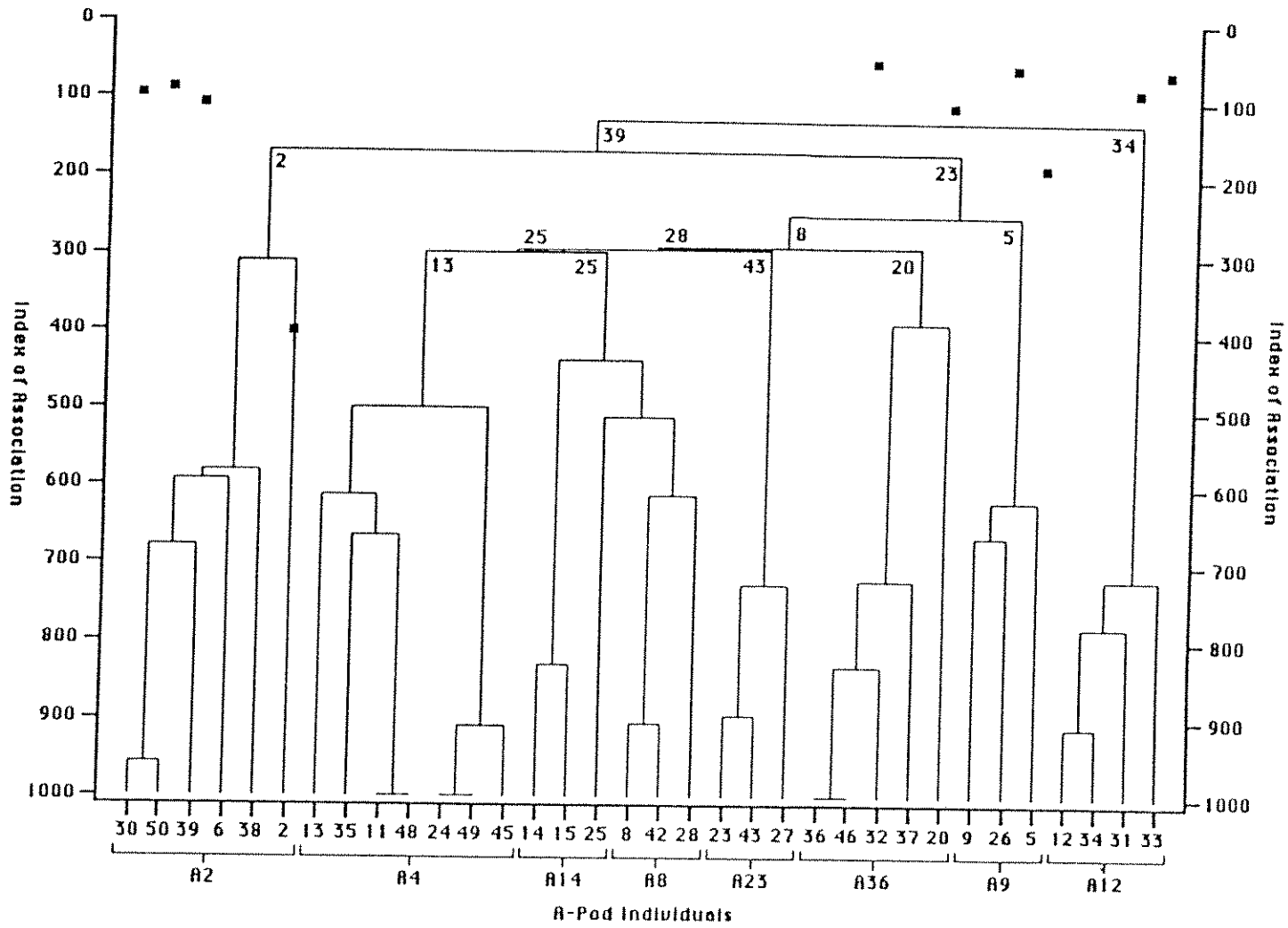

Figure 7. Cluster-analysis dendrogram of 1985 associations among A-pod individuals and solo indices (squares). Identity numbers of individuals linking clusters are shown.

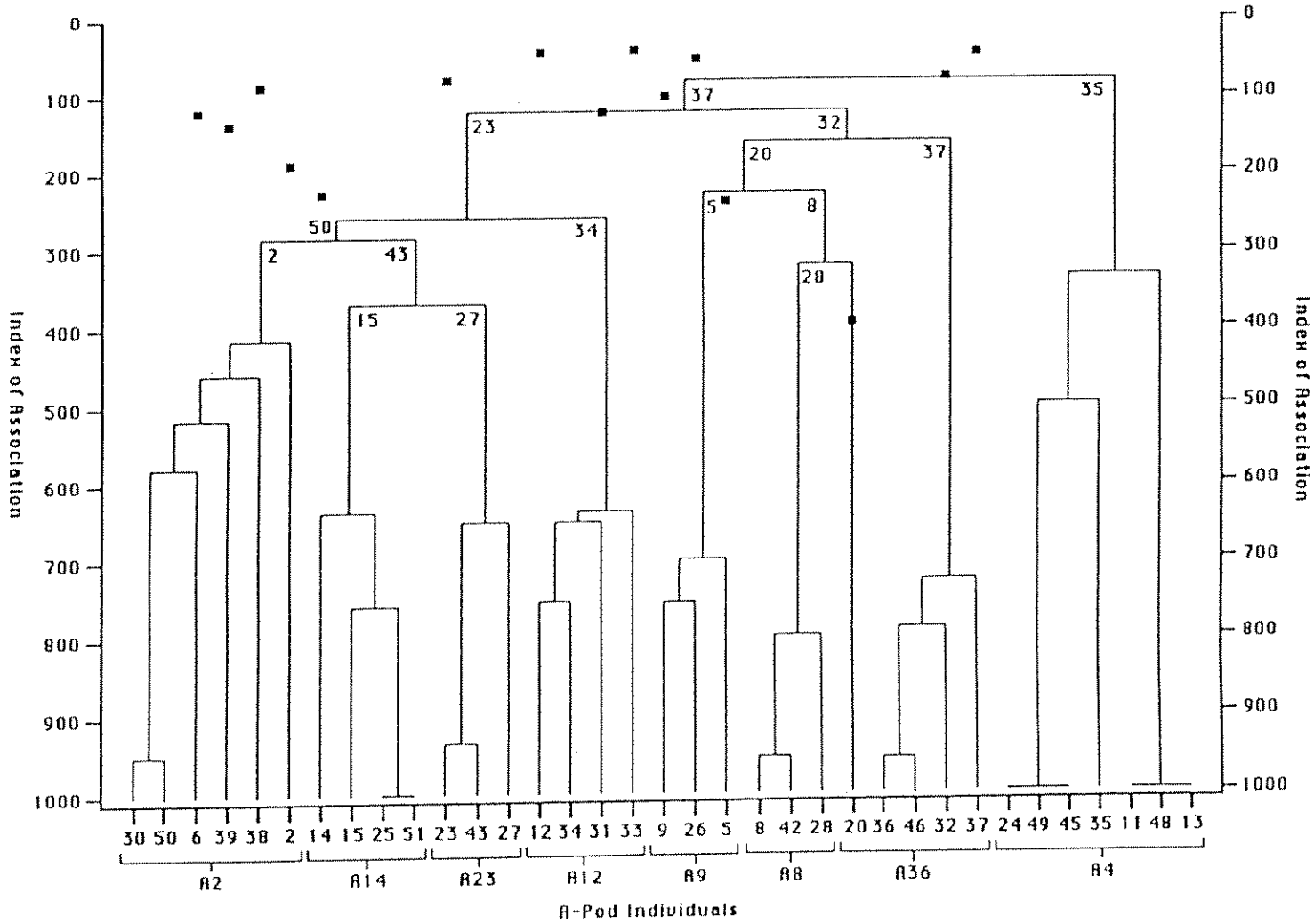

Figure 8. Cluster-analysis dendrogram of 1986 associations among A-pod individuals and solo indices (squares). Identity numbers of individuals linking clusters are shown.

Lineage Relationships

There was little difference in the within-subgroup associations between individuals of known and unknown lineages (Figure 9). This was especially evident among juvenile and subadult age classes. Because Figure 9 represents a compilation of seven years of indices, most individuals of known and unknown lineages passed from one age class to the next (Table 3), representing a continuum from calf to adult.

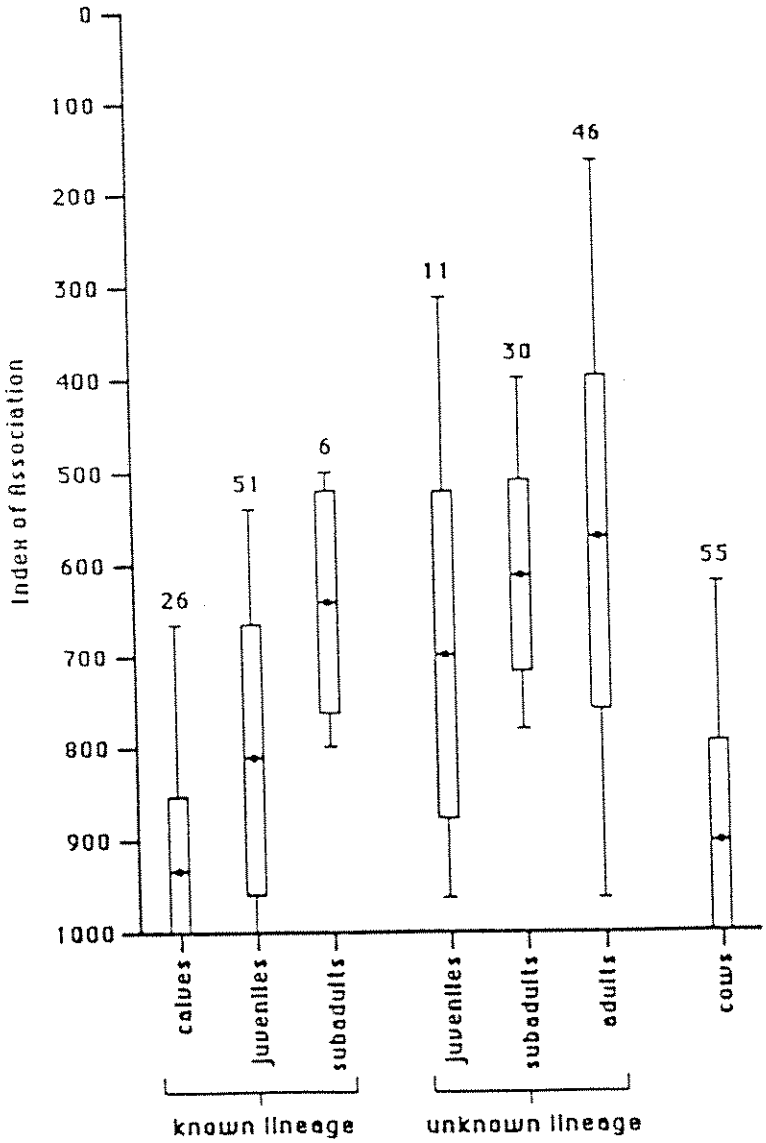

Figure 9. Means, ranges, and standard deviations of intra-subgroup linkages (see text) by age class for A-pod individuals of know and unknown lineage.

Solo Indices

Solo indices ranged from 20 to 538 (Table 4; Appendix 1). The lowest values were among juveniles and subadults, whereas the higher indices were among adults (Figure 10). This trend of increasing solitary behavior with age was in general accord with that of decreasing within-subgroup associations with increasing age (Figure 9). On eight occasions the solo index exceeded the subgroup linkage for an individual. All of these individuals were adults: A20 (n=4); A2 (n=2); A5 (n=1); and A10 (n=1). On three occasions an adult male was the only orca sighted within the study area. In 1986, R1 was sighted alone on two consecutive days, and A20 was sighted alone once (Appendix 2).

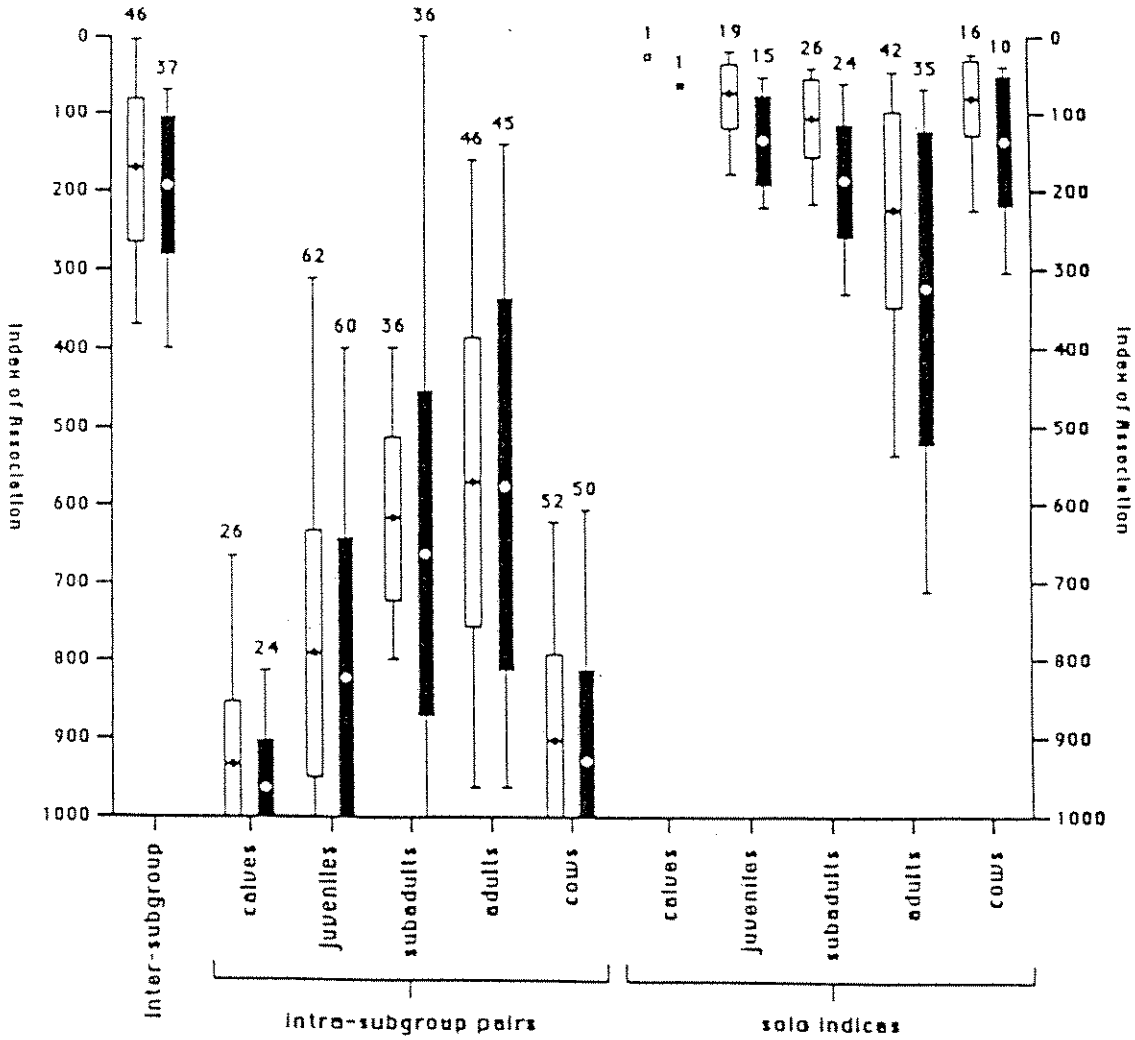

Figure 10. Means, ranges, sample sizes, and standard deviations of intra-subgroup linkages (see text) and solo indices by age class, and inter-subgroup linkages, for A-pod individuals during all active behaviors (white bars), and during foraging (black bars).

In 1982, the number of individuals with solo indices greater than zero was about twice the average of all other years. This increase was predominantly among cows and juveniles, and included the only instance of a solo calf. While the increase may have represented greater dispersal of individuals in 1982, it also may have been an artifact of inconsistent sampling criteria for that year.

Associations Among Individuals During Foraging

Associations among individuals which occurred during foraging comprised 40.9% of records selected from the database for association index calculations. Foraging associations were analyzed separately as a subset of the association analysis of all active behavior categories combined.

Foraging whales associated mostly with individuals from their own subgroup. The highest indices of foraging were found as triangular clusters along the diagonal of the matrices (Appendix 2), corresponding to within-subgroup associations. The corresponding SLCA dendrograms (Appendix 2) showed individuals linking first within their own subgroups, with only four exceptions (Appendix 2: A2, 1981; A25, 1985; A20 and A2, 1986). Within-subgroup linkages for foraging were slightly greater than indices of all active behaviors (including foraging) combined for all age classes (Figure 10). The ranges and standard deviations were also similar, with the exception of the subadult category.

The single zero within-subgroup index occurred in 1985 for A25, who had no pairings with A14 or A15 and linked first with the A8 maternal subgroup (Appendix 2). This was probably due to a low sample size of only four foraging sightings for A25. When this zero association was removed from the subadult category, the lower range limit increased to 363, the mean increased to 683.7, and the standard deviation decreased to 186.5.

Solo indices also tended to increase during foraging (Figure 10), especially among adults. Solo indices increased in 70.2 % of all cases (N=104); 41.1 % of these increases were among adults.

Within a foraging subgroup the strongest associations were between the cow and her young offspring (Figure 10). Juvenile and subadult females (A25, A28, and A34) tended to forage with their maternal subgroup, or with one another (i.e. A25 and A28 in 1985, Appendix 2). These associations varied from year to year and by individual. However, juvenile and subadult males often associated with an older male from their own subgroup for several consecutive years. Pairs of males included: A4 and A13 (1982 and 1983); A20 and A37 (1981-1984); and A6 and A39 (1983 and 1984) (Appendix 2). Two other individuals were seen foraging together throughout the study period: A2, a postreproductive female, and A38, a juvenile then subadult male. The highest within-subgroup

linkage for A2 was with A38 from 1981-1984 and in 1986 (Appendix 2).

Allomaternal Associations

Allomaternal associations within and among subgroups were observed throughout the study period, involving postreproductive, mature, and subadult females. In 1983, A2 linked first with A40 (Figure 5), a four year old juvenile. On six occasions (including two times while foraging), no other orcas accompanied them. Their index for 1983 (555) was approximately twice their indices during 1981 and 1982, when there was always another orca present, primarily A30.

In 1986 A2 linked first with A43 when foraging (Appendix 1), suggesting an allomaternal association with a juvenile from another subgroup. A23 was also present on all six occasions, however, so it was unclear with whom A2 was associating, A23 or A43. A2's linkage with A43 differed from her link with A38 by only 13 (Appendix 2), so this dendrogram configuration may be due to a low sample size.

Among the A-pods, three females (A25, A34, and A28) often were observed in association with calves or young juveniles from their own subgroups when the calf's mother was absent. These females had high association indices within their subgroups. Therefore, their allomaternal associations with siblings, or any changes in these indices with age, were not conspicuous within the matrices and dendrograms.

Each of the above three females also were seen in association with young orcas from other subgroups. In 1983, the year A25 became a subadult, she associated with A40 (index=108), and during the following two years she was seen with A43 and A50. A28 became a subadult in 1985, and in that year her indices with A43 and A50 increased from zero to 108 and 130 respectively. The most distinct increase in allomaternal associations upon attainment of sexual maturity occurred in 1986 with A34. In 1984 her association index with A50 was zero, and in 1985 it increased to 121. In 1986 it more than doubled to 259. On one of the seven occasions that A34 was seen with A50 in 1986, A30 was not present.

Associations Among Males

Males, particularly subadults and juveniles, formed play associations that recurred throughout the season, and sometimes in successive years. Examples included most pair combinations between juveniles A27, A37, A39, and A13, and subadults A6, A33, A26, A32, and A38. Some juvenile males (such as A27) were more gregarious than others.

During associations among males many chasing, rubbing, and splashing behaviors were observed, so these associations were placed in the play category. Urogenital orientations and penile displays were also observed among males. In 76.6% (N=47) of all occasions when an erect penis was observed and all individuals and their sexes were known the group consisted of males only.

During male play associations a behavioral sequence was established. As one male swam a few meters below the surface, another male rotated on his longitudinal axis to an upside-down position and then oriented towards the upright male's urogenital area. Beak-genital contact was maintained as the upright whale surfaced to breathe and dove. The two whales then spiraled into the depths. After 3-5 minutes at depth they rested briefly at the surface. When they resumed the beak-genital orientation the male's roles usually were reversed. If role reversals were observed these behaviors were termed reciprocal beak-genital orientations. Displays of erect penises by either or both males occurred during all aspects of this behavioral sequence. Beak-genital orientations have been observed among males of all age classes. Subadult or adult males approached and followed juvenile males in their maternal subgroup and the juveniles left their group and joined them. During a play bout the males remained closest to the younger male's maternal subgroup. When more than two males were participating the same sequence of behaviors was observed, but often seemed chaotic due to frequent changes in orientations and roles.

During a series of observations which occurred on August 27, 1985, urogenital orientations among males were observed which differed from the reciprocal beak-genital orientation sequence described above. At the onset of observations A38, a subadult male, was observed with juvenile male A27. Both chased and rubbed alongside one another, and engaged in reciprocal beak-genital orientations. A38 rolled at the surface with an erect penis. Forty minutes later, another subadult male, A33, approached and all three began diving close together at the surface. Within about five minutes A38 had left the area and a new sequence of behaviors began between A33 and A27. A33 swam a body length or less ahead of A27 and as he began his dive after inhaling, he arched his back and lifted his flukes upright out of the water. This movement resulted in either a fluke wave or fluke throw (Jacobsen, 1986), depending on the momentum of the lifted flukes. A27 was therefore presented with A33's ventral surface, to which he oriented and against which he rubbed. The two then swam off underwater in beak-genital position. During the next hour this sequence was repeated five more times, always with A27 orienting towards A33.

Intersexual associations.

Throughout the study period only 14 intersexual associations were recorded that involved beak-genital orientations. Eleven of these associations formed the remainder of the 47 instances

mentioned above when a penile display was observed and all individuals and sexes were known. On seven occasions a juvenile female was present among a group of males engaged in beak-genital orientations and penile displays. Three intersexual associations involved penile displays from a young bull (A26), once with a postreproductive female (A9, his probable mother), and twice with maturing females (A25 and C10).

The last of the 47 cases occurred in 1981 and involved subadult male A6 and mature female A24. On four occasions over a 1.5 month period A6 rubbed against A24 and oriented towards her urogenital area. On one of these occasions a penile display was observed. A24 gave birth to A49 about 11.5 months after the penile display was observed. The gestation period for orcas has been estimated at 15-17 months (Perrin and Reilly 1984, Walker et al. 1988). Therefore, A24 was probably at least 3.5 months pregnant during her interactions with A6.

There were few long term or recurring associations observed between mature males and females from different maternal subgroups. An exceptional case occurred during 1985 and 1986 between a mature bull, A20, and a maturing female, A28 (aged 14 in 1986). They were observed chasing and rubbing alongside one another, and reciprocated beak-genital orientations. In 1986 A20 rested with the A8 subgroup on 2 occasions, swimming closest to A28 and synchronizing his surfacing movements with hers.

The highest association index for A20 and A28 from 1981 to 1984 was 48 (Appendix 1). In 1985 their index increased to 292 and was the association linking A36 and A8 subgroups (Figure 7). On the three days in 1985 when A20 was absent from A36 pod, A5 pod was also absent from the study area (Appendix 3), so A20 may have been traveling with A28. In 1986 their index was 320, a value greater than A20's link with his subgroup. A20's solo index was also very high, so this was why he appeared to have switched subgroups in the 1986 dendrograms (Figure 8, Appendix 2).

A similar intersexual association occurred in 1984 between maturing female A25 and mature male C2. Both were observed together in resting groups and reciprocating beak-genital orientations. When C2 was added to the 1984 association analysis his index with A25 was 294.

Males performed another type of orientation behavior towards females when several pods joined together. On these occasions subadult and adult males left their subgroups and roamed independently among the other subgroups. A male would swim three to six body lengths behind a subgroup and make high arched dives while the other subgroup dove shallowly. After a period of 5-30 minutes he swam away, located another subgroup, and followed it in the same manner.

Pod Sightings and Associations

Throughout the study period, members of all individual resident pods were sighted together within the study area, except for 25 occasions (Appendix 3). In all other cases, when an animal was missing from its pod it was not sighted again, and was presumed dead.

Although all twenty northern resident pods were sighted in the Johnstone Strait during the study period (Table 5), the A-pods were sighted most frequently (Figure 11) and accounted for 71.2% of all sightings (N=2265). The predominance of the five A-pods was represented in the left skewed frequency distribution of number of pods sighted per observer day (Figure 12).

Table 5: Number of observer days, resident pod sightings, collective transient pod sightings, and days no orcas were sighted, 1979-1986.

Year	1979	1980	1981	1982	1983	1984	1985	1986	Total
Days	49	65	65	66	63	66	83	79	536
A2	31	1	38	40	41	43	66	55	315
A12	31	1	38	31	21	31	35	39	227
A36	31	1	38	39	42	42	60	46	299
A4	14	16	36	31	24	10	14	17	162
A9	28	43	39	35	29	31	52	46	303
A14	28	43	39	35	29	31	52	49	306
B	5	6	7	13	8	9	8	24	80
C5	0	0	1	11	23	25	31	30	121
C6	0	0	1	6	0	2	28	20	57
D3	0	9	4	2	0	19	18	34	86
D7	0	9	4	2	0	3	2	32	52
G4	0	0	1	9	12	2	3	1	28
G2	0	0	1	2	0	2	2	1	8
H	0	1	2	17	4	5	8	24	61
I1	1	0	3	3	2	1	0	2	12
I2	1	0	3	3	2	1	2	4	16
I11	0	0	4	4	2	0	0	6	16
I15	0	0	4	4	2	0	5	6	21
I31	0	0	1	2	5	7	3	16	34
R	0	0	0	2	2	0	9	2	15
W	0	0	0	14	3	7	6	1	31
Trans.	0	1	2	1	1	3	3	4	15
total	170	131	266	306	252	274	407	459	2265
None	16	18	15	13	2	7	7	7	85

The number of orcas sighted within the Johnstone Strait varied annually (Figures 11-13) according to pod movements within the northern community. The annual average number of orcas sighted per observer day ranged from 11.8 to 34.6, and the annual maximum number of orcas sighted in one day ranged from 30 to 107 (Figure 13). However, the population of the northern community increased by only 18 orcas throughout the study period (Table 2; Figure 13).

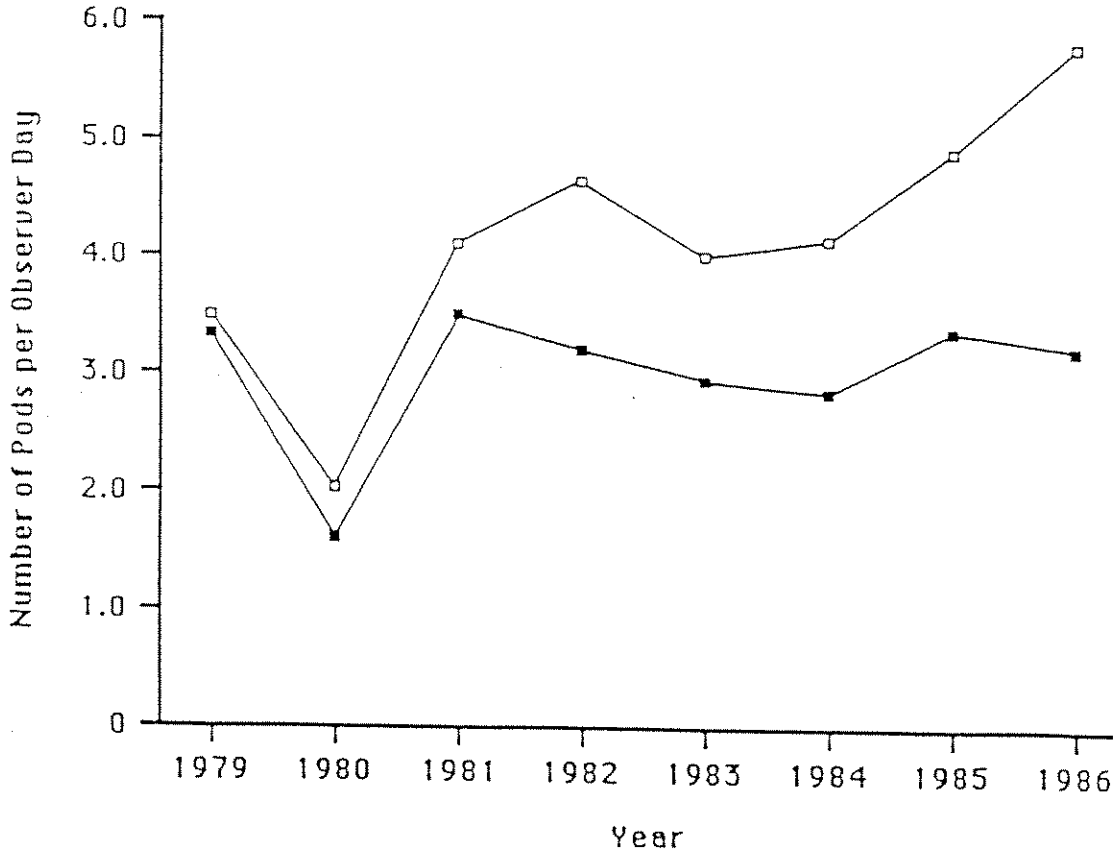

Figure 11. Number of resident pods sighted annually per observer day (open squares) and number of A-pods sighted annually per observer day (solid squares).

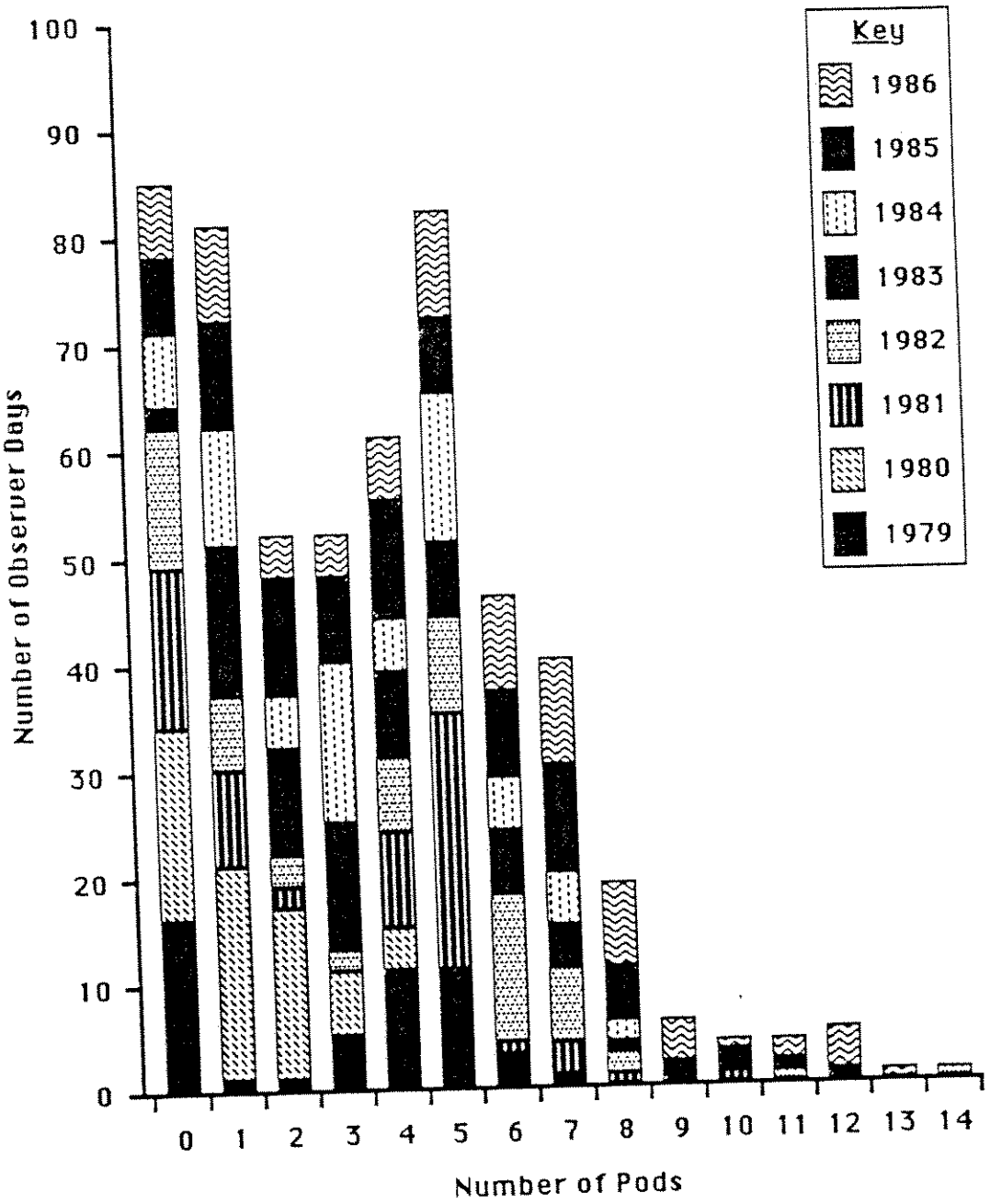

Figure 12. Frequency distribution of number of resident pods sighted per observer day per year (see key) cumulative over the 8 year study period.

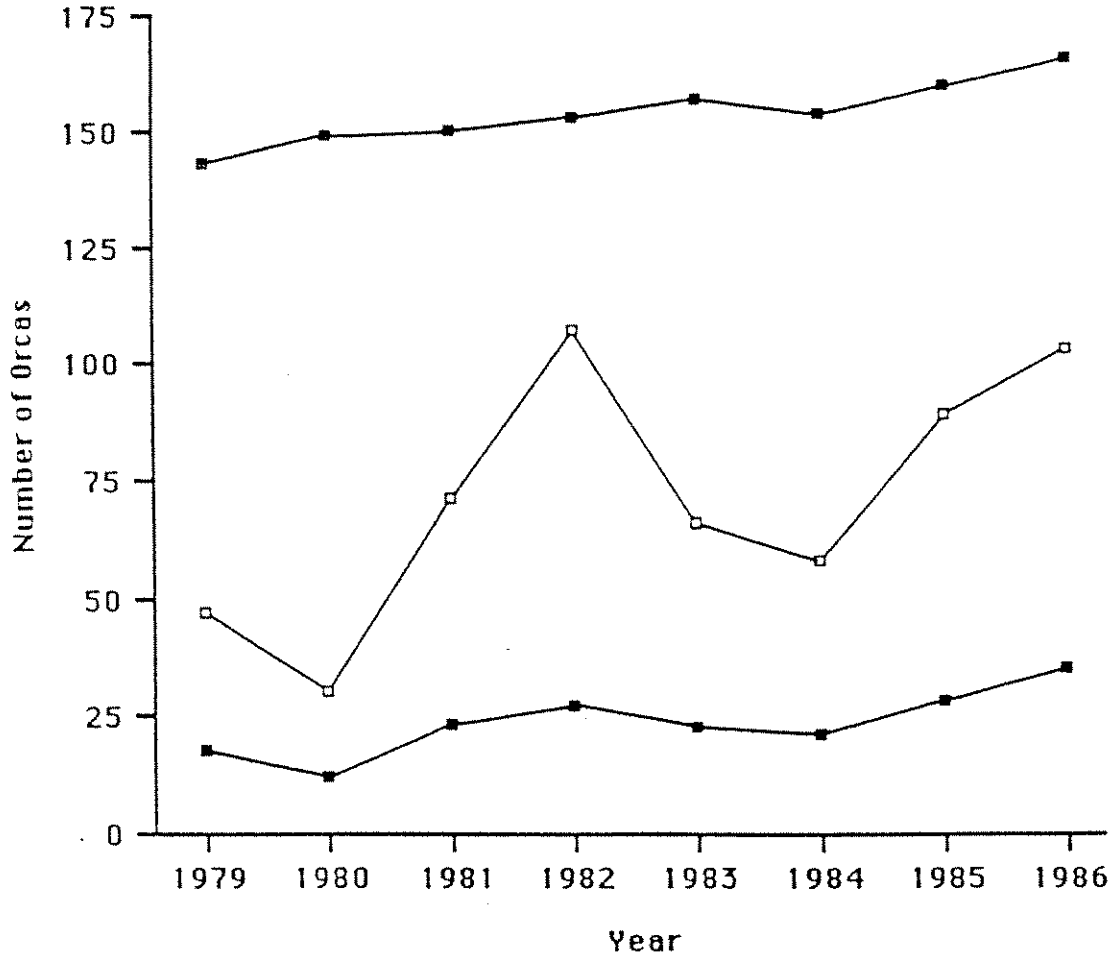

Figure 13. Annual census of northern resident community (crossed squares, data from bigg 1982 and pers. comm.), annual maximum number of orcas sighted in one observer day (open squares), and annual average number of orcas sighted per observer day (solid squares).

After 1983 there was an increase in the average number of pods sighted per observer day (Figure 11). The number of A-pod sightings did not increase proportionately, indicating that the increase in sightings was due to other pods in the community. The increase in pod sightings beginning in 1983 also corresponded to a decrease in the number of observer days in which no whales were sighted (Table 5). Although these data suggested that daily use of the study area by orcas had increased since 1983, they also may reflect changes in observer effort.

The most significant change in observer effort occurred in 1983 with the establishment of a cliff observation site overlooking the Johnstone Strait (Kruse, 1985, and in press). In addition, an increase in commercial whale watching activity after 1983 also increased the exchange of sighting information.

Consequently, pod sighting data from 1983 on was probably a more accurate representation of the presence of orcas within the study area than during the previous four years. Data from 1979-1982 would, therefore, tend to yield underestimates of the number of pods and number of orcas sighted per observer day.

The amount of mixing among pods within the study area varied annually, according to the number and frequency of pods sighted. Mixing was greatest during 1982 and 1986 when every pod was sighted at least once (Table 5), resulting in the two highest percentages of possible pod pairs observed (Figure 14). By the end of the study period only four pod pairs (1.9%) had not been observed.

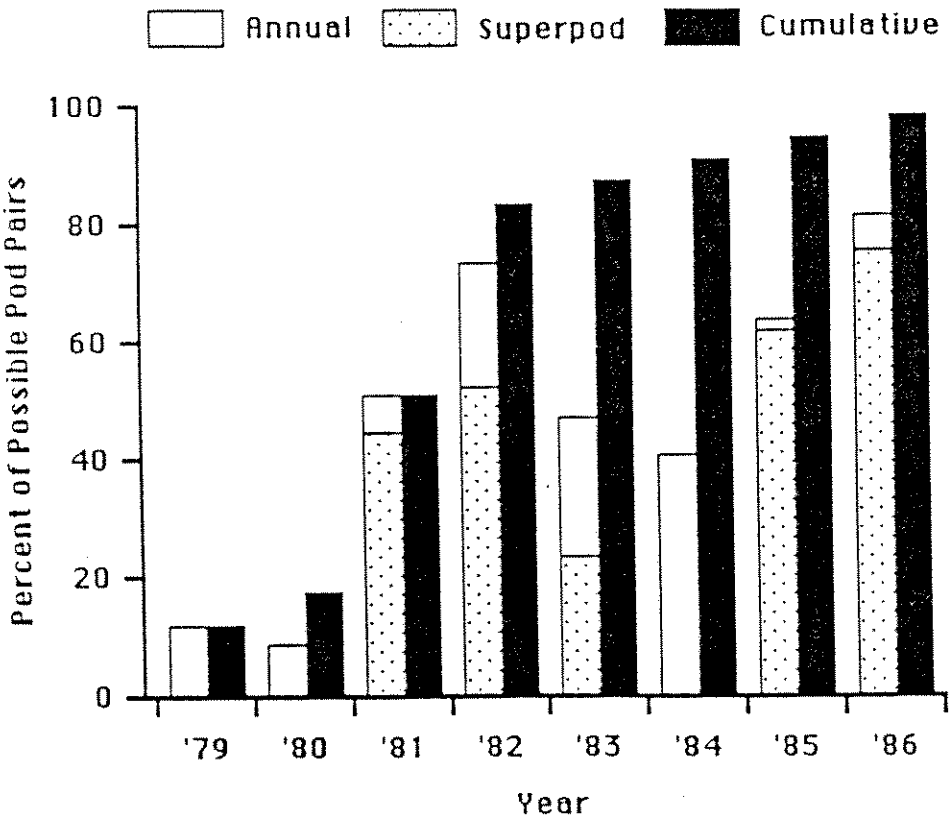

Figure 14. Annual and cumulative percentages by year of possible resident pod pairs sighted in association (see text) and annual percentage of possible resident pod pairs sighted on days when at least 9 resident pods were present (superpod days).

Mixing among pods was not always a gradual process occurring throughout each field season. On 21 days during five field seasons there were nine or more pods sighted within the study area (Figure 12). These large gatherings, known as "superpods" (Hoyt 1981), generally lasted for only one to two days and were

often due to the arrival of rarely sighted pods. Consequently, from 50.6% to 96.7% of pod pairs observed during a year occurred during superpod events (Figure 14).

During the study period seven pods divided into their component subgroups, which were subsequently referred to as pods. From 1979-1981, the three subgroups in A1 pod (A2, A12 and A36) were sighted with equal frequency (Table 5). Starting in 1982 the three subgroups were sighted with unequal frequency (Figure 15), and each was called a pod. In 1986 the two pairs of maternal subgroups in A5 pod (A9 and A8, A14 and A23) began to travel independently (Figure 15). Beginning in 1982 C5 subgroup was sighted more frequently than C6 subgroup. In 1983 C5 was the fifth most frequently sighted pod, and C6 pod was completely absent (Figure 15). From 1984 to 1986 D3 subgroup was sighted more frequently than D7 subgroup. Other progressive inequalities in sighting frequency occurred among G2 and G4 (1982, 1983, 1985, 1986), I1 and I2 (1985,1986), and I11 and I15 subgroups (1985) (Figure 15).

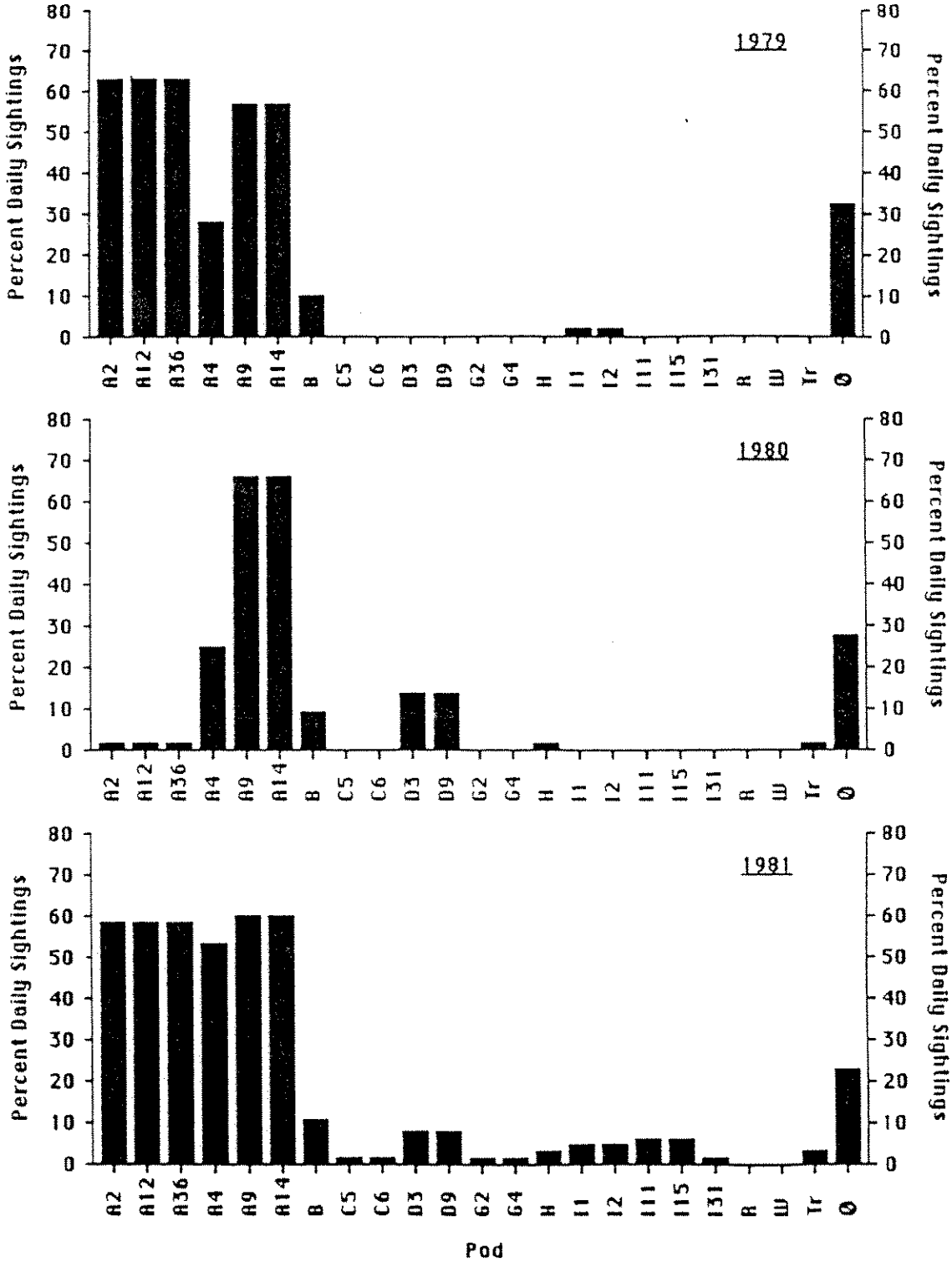

Figure 15. Normalized (see text) annual pod sighting data for 1979, 1980, and 1981 (Tr=transient pods, 0=days no whales sighted).

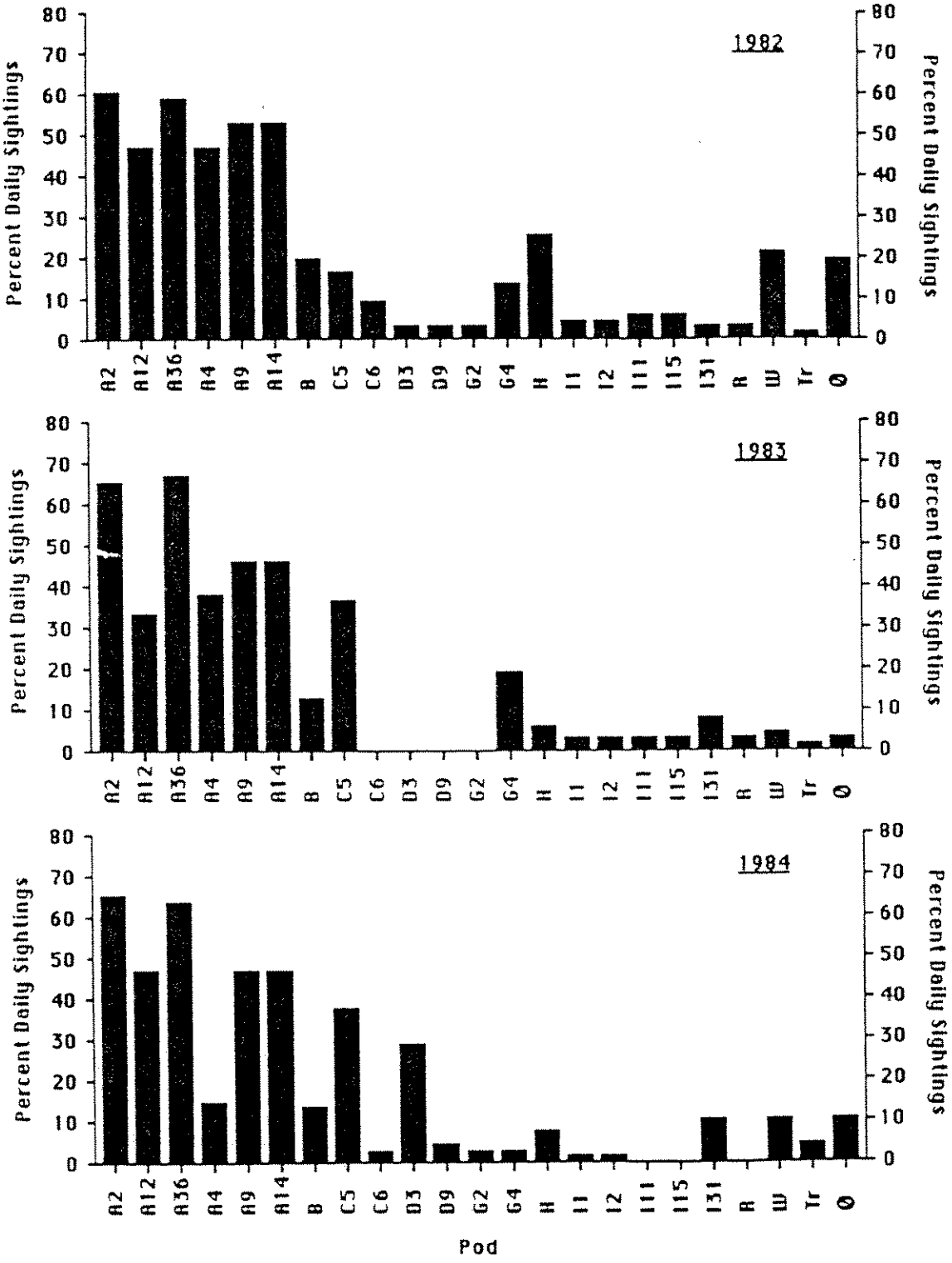

Figure 15 (continued). Normalized (see text) annual pod sighting data for 1982, 1983, and 1984 (Tr=transient pods, 0=days no whales sighted).

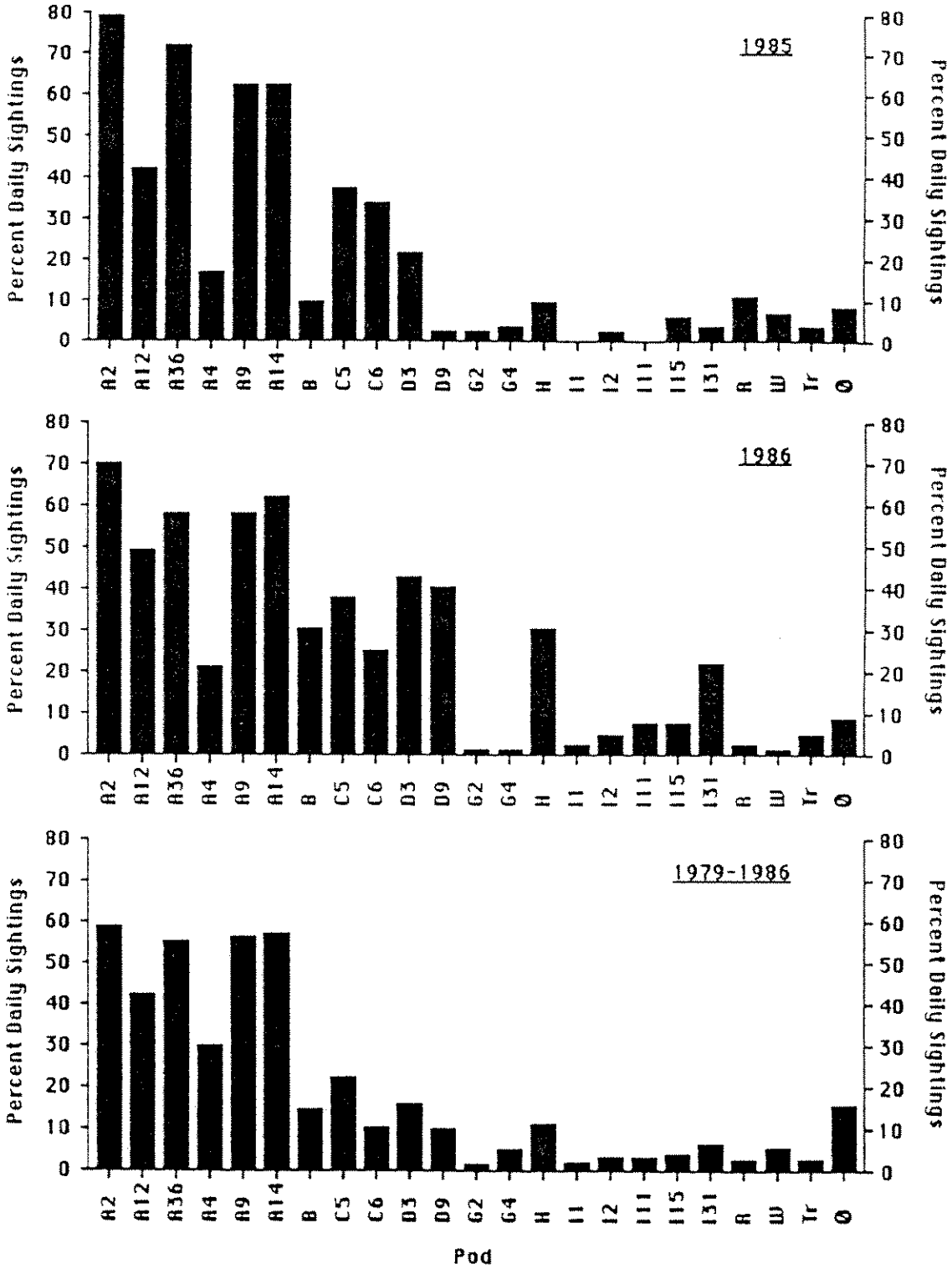

Figure 15 (continued). Normalized (see text) annual pod sighting data for 1985, 1986, and all years combined (Tr=transient pods, 0=days no whales sighted).

Resident Pod Association Indices

Throughout the study period there were several changes in association among the five A-pods. Pods A5, A2, and A36 maintained a high index of association throughout the study period (except during the almost complete absence of pod A1 in 1980), ranging from a high of 884 in 1986 to a low of 542 in 1983 (Figures 16-23; Appendix 4). Pod A4 also was associated closely with the A1 subgroups until 1983, when its index dropped below 500 where it remained until 1986. In 1986 pod A4 was sighted more frequently than in the previous two years but was associated more with pod C5 than other A-pods (Figure 23).

Among the three subgroups in pod A1, the A2, and A36 subgroups maintained the closest association throughout the study period, with indices ranging from 1000 to a low of 871 in 1986 (Figures 16-23; Appendix 4). The A12 subgroup began to disassociate from the A2 and A36 subgroups in 1982, with indices of 788 and 771 respectively (Figure 19; Appendix 4). From 1982 to 1985 there was at least one other pod that associated more with pods A2 and A36 than pod A12 (Figures 19-22). In 1982 and 1984 pod A12 was sighted solo (Figures 19 and 21). In 1986, however, pod A12 increased its association with pods A2 and A36 to values greater than in 1982 (808 and 776 respectively, Appendix 4; Figure 23).

Throughout the study period several other subgroups associated closely with A-pods within the study area. In 1981 the entire C-pod was sighted once, by itself (Figure 18). Begining in 1982, the C5 subgroup (C5, a postreproductive cow, adult male C2, and adult female C10) associated closely with pods A2 and A36, with a maximum index of 716 in 1984 (Figures 19-21; Appendix 4). In 1985, one female in both C-pods had a newborn calf, and the two pods were again closely associated, with an index of 915 (Figure 22). Both pods also were closely associated with A-pods. In 1986 pod C5 associated primarily with pods A4 and A2 (Figure 23), and its association with pod C6 decreased to 480 (Appendix 4).

Pod D3 also had a similar sequence of associational changes. From 1980 to 1982 the D3 and D7 subgroups were always sighted together (index = 1000), and both were entirely absent in 1983 (Figures 17-20). In 1984 pod D3 associated most with pod A5, and its index with pod D7 decreased to 272 (Figure 21). In 1985 pod D3's index with pod D7 decreased further to 200 (Appendix 4), and it linked first with pod C5 (Figure 22). In 1986 both D-pods were once again highly associated with an index of 939 (Figure 23).

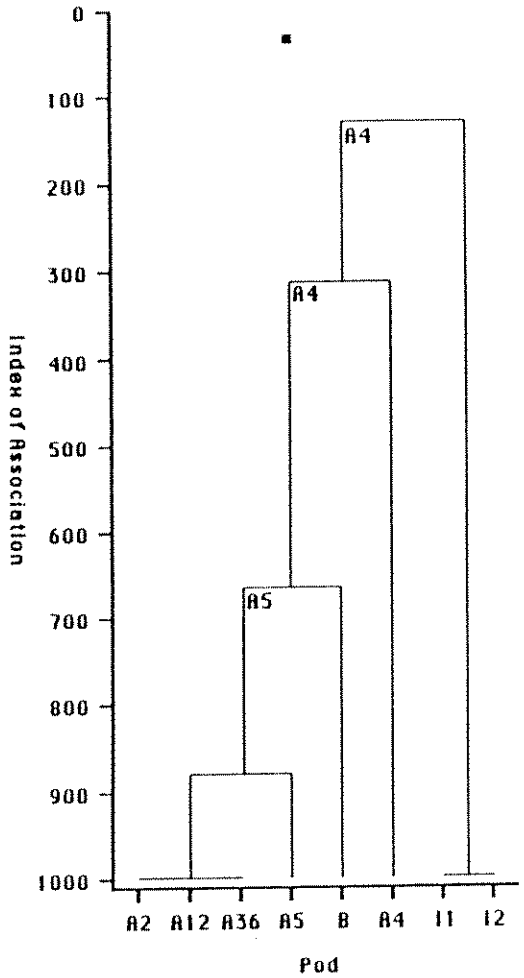

Figure 16. Cluster-analysis dendrogram of 1979 associations among pods and solo indices (squares). Pod associations linking clusters are shown.

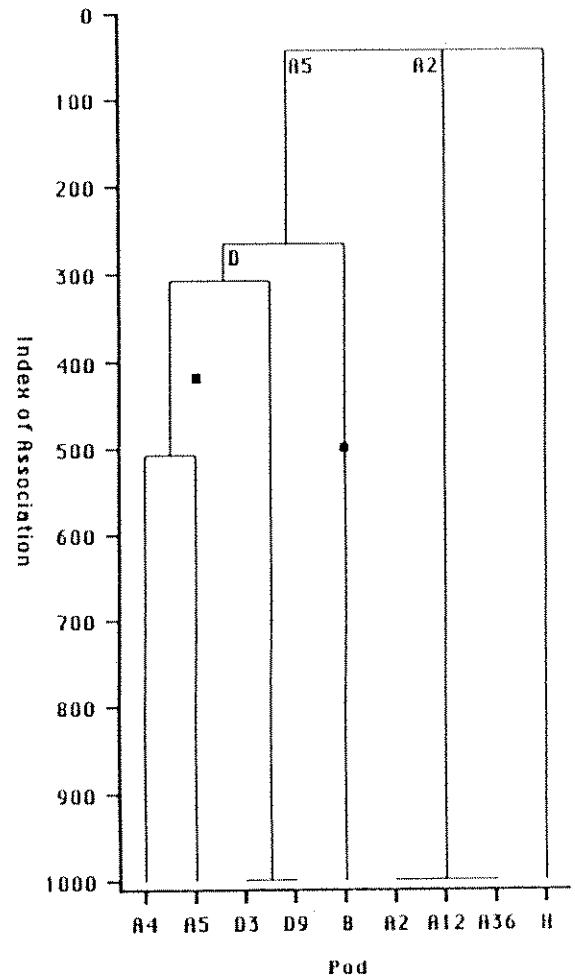

Figure 17. Cluster-analysis dendrogram of 1980 associations among pods and solo indices (squares). Pod associations linking clusters are shown.

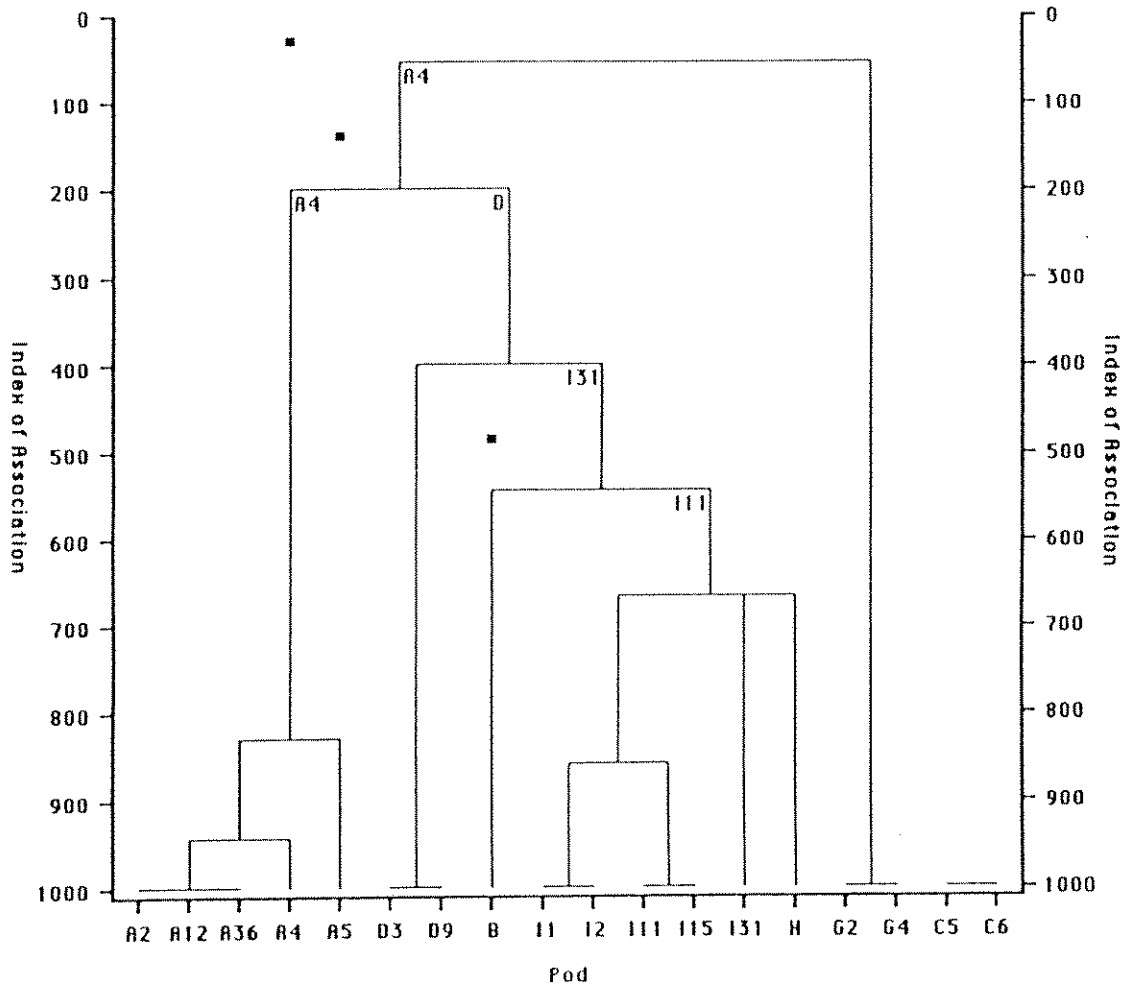

Figure 18. Cluster-analysis dendrogram of 1981 associations among pods and solo indices (squares). Pod associations linking clusters are shown.

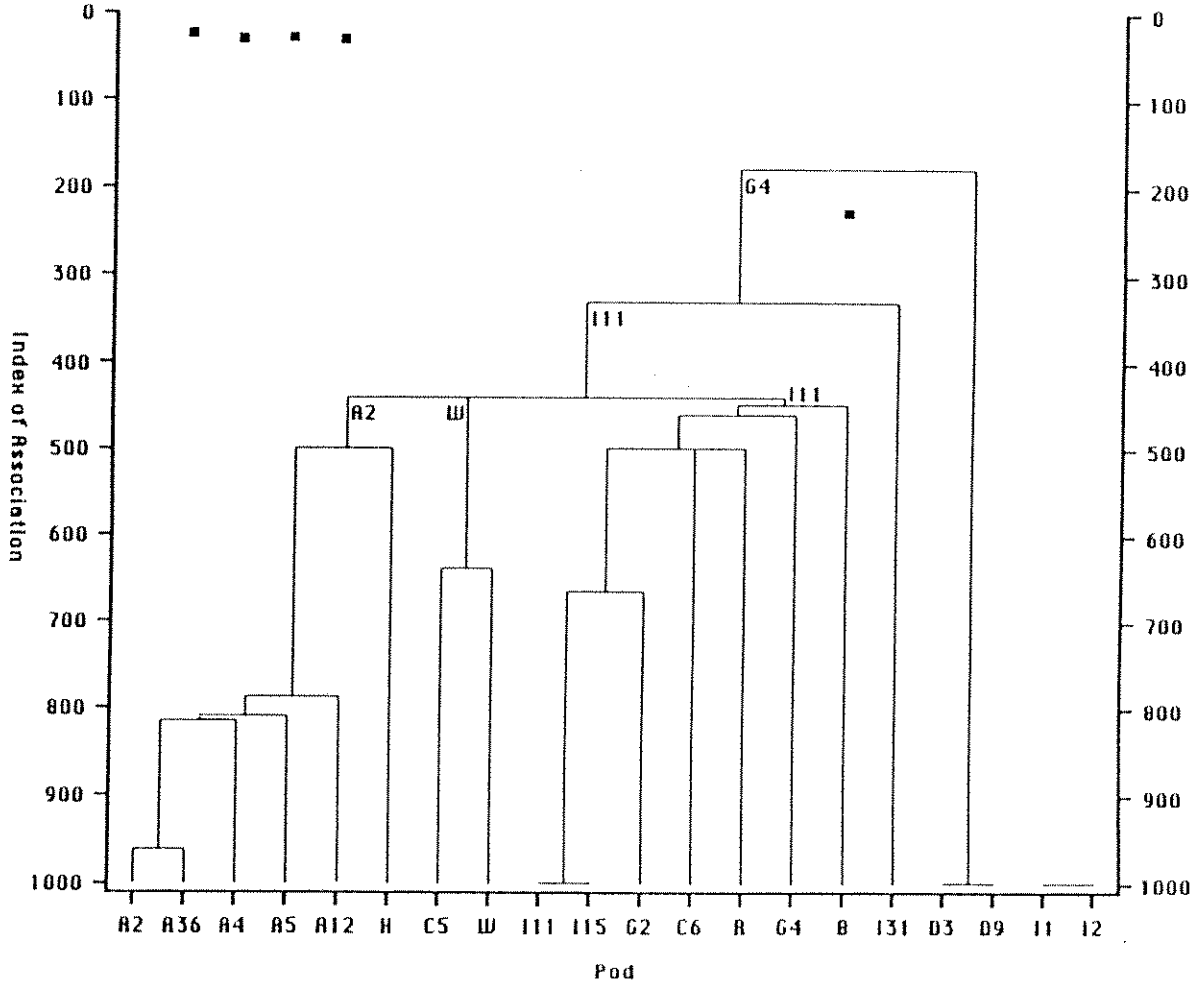

Figure 19. Cluster-analysis dendrogram of 1982 associations among pods and solo indices (squares). Pod associations linking clusters are shown.

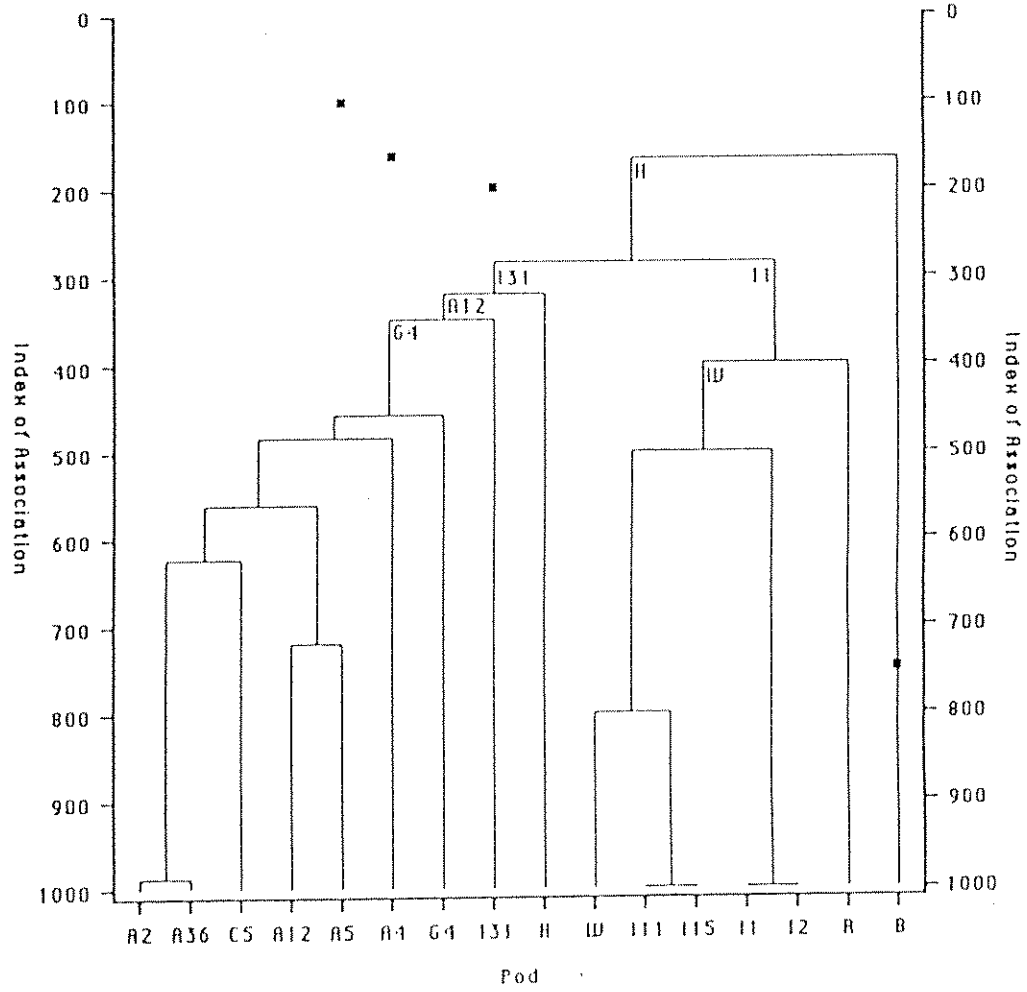

Figure 20. Cluster-analysis dendrogram of 1983 associations among pods and solo indices (squares). Pod associations linking clusters are shown.

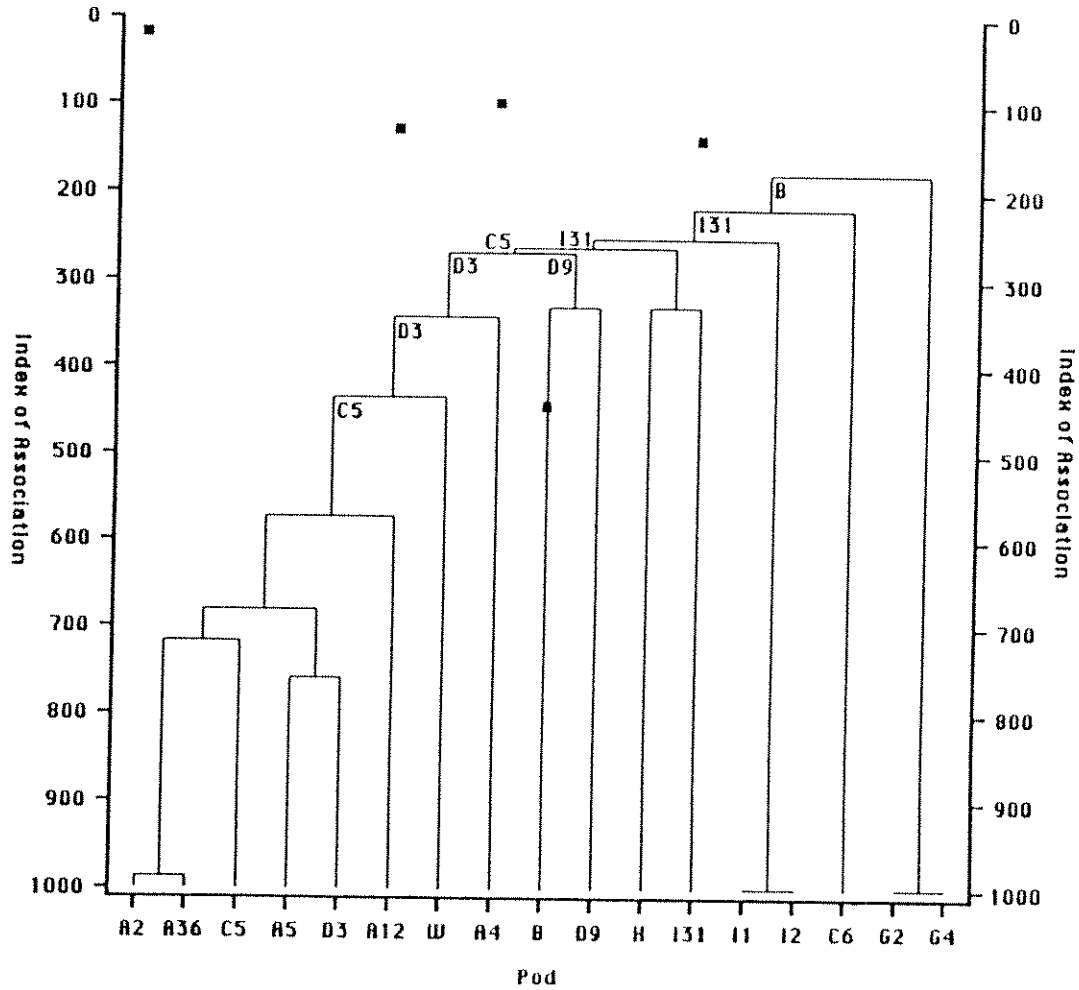

Figure 21. Cluster-analysis dendrogram of 1984 associations among pods and solo indices (squares). Pod associations linking clusters are shown.

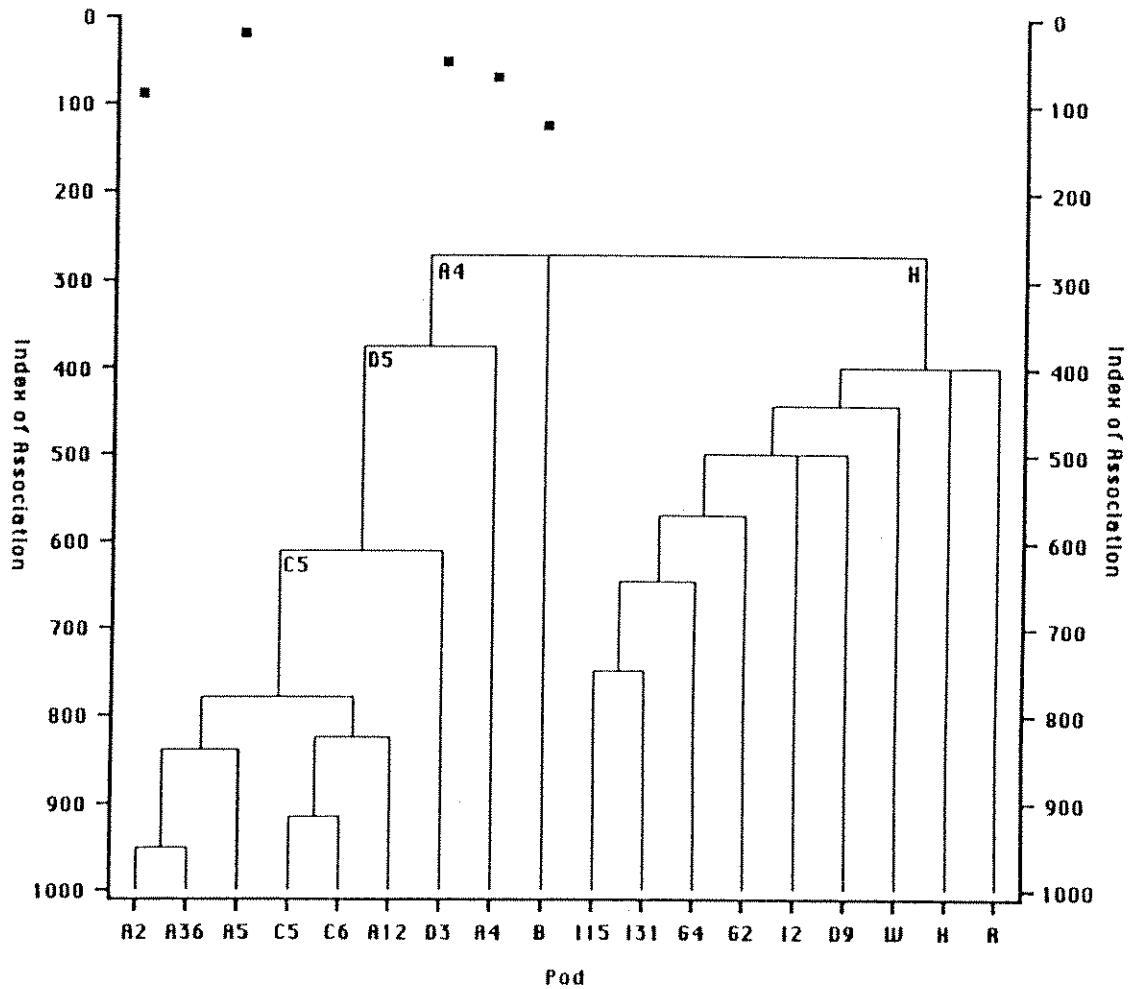

Figure 22. Cluster-analysis dendrogram of 1985 associations among pods and solo indices (squares). Pod associations linking clusters are shown.

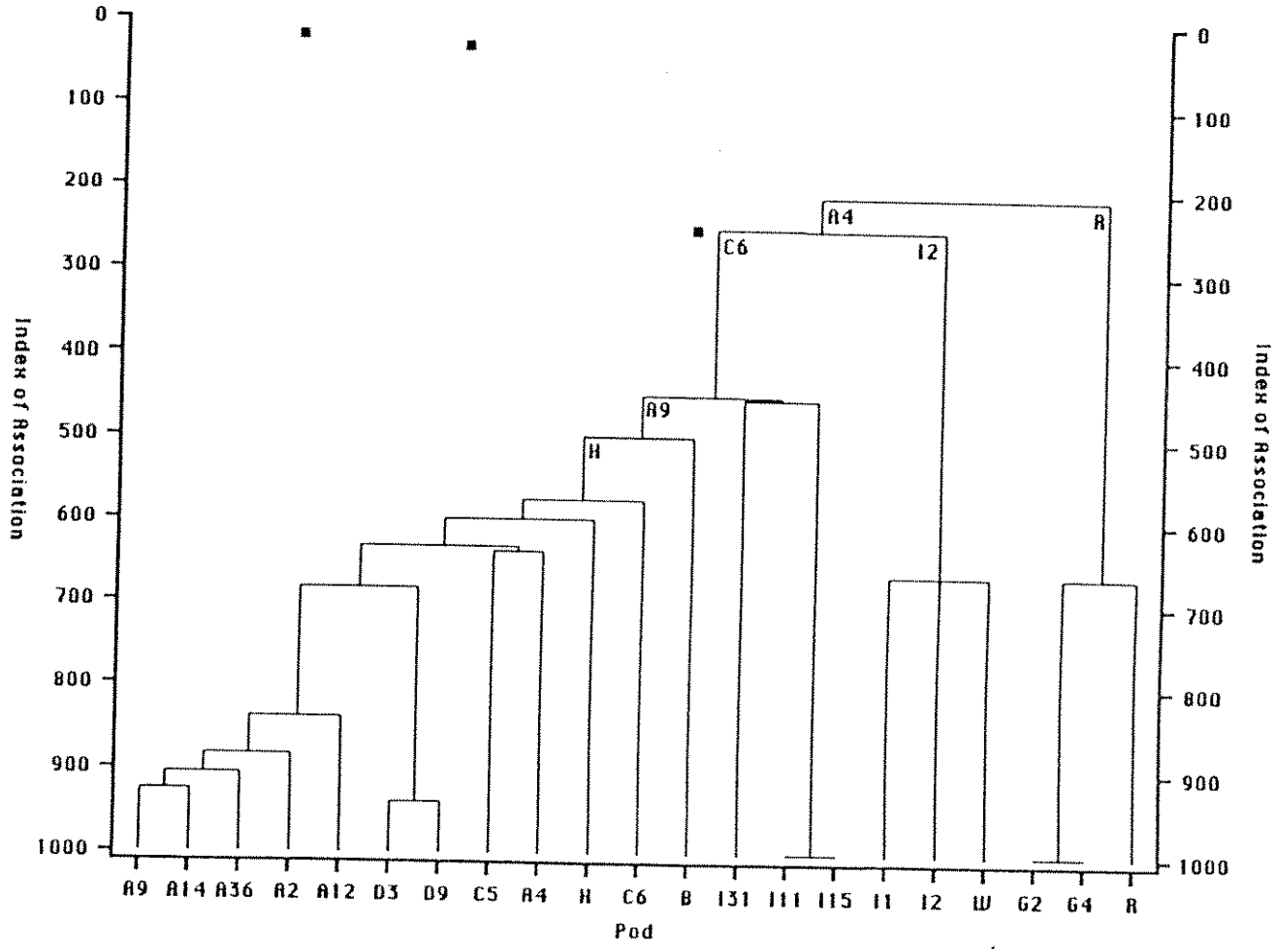

Figure 23. Cluster-analysis dendrogram of 1986 associations among pods and solo indices (squares). Pod associations linking clusters are shown.

Four other pods, H, G4, W, and I31 also visited the study area for two to four years, and associated with A-pods. In 1982 pod H was sighted often with pod A5 (index = 500, Figure 19). From 1983 to 1985 H-pod was not sighted as frequently (Figure 15), and its highest association value with A-pods decreased to a low of 222 in 1984 (Appendix 4). In 1986 H-pod increased its association with A-pods to a high of 600 (Figure 23). Pod G4 followed a pattern similar to pods C5 and D3, associating often with A-pods in 1982 and 1983, then resuming its association with pod G2 in 1984 to 1986 (Figures 19-23). Pod W was first sighted in 1982 (Figure 15), and linked first with pod C5 and second with pods A2, A4 and I11 (Figure 19). In 1984 pod W was sighted half as often as in 1982 (Figure 15) but again associated most with pod C5 (Figure 21). In 1983, 1985, and 1986 pod W was sighted less frequently and associated most with pods I, G, and R (Figures 20, 22, 23). The last pod, I31, began to be sighted frequently in 1983 (Figure 15) and had A-pod association indices ranging from 58 to 476 (Appendix 4).

In all the above instances of changes in associations among subgroups and pods, each subgroup contained at least three orcas (a cow, her offspring and/or other possibly closely related individuals). Similar changes in association occurred between pods I31 and I15, but involved only one individual, I33. Prior to 1985 pod I31 consisted of five individuals: a cow (I31), an adult male, two juveniles, and one mature female (I33). From 1981 to 1983 pod I31 was sighted eight times and pod I15 ten times but both groups were together only on three of those occasions (Appendices 3 and 4). In 1984, pod I31 was sighted seven times, but I33 was absent and was presumed dead. Pod I15 was not sighted. In 1985, pod I31 was sighted three times, associated each time with pod I15, and I33 was again present. Pod I15 was sighted an additional two times without pod I31 or I33. Both I31 and I33 had new calves at their sides, so their reunion is similar to that of pods C5 and C6. In 1986 pod I31 was sighted 17 times, but I33 and her calf were sighted only during the five occasions when pod I15 also was present plus one time when pod I15 but not pod I31 was sighted (Appendix 3).

Pod Solo Indices

Throughout the study period only 9 of the 20 northern resident pods were sighted solo: A2, A12, A36, A4, A5, B, D5, D9 and I31 (Figure 24; Appendices 3 and 4). The number of sightings of solo pods varied annually from 1 to 21 (Figure 12, frequency of one pod sighted). The A-pods comprised 63.8% of all solo pod sightings (N=80), and pod B comprised 31.3%. In 1980, pod A5 accounted for 85.7% of all solo sightings (N=21), which was three times the number of annual solo sightings for any other pod. Pod A5 therefore had the greatest annual solo index (418) of any other A-pod (Figures 16-23; Appendix 4) and a greater accumulative solo index (97, Figure 24). Since the presence of pod A5 was relatively consistent throughout the study period (Figure 15: average = 56.6%, s.d. = 7.3), the magnitude of its

1980 solo index was due primarily to the absence of other pods, especially pod A1.

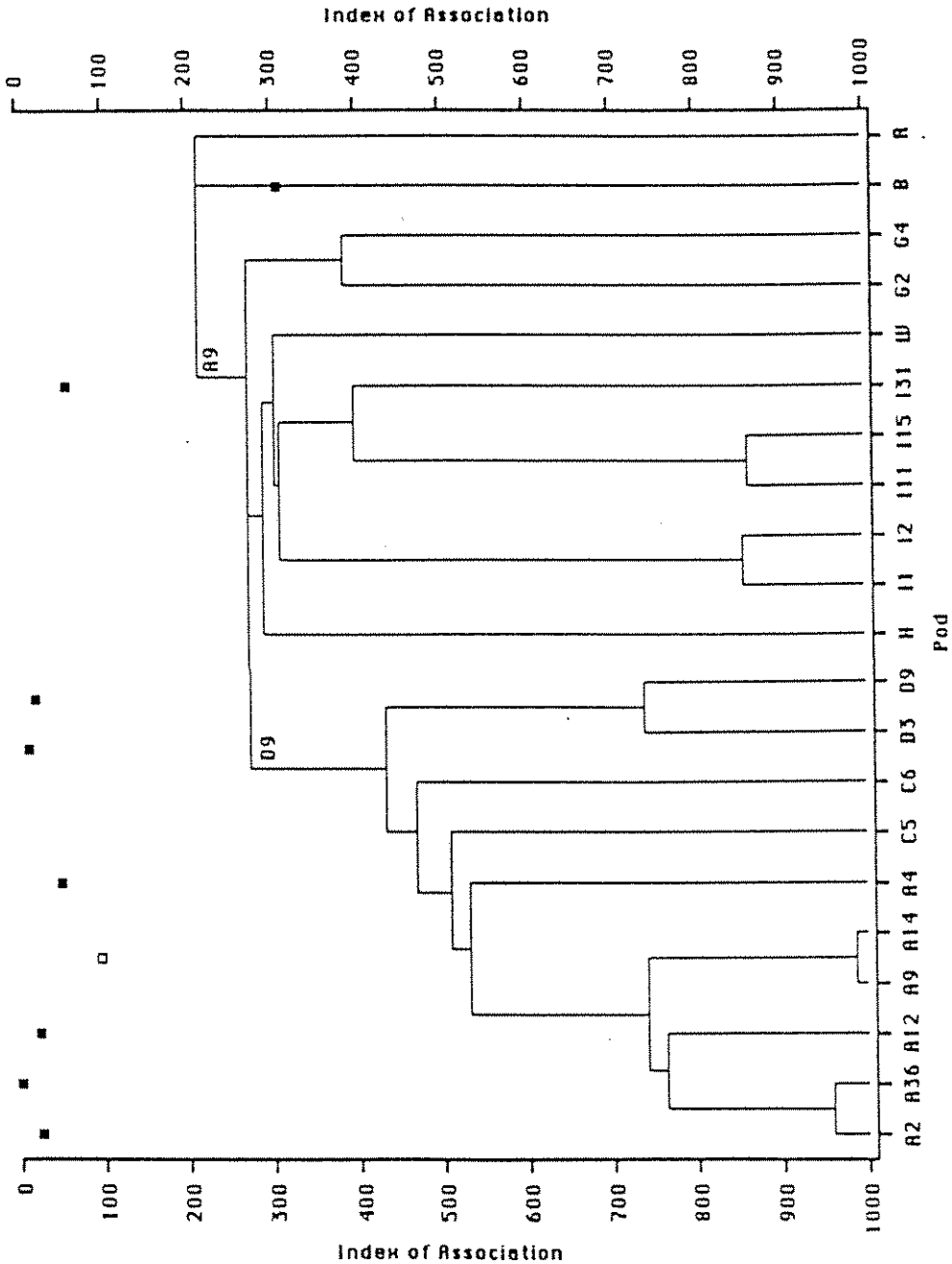

Figure 24. Cluster-analysis dendrogram of 1979 - 1986 associations among pods and solo indices (squares). Pod associations linking clusters are shown.

Pod B was the only pod other than the A-pods to be sighted every year (Table 5). However, it had one of the lowest overall indices of association with the A-pods (Figure 24), primarily because it was sighted solo 31.3% of the time. Pod B had the greatest annual solo index (750, Figure 20), and its average solo index was 2.3 times greater than the average solo index of the eight other pods sighted alone (Figure 24). For three years pod B was the only pod with a solo index greater than its first linkage with another pod (Figures 17, 20, 21). The composition of pod B was also unusual: only one of nine members present during the study period was female, and five of eight males were mature.

Pod Associations For All Years Combined

Despite annual changes in associations among pods and their component subgroups, the overall pattern of associations was generally consistent. When pod association data for all eight years were combined, one large cluster was evident plus several smaller clusters loosely grouped into a second large cluster (Figure 24). The first cluster included all A-pods plus pods C and D, with a lowest linkage of 434. Among the remaining pods close associations occurred among pods I1 and I2 (857), pods I11, I15, and I31 (864 and 400), and pods G2 and G4 (388). Linkages between these pods and pods B, H, R, and W (occurring within the range of 312 to 217) were close or equal and included linkages to the first cluster. Consequently it was difficult to discern which larger cluster pods B, H, R, and W associated with most.

By referring to the indices directly (Appendix 4), these associations were somewhat resolved. Pod B, when not by itself, associated primarily with pods A and H. Pod H associated almost equally with pods A, B, and C as it did with pod I15 with which it is linked in the dendrogram (Figure 24). Pod W associated mostly with the I-pods. The last and third least frequently sighted pod, R, associated most with pods W and G2. Two large groups of pods were therefore possible: 1) the A group, consisting of pods A, B, C, D, and H, and 2) the I group, with pods I, G, W, and R.

Transient Pods

Transient pods were sighted 15 times during the entire study period (Table 5, Appendix 3), comprising only 0.66 % of all pod sightings. The transients traveled through the study area and did not stay for more than 12 hours. Resident pods were within 0.5 n.mi. of transient pods on five occasions, but interactions were observed only once.

On two of the five occasions (July 7, 1981 and August 30, 1981), the transient whales were in a close group swimming along a shoreline into a flooding current, and the resident whales were dispersed across the center portion of the channel and swimming

with the current. On July 18, 1982 a male transient (O5, traveling with O4) was observed pursuing and possibly capturing a Dall's porpoise while resident orcas were foraging for salmon in the vicinity. After the attack the transients left the study area, traveling in an opposite direction to the residents. On September 11, 1984 nine transient whales entered a strong (2-4 knots) flooding tidal rip on one side of a 1 n.mi. passage and swam in place against the current as a close group of 15 resident whales passed through on the opposite side with the current. In all the above accounts, the resident and transient pods passed one another swimming in opposite directions without apparent interaction.

During the fifth encounter, changes in behavior were observed in both resident and transient pods. On August 30, 1986 the three members (a cow, bull, and juvenile) of the transient pod M were slowly traveling east along the West Cracroft Island shoreline. Eight resident pods (A2, A36, A12, A5, C6, D3, D7, and I31) were scattered across the Johnstone Strait foraging to the west. Pod D7 was foraging along the shoreline toward the approaching pod M but a headland obscured one from the other. When pod D7 passed the headland the two pods were within a quarter nautical mile of one another, and pod M reversed direction and swam west for about a quarter nautical mile. Pod M then reversed direction again, angling offshore for about 100 meters, and continued swimming slowly east.

Within 30 minutes all resident pods in the Strait had reversed direction and were foraging eastwardly. It was unknown if the reversal was in response to pod M or a common foraging reversal (Jacobsen 1986). During the next hour there were about four resident pods or subgroups either behind, ahead or offshore of pod M at distances of 100 m or more. At one point, pod A36 swam over to the shoreline and then oriented back towards pod M. Underwater sound recordings made near pod M contained echo-location pulses scanning the area, presumably from pod A36. Only resident pod vocalizations (Ford 1984, 1987) were heard throughout two recording sessions. Pod M swam southeast into the middle of the Strait and was last seen traveling slowly east, about 2-3 nautical miles ahead of the nearest resident pod. Throughout the entire incident all pod members remained close together, and no sudden movements were detected. The transients, after their first reversals in direction, maintained a consistent travel speed (about 2-3 knots) and eastward direction.

DISCUSSION

Summary of Associations Among Individuals

The results of this study confirm that the maternal subgroup is the basic unit of orca social structure. Associations among individuals of all ages and sex classes within maternal subgroups were stronger than all other associations during all behaviors over a period of at least seven years. All individuals within maternal subgroups most likely were related along matrilines. There seemed to be no dispersal by males from the maternal group and only gradual and limited dispersal by females as they matured and had offspring. All of these findings were in complete agreement with the conclusions made by Bigg (1982, 1987).

Many terrestrial mammals have matrilineal social systems similar to orca: elephants (Douglas-Hamilton and Douglas-Hamilton 1975, Dublin 1983); hyenas (Kruuk 1972); baboons (Kummer 1968); rhesus monkeys (Sade 1965); Japanese monkey (Itani 1959); wolves (Mech 1970); and lions (Schaller 1972). However, in all terrestrial mammals studied, dispersal by males and/or females from their maternal kin group occurs at sexual maturity (Greenwood 1980, Pusey and Packer 1986). A partial exception may be the pygmy chimpanzee (Pan paniscus) where males remained with their mothers until adulthood (Nishida and Hiraiwa-Hasegawa 1987).

Lineage Relationships Among A-Pod Individuals

It was likely that all individuals within a subgroup were closely related to the cow of the maternal subgroup. Juveniles and subadults were most likely to be the cow's direct offspring. Thus A38 would have been the offspring of A30, A33 the offspring of A12, A26 the offspring of A9, A25 the offspring of A14, and A27 the offspring of A23 (Table 3). Two whales passed from subadult to adult during the study period: A6, the probable offspring of A30, and A32, the probable offspring of A36. All but one (A25) of the above seven individuals were male, indicating that males stayed with their maternal subgroups at least into early adulthood. Of the four males that were adults throughout the study period, two had high mean linkages with a maternal subgroup: A5 at 606 and A31 at 713. Thus it was possible that A5 was the son of A9 and A31 the son of A12.

The maternal relationships of the two remaining adult males, A4 and A20, and the adult female A2, were less certain. They were likely to be as old as or older than the cow(s) within their subgroup, so were unlikely to be the offspring of these cows or any other cows still living. The two next most probable lineage relationships were parental and sibling.

The subgroup linkages for A4, A20 and A2 were among the lowest, which may have indicated a weaker bond with their subgroup. In Figure 9 the range of adult subgroup linkages descended to overlap the mean of linkages between subgroups. All of the nine adult indices that fell below the standard deviation (less than 387) belonged to these three individuals (A2, n=3; A4, n=2; and A20, n=4). However, for six of these instances the orcas' solo indices were greater than their subgroup linkage (twice for A2 and all four times for A20). This indicated that these adults were not leaving their subgroup in preference for some other but were simply more often solitary than associated with their subgroup.

The above lines of evidence strongly suggest that males remain with their maternal subgroup throughout their lives. When their mothers die they may either remain with their siblings, emigrate, or travel alone. Since the last two options have not been observed so far, the first seems to be predominate.

If A20 was an example of an adult male who remained with his maternal subgroup after his mother died, then A36 may have been his sister. Although A4's index of association with his pod averaged 460, he was often solitary and it was less clear which adult cow he was most closely associated with, A10 or A11. A sibling relationship with one of these females also may have been possible, assuming that his mother was deceased. Support for these arguments could be found by observing the association patterns of known brother-sister pairs as they mature, as the sister starts producing her own calves, and when their mother dies.

The remaining adult, A2, a postreproductive female, was often solo but maintained an association with the A30 maternal subgroup. If the associational argument presented for adult males A20 and A4 was used for A2 then A30 could be her sister. If this was true, then A2 was either nonreproductrive or all her calves must have perished before Bigg's study began. A more likely relationship would have been parental - A2 was the mother of A30. Because female longevity may be 50 years and perhaps as long as 80 years (Bigg et al. 1987), grandmothers would be expected within pods. Another example of this grandmother-mother-calf relationship was A14, A25 and A51, whose future pattern of associations may provide an insight into that of A2 and A30.

The use of association patterns in speculations on lineage relationships among A-pod individuals becomes tenuous when considering cows. It may have been possible that females who maintained consistent associations throughout the study period were more closely related than those who did not maintain close associations. Examples of sister relationships may have been A14 and A23, and A8 and A9. The A-pod lineage relationships outlined above are identical to those arrived at by Bigg et al. (1987) in their analysis of photographic records collected since 1973.

Allomaternal Associations

Allomaternal associations were observed among calves or young juveniles and females from the same or from other maternal subgroups. It was likely that as females approached or attained reproductive age, their associations with young calves increased their learning of parental skills (Jolly 1985, Fagan 1981, Lancaster 1971). One might, therefore, expect an increase in their allomaternal associations. This trend was observed in my study for three subadult females within the A-pods (A25, A34, and A28). Waite (1988), in a detailed study of allomaternal care among the A-pods, also observed associations between females and young orcas of both kin and non-kin groups. Allomaternal care was observed for females in the southern community of orcas (Haenel 1986, and Heimlich-Boran 1986c and 1988).

Allomaternal care by a postreproductive female was observed in this study between A2 and her probable grandaughter A50, and perhaps with A43, an unrelated calf. Active mammary glands have been found in postreproductive female short-finned pilot whales (Globicephala macrorhynchus, Kasuya and Marsh 1984). It was possible that these pilot whale females provided milk to other mothers' calves. Although it is unknown if postreproductive orca females have active mammary glands, allomaternal milk provisioning may also occur among killer whales.

Allomaternal associations between males and calves or young juveniles were not as evident in this study as allomaternal associations involving females. Waite (1988), however, observed allomaternal associations by males, but only within maternal subgroups. Long term associations among mature males and juvenile or subadult males were observed within subgroups in this study, especially during foraging.

Associations Among Males

Associations between males of all ages from different subgroups occurred and involved many play behaviors. Play can be regarded as a context where behaviors that will be important in adult life were practiced in a non-serious manner by young animals (Fagen 1981). Dominance hierarchies can be established at a young age during mock-fighting playbouts that may persist into adulthood (Kitchen, personal communication). The reciprocal beak-genital orientations observed among male orcas throughout their lives seemed to be an important stereotyped behavior that varied according to context. When practiced between juvenile males it seemed predominantly playful. When subadult and juvenile males exchanged beak-genital orientations the interaction may have been playful, as between A38 and A27. The same behavior also may have been used as a way of reinforcing dominance, as between A33 and A27, especially when not reciprocal. These events may also have indicated an assertion of dominance of A33 over A38, as it appeared that A33 displaced A38 from A27.

A similar behavior, beak-genital propulsion, was observed by Bateson (1974) among captive spotted dolphins (Stenella attenuata) and spinner dolphins (Stenella longirostris). The beak-genital orientations observed among orca differed physically from beak-genital propulsion in two ways. First, the orienting animal did not seem to insert its beak into the others urogenital slit, which may have been due the blunter shape of the beak compared to elongated and narrower beak of Stenella species. Secondly, the orienting orca did not seem to propel the other orca, as the other orca moved its flukes rather than remaining passive.

Due primarily to the difficulties of making continuous visual observations of wild orcas, any discussion of dominance hierarchies among males is highly speculative. However, three arguments supporting a dominance hierarchy can be made for male orcas. First, among captive bottlenosed dolphins, the dominant male was the actor in homosexual interactions which included penile displays and intromissions (Caldwell and Caldwell 1977; Ostman in press). The beak-genital propulsion observed by Bateson (1974) also was related to dominance, the animals of lower rank propelling those of higher rank. Beak-genital orientations among orcas were reciprocal and one way, so this behavior may have served to maintain dominance relationships as among the Stenella. Secondly, after vigorous play bouts among male orcas, new cuts and scratches were often seen on their bodies. These injuries ranged from more common superficial tooth rakes, to occasional cuts that exposed the white blubber layer beneath the skin, or tears in the posterior edge of the dorsal fin. In general, males tended to have more scratch marks and scars on their bodies than females.

Thirdly, male orcas are sexually dimorphic in size. In terrestrial mammals, sexual dimorphism was positively correlated to high levels of male-male aggression (Popp 1983; Alexander et.al. 1979). Although these arguments suggest that male orcas establish dominance hierarchies verification awaits a direct measure of reproductive success and continuous observation of dominance behavior.

Intersexual Associations

Of the 14 intersexual associations observed that involved urogenital orientations or an erect penis, only the one between A20 and A28 recurred often enough to significantly affect the formation of clusters in the dendrograms. A20 was probably the oldest male within the A-pods (Bigg et al. 1987). Assuming that dominance hierarchies existed among male orcas, it is possible that A20 was the alpha male, at least among other A-pod males, and that he excluded other males from associating with A28. A20's association with A28 therefore might have been similar to tending bonds observed among migratory ungulates (bison, Lott 1971; caribou, Espmark 1964, Lent 1965).

Short term intersexual associations often resulted when several pods met and mature males followed behind females from other pods. A possible explanation for this following behavior may be that the males were assaying the female's reproductive readiness by tasting the water for pheromonal or other chemosensory cues present in the female's excretions (Walker et al. 1988). Norris and Dohl (1980) were led to identical speculations during their observations of wild spinner dolphins (Stenella longirostris). Herman and Tavolga (1980) and Donaldson (1977) gave additional evidence for gustatory sensitivity from behavioral observations. A few controlled experiments on captive dolphins have shown their ability to distinguish between a wide variety of tastes, with threshold levels comparable to humans for sour, bitter, salty, and sweet (Nachtigall 1986). It seems probable that male orcas could detect an estrous female, an assumption that could be tested with captive and wild orcas.

The intersexual associations observed in this study seemed to have been behavioral responses used by males to increase their chances of locating and mating with an estrous female. When many pods foraged in the same area throughout the season the long term tending bond-like behavior (such as that observed between A20 and A28) was possible. During the brief encounters with visiting pods the following behavior seemed to have been a way for males to quickly locate estrous females. Due to the mobility and wide distribution of pods, mating opportunities for a male were likely to have been unpredictable. In addition, because the minimum calving interval is about 3 years (Bigg 1982), only a small proportion of the female population is likely to be receptive at any one time. Therefore, competition is probably high among males for any estrous females present. Females may select mates according to their sexually dimorphic traits, physical and/or vocal (Dahlheim and Awbry 1982).

The above attributes suggest a multi-male mating system among orcas. Among long lived terrestrial mammals high degrees of sexual dimorphism and male dominance hierarchies have been correlated to polygynous mating systems (Ralls 1977, Crook 1972, Alexander et al. 1979). Harcourt et al. (1981) compared testis and body sizes of 33 primate species and found that primates with testes larger than that predictable by body size tended to have multi-male breeding systems. Kenagy and Trombulak (1986) found the same relationship among 133 mammalian species. They included five odontocete species, excluding orca, and predicted multi-male breeding systems for all of them. Landino (1985, personal communication) conducted a more complete survey of odontocetes, and predicted a multi-male breeding system for orca. Due to the difficulties of observing mating behavior, the exact nature of the orca's mating system may never be known with certainty.

Pod Sightings and Associations

Throughout the study the orcas predominantly remained associated with their maternal subgroups. However, the sequence

of associations of female I33 seemed to be an exception to the general rule of subgroup fidelity.

The behavior of I33 can be interpreted from two perspectives. When viewed as an individual she accounted for 18 of 24 instances when a pod was sighted and members were missing (Appendix 3). The sequence of her sightings suggests that she likely was associated with I15 pod during her absence from I31 pod. If this was true then I33 was a unique example of an emigration from one pod to another. She may have been solitary, or with pods other than I15.

If I33 is viewed as a very young maternal subgroup - a pregnant female who gave birth and traveled with her calf - then her behavior was similar to other subgroups that split off from their pods during the course of this study. Since the degrees of relatedness among I33, I31, and the cows of I15 pod are unknown, the causes of their observed associations are uncertain. In time, such unusual patterns of association may provide insight into the details of pod organization, especially the social interactions among females.

Throughout the study period the five A-pods were the most frequently sighted pods in the Johnstone Strait. This suggests that, at least during seasonal salmon migrations, home ranges were maintained within the northern community, and that Johnstone Strait was a core area within the home range (Jewell 1966, Adams and Davis 1967) of the A-pods.

The existence of two large groups of pods, the A group and the I group, is evident from pod association indices calculated for all eight years of the study period combined. The combination of pods into these two large groups suggests that there were at least two home ranges established seasonally within the northern community. The A group inhabited a home range that included the Johnstone Strait as a core area where they were sighted most frequently. Since all observations have been from the Johnstone Strait, it is impossible to determine how many home ranges were represented in the I group and if they were inhabited as consistently. Given the mobile nature of the prey source and the appearance of I group pods in the study area, the boundaries of the ranges were probably not exact and may have changed seasonally according to salmon abundance. There has been no evidence from surface observations of any territoriality or agonistic interactions among pods in the northern and southern communities (Jacobsen 1986, Heimlich-Boran 1986c, 1988).

Since pods seemed to be primarily composed of one or more maternal kin groups that gradually dispersed from one another, it is possible that pods that maintained a high degree of association were more closely related than those pods that seldom associated. The A group may therefore represent one large lineage and the I group another. This large scale lineage argument based on associations among pods is likely to be tenuous. Due to the great longevity of this species little is

known about the long term associations among related family groups.

More reliable insight into the lineage relationships among family groups may be available from the whales' acoustic behavior. In his analysis of stereotyped vocalizations of all northern community pods, Ford (1984, 1987) discovered three distinct dialect groups he called clans. Ford speculated that each clan may represent a separate lineage of whales descended from some pod that immigrated into the area many generations ago. Ford also used Dice's index to calculate acoustic relationships among pods, so our data can easily be compared (Figure 25). To facilitate comparison, the component subgroups of each larger pod category (A1, A5, C, D, G, I1, I11) have been combined, taking the average linkage in the case of the C5 and C6 pods.

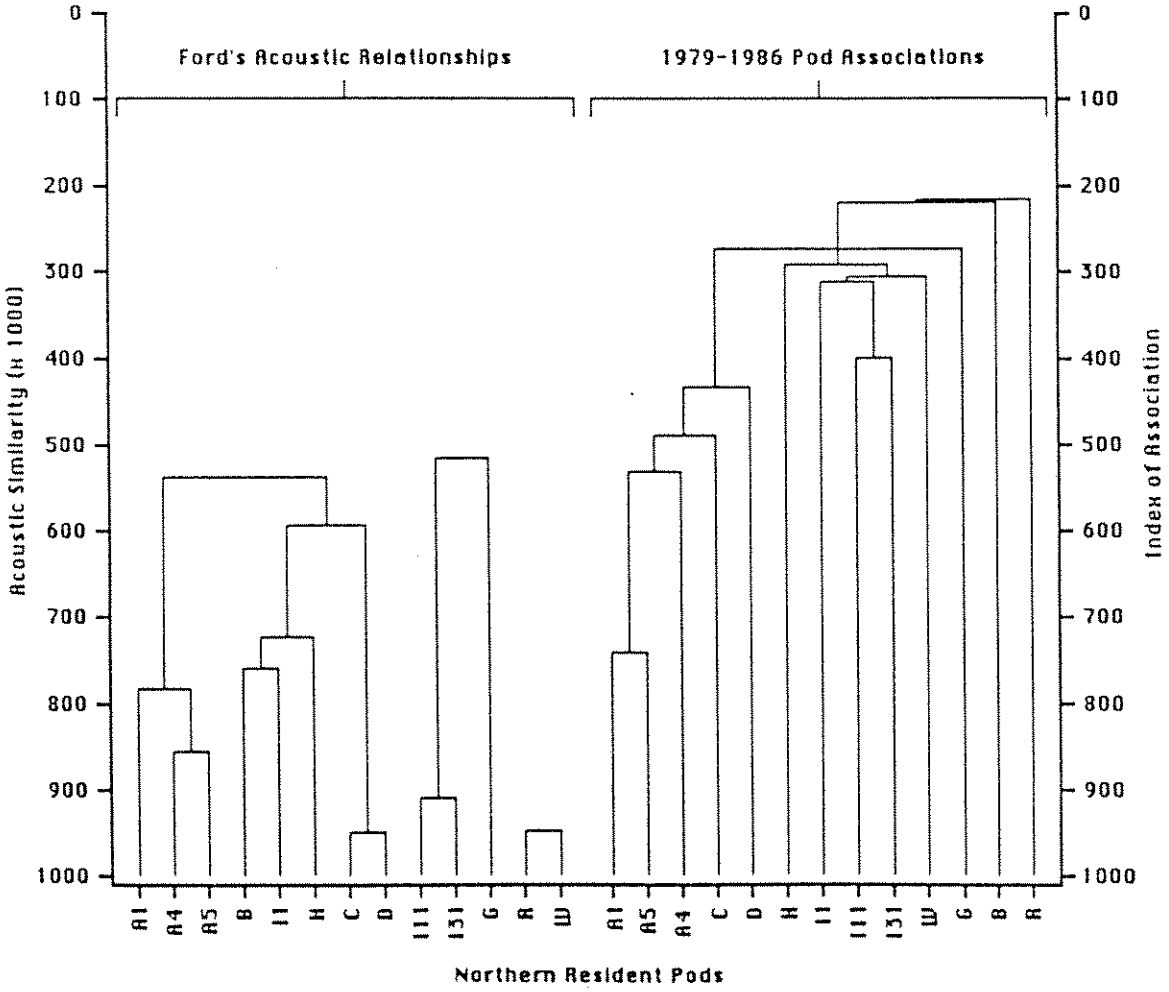

Figure 25. Comparison of Ford's (1984) acoustic similarity among northern resident pods and this study's 1979 - 1986 associations among pods.

Any comparisons made between the two sets of data in Figure 25 must be treated with caution. The association data was from a limited portion of the range of the northern community. Associations among even the most frequently sighted pods outside of the study area were largely unknown. The causative factors underlying the evolution and maintenance of dialects are not likely to be identical to those that brought pods together at the same time in Johnstone Strait during the salmon migration.

The comparison does show that the acoustic similarity analysis clustered pods in a more definitive manner than the association data did and is likely a better indicator of lineage. The comparison also shows that pods of different clans associated with one another, an observation also made by Ford (1984) in his analysis of pod sighting data from 1973 to 1983. Pods with the highest acoustic similarity tended to be closely associated (A1, A4 and A5; C and D; H and I1; and I11 and I31), but not without execption (B and I1; and R and W). If continuous association data were available for all pods perhaps this tendency would be stronger.

CONCLUSION

The orca is a long lived species living in a complex and multi-level society that appears to be unique among all mammals. Consequently, several more generations will have to be observed to fully understand the long term significance of associations described in this study. Additionally, many time based and/or focal animal studies are needed to describe in detail many of the social behaviors presented here. In particular the role of stereotyped behaviors, such as beak-genital orientations, in the maintenence of probable dominance hierarchies among males needs clarification. Such a study was initiated by Rose (personal communication) in the Johnstone Strait in 1987. A more detailed study of associations and behaviors among mature males and females would likely reveal more about courtship and mating behavior. The orca seems to be unique among cetaceans in that long term studies can be conducted on all individuals within the population, and hence offers an unusual opportunity to gain insight into mammalian evolution.

LITERATURE CITED

Adams, L., and S.D. Davis. 1967. The internal anatomy of home range. J. Mamm. 48:529-536.

Alexander, R.D., J.L. Hoogland, R.D. Howard, K.M. Noonan, and P.W. Sherman. 1979. Sexual dimorphisms and breeding systems in pinnipeds, ungulates, primates, and humans. In: "Evolutionary Biology and Human Social Behavior: An Anthropological Perspective", N. A. Changon and W. Irons, eds., Wadsworth, Belmont, Calif., pp 402-435.

Altmann, J. 1974. Observational study of behavior: sampling methods. Behavior, 49:227-265.

Asper, E.D., and L.H. Cornell. 1977. Live capture statistics for the killer whale (Orcinus orca) 1961-1976, in California, Washington, and British Columbia. Aquatic Mamm., 5:21-27.

Balcomb, K.C., J.R. Boran, R.W. Osborne, and N.J. Haenel. 1980. Observation of killer whales (Orcinus orca) in Greater Puget Sound, State of Washington. NTIS PB80-224728, United States Department of Commerce, Springfield, Va.

Balcomb, K.C., J.R. Boran, and S.L. Heimlich. 1982. Killer whales in greater Puget Sound. Rep. Intl. Whal. Commn., 32:681-686.

Bain, D.E. Personal Communication. Long Marine Lab, Univ. of Calif. at Santa Cruz, Santa Cruz, California, 95064.

Bain, D.E. 1985. Orca studies at University of California, Santa Cruz. Cetus, 6(1):18.

Bain, D.E. 1986. Acoustic behavior of Orcinus: sequences, periodicity, behavioral correlates and an automated technique for call classification. In: "The Behavioral Biology of Killer Whales", B. C. Kirkevold and J. Lockard eds., A. R. Liss, New York, N. Y., pp. 335-371.

Bateson, G. 1974. Observations of a cetacean community. In: "Mind in the Waters", J. McIntyre, ed., C. Scribner's Sons, N. Y., pp. 146-165.

Berzin, A.A. and V.L. Vladimirov. 1983. A new species of killer whale (Cetacea, Delphinidae) from Antarctic waters. Zool. Zhurnal, 62(2):287-295.

Bigg, M.A. Personal Communication. Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, British Columbia, Canada, V9R 5K6.

Bigg, M.A. 1982. An assessment of killer whale (Orcinus orca) stocks off Vancouver Island, British Columbia. Rep. Intl. Whal. Comm., 32:655-666.

Bigg, M.A., I.B. MacAskie, and G. Ellis. 1976. Abundance and movements of killer whales off eastern and southern Vancouver Island, with comments on management. Unpub. Rep. Arctic Biol. Stn., Ste. Anne de Bellevue, Quebec. 21 pp.

Bigg, M.A. and Wolman, A.A. 1975. Live-capture killer whale (Orcinus orca) fishery, British Columbia and Washington, 1962-73. J. Fish. Res. Bd. Can., 32:1213-1221.

Bigg, M.A., G.M. Ellis, J.K.B. Ford, and K.C. Balcomb. 1987. "Killer Whales: A Study of Their Identification, Genealogy, and Natural History in British Columbia and Washington State". Phantom Press, Nanaimo, B.C., 79pp.

Caldwell, M.C. and D.K. Caldwell. 1977. Cetaceans. In: "How Animals Communicate", T. A. Sebeok, ed., Indiana University Press, pp. 794-808.

Condy, P.R., R.J. Van Aarde, and M.N. Bester. 1978. The seasonal occurence and behavior of killer whales, Orcinus orca, at Marion Island. J. Zool. (Lond.), 184:449-464.

Crook, J.H. 1972. Sexual selection, dimorphism, and social organization in the primates. In: "Sexual Selection and the Descent of Man, 1871-1971", B. Campbell, ed., Aldine, Chicago, Ill., pp. 231-281.

Dahlheim, M.E., and F. Awbrey. 1982. A classification and comparison of vocalizations of captive killer whales (Orcinus orca). J. Acoustical Soc. Amer., 72:661-670.

Dice, L.R. 1945. Measures of the amount of ecologic association between species. Ecology, 26(3):297-302.

Donaldson, B.J. 1977. The tongue of the bottlenosed dolphin (Tursiops truncatus). In: "Functional Anatomy of Marine Mammals, Vol. 3", R. J. Harrison ed., pp. 175-197.

Douglas-Hamilton, I. and O. Douglas-Hamilton. 1975. "Among the Elephants." Viking Press, New York, 284 pp.

Dublin, H.T. 1983. Cooperation and reproductive competition among female African elephants. In: "Social Behavior of Female Vertebrates", S.K. Wasser ed., Academic Press, N.Y., pp. 291-313.

Duffield, D.A. 1986. Orcinus orca: taxonomy and evolution - cytogenetics and phylogeny. In "The Behavioral Biology of Killer Whales", B. C. Kirkevold and J. Lockard eds., H. Liss, New York, N. Y., pp. 19-34.

Espmark, J. 1964. Rutting behavior in reindeer (Rangifer tarandus L.). Anim. Behav., 12:159-163.

Evans, W.E., A.V. Yablokov, and A.E. Boweles. 1982. Geographic variation in the color pattern of killer whales (Orcinus orca). Rep. Int. Whal. Commn., 32:687-694.

Fagan, R. 1981. Animal play behavior. Oxford University Press, N. Y., 684 pp.

Ford, J.K.B. and H.D. Fisher. 1982. Killer whale (Orcinus orca) dialects as an indicator of stocks in British Columbia. Rep. Int. Whal. Commn., 32:671-679.

Ford, J.K.B. and H.D. Fisher. 1983. Group-specific dialects of killer whales (Orcinus orca) in British Columbia. In: "Communication and Behavior of Whales", R. Payne (ed.)., A.A.A.S. Selected Symp #76. Westview Press, Boulder, Colorado, pp. 129-161.

Ford, J.K.B. 1984. Call traditions and dialects of killer whales (Orcinus orca) in British Columbia. Doctoral thesis, Dept. Zool., University of British Columbia, 434 pp.

Ford, J.K.B. 1987. A catalogue of underwater calls produced by killer whales (Orcinus orca) in British Columbia. Canadian Data Report of Fisheries and Aquatic Sciences, No. 633, 165 pp.

Gaskin, D.E. 1982. "The Ecology of Whales and Dolphins". Heinemann Educational Books, Exeter, New Hampshire, 459 pp.

Greenwood, P.J. 1980. Mating systems, philopatry, and dispersal. Anim. Behav., 28:1140-1162.

Haenel, N.J. 1986. General notes on the behavioral ontogeny of Puget Sound killer whales and the occurrence of allomaternal behavior. In "The Behavioral Biology of Killer Whales", B. C. Kirkevold and J. Lockard eds., A. R. Liss, New York, N. Y., pp. 285-300.

Harcourt, A.H., P.H. Harvey, S.G. Larson, and R.V. Short. 1981. Testis weight, body weight and breeding system in primates. Nature, 293:55-57.

Heimlich-Boran, J.R. 1986a. Fishery correlations with the occurrence of killer whales in greater Puget Sound. In "The Behavioral Biology of Killer Whales", B. C. Kirkevold and J. Lockard eds., A. R. Liss, New York, N. Y., pp. 113-131.

Heimlich-Boran, J.R. 1986b. Photogrammetric analysis of growth in Puget Sound Orcinus orca. In "The Behavioral Biology of Killer Whales", B. C. Kirkevold and J. Lockard eds., A. R. Liss, New York, N. Y., pp. 97-112.

Heimlich-Boran, S.L. 1986c. Cohesive relationships among Puget Sound killer whales. In "The Behavioral Biology of Killer Whales", B. C. Kirkevold and J. Lockard eds., A. R. Liss, New York, N. Y., pp. 251-284.

Heimlich-Boran, S.L. 1988. Association patterns and social dynamics of killer whales (Orcinus orca) in greater Puget Sound. Master's thesis, Moss Landing Marine Lab and Dept. Biology, San Jose State University, 98 pp.

Herman, L.M. and W.N. Tavolga. 1980. The communication systems of cetaceans. In: "Cetacean Behavior, Mechanisims and Functions", L. Herman, ed., John Wiley Interscience, N. Y., pp. 149-209.

Hershkovitz, P. 1966. Catalog of living whales. Smithsonian Institution, Washington D.C., 259 pp.

Heyning J.E. and M.E. Dahlheim. 1988. Orcinus orca. Mammalian species, American Society of Mammalogists, 304:1-9.

Hoyt, E. 1981. The whale called killer. E. P. Dutton, N. Y., 226 pp.

Itani, J. 1959. Paternal care in the wild Japanese monkey, Macaca fuscata fuscata. Primates, 2:61-93.

Jacobsen, J.K. 1985. Respiratory pattens during rest and sleep of the killer whales (Orcinus orca) in the Johnstone Strait, British Columbia. Cetus, 6(1):18.

Jacobsen, J.K. 1986. The behavior of Orcinus orca in the Johnstone Strait, British Columbia. In: "The Behavioral Biology of Killer Whales", B. C. Kirkevold and J. Lockard eds., A. R. Liss, New York, N. Y., pp. 135-185.

Jewell, P.A. 1966. The concept of home range in mammals. Symposia of the Zool. Society of London, 18:85-109.

Jolly, A. 1985. The evolution of primate behavior. Macmillan Publishing Company, N. Y., sec. ed., 526 pp.

Jonsgard, A. and P.B. Lyshoel. 1970. A contribution to the biology of the killer whale, Orcinus orca (L.). Norw. J. Zool., 18:41-48.

Kasuya, T., and H. Marsh. 1984. Life history and reproductive biology of the short-finned pilot whale, Globicephala macrorhynchus, off the Pacific coast of Japan. Rep. Int. Whal. Comm., Special Issue 6, pp. 260-310.

Kenagy, G. J. and S. C. Trombulak. 1986. Size and function of mammalian testes in relation to body size. J. Mammal., 67(1):1-22.

Kitchen, D.K. Personal Communication. Humboldt State Univ., Dept. Wildlife, Arcata, California, 95521.

Kruse, S.L. 1985. Movements of killer whales in Johnstone Strait, B. C. Abstract, Sixth Biennial Conference on the Biology of Marine Mammals, The Society for Marine Mammalogy.

Kruse, S.L. (In press) The interactions between killer whales and boats in Johnstone Strait, B.C. In: "Dolphin Societies: Methods of Study", K. Pryor and K. Norris eds., Univ. of Calif. Press, Berkeley, California.

Kruuk, H. 1972. "The Spotted Hyena". University of Chicago Press, Chicago, Ill., 335 pp.

Kummer, H. 1968. "The Social Organization of Hamadryas Baboons". University of Chicago Press, Chicago, Ill.

Lancaster, J.B. 1971. Play-mothering: the relation between juvenile females and young infants among free-ranging vervet monkeys (Cercopithecus aethiops). Folia Primatol., 15:161-182.

Landino, S.W. 1985. Cetacean breeding systems revealed by interspecific comparison. Abstract, Sixth Biennial Conference on the Biology of Marine Mammals, The Society for Marine Mammalogy.

Landino, S.W. Personal Communication. Fisheries Research Inst., WH-10, University of Washington, Seattle, WA 98195.

Lehner, P.N. 1979. "Handbook of Ethological Methods". Garland STPM Press, 403 pp.

Lent, P.C. 1965. Rutting behaviour in a barren-ground caribou population. Anim. Behav., 13:259-264.

Lopez, J.C. and D. Lopez. 1985. Killer whales of Patagonia and their behavior of intentional stranding while hunting nearshore. J. Mammal., 66(1):181-183.

Lott, D.F. 1971. Sexual and aggressive behavior of adult male american bison (Bison bison). In: "The Behavior of Ungulates and its Relation to Management", V. Geist and F. Walther eds., vol. 1, IUCN Publications, pp. 382-394.

Martinez, D.R. and E. Klinghammer. 1970. The behavior of the whale, Orcinus orca: a review of the literature. Z. Tierpsychol., 27:828-839.

Matkin, C.O. and S. Leatherwood. 1986. General biology of the killer whale: a synopsis of knowledge. In: "The Behavioral Biology of Killer Whales", B. C. Kirkevold and J. Lockard eds., A. R. Liss, New York, N. Y., pp. 35-68.

Mech, L.D. 1970. "The Wolf: Ecology and Behavior of an Endangered Species." Natural History Press, Garden City, N. J.

Mikhalev, Y.A., M.V. Ivashin, V.P. Savusin, and F.E. Zelenaya. 1981. The distribution and biology of killer whales in the southern hemisphere. Rep. Intl. Whal. Commn., 31:551-565.

Morgan, B.J.T., M.J.A. Simpson, J.P. Hanby, and J. Hall-Craggs. 1976. Visualizing interaction and sequential data in animal behavior: theory and application of cluster-analysis methods. Behavior, 56:1-43.

Morton, A.B., J.C. Gale, and R.C. Prince. 1986. Sound and behavioral correlations in captive Orcinus orca. In: "The Behavioral Biology of Killer Whales", B. C. Kirkevold and J. Lockard eds., A. R. Liss, New York, N. Y., pp. 303-333.

Nachtigall, P.E. 1986. Vision, audition and chemoreception in dolphins and other marine mammals. In: "Dolphin Cognition and Behavior: a Comparative Approach", R. J. Shusterman, J. A. Thomas, and F. G. Wood, eds., Lawrence Erlbaum Associates, Publishers, Hillsdale, N. J., pp. 79-113.

Nishiwaki, M. and C. Handa. 1958. Killer whales caught in the coastal waters of Japan for recent 10 years. Sci. Rep. Whales Res. Inst., 13:85-96.

Nishiwaki, M. 1963. Taxonomical considerations on the genera of Delphinidae. Sci. Rep. Whales Res. Inst., 13:85-96.

Nishida, T. and M. Hiraiwa-Hasegawa. 1987. Chimpanzees and bonobos: cooperative relationships among males. In: "Primate Societies", B.B. Smuts, D.L. Cheney, R.M. Seyfarth, R. W. Wrangham, and T.T. Struhsaker, eds., Chicago University Press, Chicago, Ill., pp. 165-177.

Norris, K.S. and T.P. Dohl. 1980. The structure and functions of cetacean schools. In: "Cetacean Behavior, Mechanisims and Functions", L. Herman, ed., John Wiley Interscience, N.Y., pp. 211-261.

Osborne, R.W. 1986. A behavioral budget of Puget Sound Killer Whales. In "The Behavioral Biology of Killer Whales", B. C. Kirkevold and J. Lockard eds., A. R. Liss, New York, N. Y., pp. 211-250.

Ostman, J.S.O. 1985. Changes in aggressive and homosexual behavior among two male bottlenose dolphins (Tursiops truncatus) in a captive colony. Abstract, Sixth Biennial Conference on the Biology of Marine Mammals, The Society for Marine Mammalogy.

Ostman, J. (in press) Postural movements as communication signals in bottlenose dolphins. In: "Dolphin Societies: Methods of Study", K. Pryor and K. Norris eds., University of California Press, Berkeley, Ca.

Perrin, W.F. (ed.). 1982. Report of the workshop on identity, structure, and vital rates of killer whale populations, Cambridge, England, June 23-25, 1981. Rep. Int. Whal. Commn., 32:617-631.

Perrin, W.F., and S.B. Reilly. 1984. Reproductive parameters of dolphins and small whales of the family Delphinidae. In: "Reproduction in whales, dolphins, and porpoises", W. F. Perrin, R. L. Brownell, Jr., and D. P. DeMaster, eds., Rep. Int. Whal. Comm., Special Issue, 6:97-133.

Popp, J.L. 1983. Ecological determinism in the life histories of baboons. Primates, 24(2):198-210.

Pusey, A.E. and C. Packer 1987. Dispersal and philopatry. In: "Primate Societies", B.B. Smuts, D.L. Cheney, R.M. Seyfarth, R. W. Wrangham, and T.T. Struhsaker, eds., Chicago University Press, Chicago, pp. 250-266.

Ralls, K. 1977. Sexual dimorphism in mammals: avian models and unanswered questions. Amer. Nat., 111(981):917-938.

Ray, R.D., M.L. Carlson, M.A. Carlson, T.M. Carlson, and J.D. Upson. 1986. Behavioral and respiratory synchronization quantified in a pair of captive killer whales. In: "The Behavioral Biology of Killer Whales", B. C. Kirkevold and J. Lockard eds., A. R. Liss, New York, N. Y. pp. 187-209.

Rose, N. Personal Communication. Inst. Marine Science, Univ. Calif., Santa Cruz, Calif., 95064.

Sade, D.S. 1965. Some aspects of parent-offspring and sibling relations in a group of rhesus monkeys, with a discussion of grooming. Amer. Jour. Physical Anthropology, 23:1-17.

Schaller, G.B. 1972. "The Serengeti Lion: A Study of Predator-Prey Relations". The University of Chicago Press, Chicago, Ill. 480 pp.

Slijper, E.J. 1962. "Whales". Basic Books, Inc., N. Y., pp. 58-92.

Waite, J.M. 1988. Alloparental care in killer whales (Orcinus orca). Master's thesis, University of California at Santa Cruz, 65 pp.

Walker, L.A., L. Cornell, K.D. Dahl, N.M. Czekala, C.M. Dargen, B. Joseph, A.J.W. Hsueh, and B.L. Lasley. 1988. Urinary concentrations of ovarian steroid hormone metabolites and bioactive in killer whales (Orcinus orca) during ovarian cycles and pregnancy. Biol. Reprod. 39(5):1031-1020.

Wasser, S.K. and D.P. Barash. 1983. Reproductive suppression among female mammals: inplications for bio-medicine and sexual selection theory. Quart. Rev. Biol., 58:513-538.

Wells, R.S. 1986. Structural aspects of dolphin societies. Doctoral thesis, University of California at Santa Cruz, 234 pp.

APPENDIX 1

Annual Indices of Association for A-Pod Individuals During All Active Behaviors

The association indices calculated for each year were arranged into triangular matricies with solo indices placed along the diagonal. The IDs of all individuals within the five A-pods were arranged along both axes of each matrix as subgroups, in the same order as in Table 3. A matching triangular matrix was formed by placing pair totals (Nij) below the diagonal, and individual totals (Ni or Nj) along the bottom line. For example, in the 1980 matrix (Table 6) the index of association for pod A4 individuals A10 and A13 is 545. This was calculated from a pair total (Nij) of 6, and individual totals (Ni and Nj) of 11 for A10 and 11 for A13: 1000(2x6 / 11+11)=545. The solo index for A10 is 181.

Table 6. 1980 association indices among A-pod individuals (above diagonal), solo indices (underlined, along diagonal), pair totals (below diagonal), and individual totals (along bottom).

	Pod A4						Pod A5												
	A11	A35	A13	A24	A10	A4	A9	A26	A5	A8	A42	A28	A14	A15	A25	A23	A29	A27	
A11	0	785	880	740	560	285	0	0	0	0	0	0	0	0	0	0	0	0	A11
A35	11	0	720	518	400	428	0	0	0	0	0	0	46	88	76	0	0	0	A35
A13	11	9	0	750	545	320	0	0	0	0	0	0	0	47	40	0	0	0	A13
A24	10	7	9	153	666	370	0	0	0	0	0	0	0	0	0	0	0	0	A24
A10	7	5	6	8	181	400	0	0	41	0	0	0	0	0	0	0	0	0	A10
A4	4	6	4	5	5	357	0	0	39	0	0	0	46	44	38	54	52	90	A4
A9	0	0	0	0	0	0	0	964	676	36	35	35	70	67	90	0	0	0	A9
A26	0	0	0	0	0	0	27	0	676	36	35	35	70	67	90	0	0	34	A26
A5	0	0	0	0	1	1	22	22	189	31	30	60	60	88	160	33	32	149	A5
A8	0	0	0	0	0	0	1	1	1	37	945	857	107	137	153	0	0	35	A8
A42	0	0	0	0	0	0	1	1	1	26	0	877	105	169	151	0	0	34	A42
A28	0	0	0	0	0	0	1	1	2	24	25	0	103	133	238	38	37	101	A28
A14	0	1	0	0	0	1	2	2	2	3	3	3	68	900	776	76	75	67	A14
A15	0	2	1	0	0	1	2	2	3	4	5	4	27	0	811	74	72	65	A15
A25	0	2	1	0	0	1	3	3	6	5	5	8	26	28	0	163	161	205	A25
A23	0	0	0	0	0	1	0	0	1	0	0	1	2	2	5	0	978	830	A23
A29	0	0	0	0	0	1	0	0	1	0	0	1	2	2	5	23	0	851	A29
A27	0	0	0	0	0	2	0	1	5	1	1	3	2	2	7	22	23	0	A27
TOTAL	14	14	11	13	11	14	28	28	37	27	28	29	29	31	38	23	24	30	

Table 7. 1981 association indices among A-pod individuals (above diagonal), solo indices (underlined, along diagonal), pair totals (below diagonal), and individual totals (along bottom).

	Pod A2						Pod A36				Pod A12				Pod A4					
	A2	A30	A40	A39	A38	A6	A36	A37	A32	A20	A12	A34	A33	A31	A11	A35	A13	A24	A10	A4
A2	428	210	210	216	312	250	52	48	0	0	0	0	0	0	0	0	0	232	243	0
A30	4	0	1000	909	642	611	0	0	0	0	0	0	0	0	0	0	0	153	54	0
A40	4	17	0	909	642	611	0	0	0	0	0	0	0	0	0	0	0	153	54	0
A39	4	15	15	0	666	571	0	58	0	51	0	0	0	0	0	0	0	105	55	0
A38	5	9	9	9	90	466	0	0	0	0	0	0	0	0	0	0	0	60	64	0
A6	5	11	11	10	7	52	0	0	0	47	0	0	0	0	0	0	0	341	51	48
A36	1	0	0	0	0	0	0	918	555	200	0	0	0	0	0	0	0	0	54	0
A37	1	0	0	1	0	0	17	0	512	279	0	0	0	45	0	0	0	0	50	0
A32	0	0	0	0	0	0	10	10	105	190	0	0	0	0	55	55	55	0	0	195
A20	0	0	0	1	0	1	4	6	4	391	0	0	0	0	50	50	50	0	0	88
A12	0	0	0	0	0	0	0	0	0	0	111	764	722	571	0	0	0	0	0	0
A34	0	0	0	0	0	0	0	0	0	0	13	0	647	700	0	0	0	0	0	0
A33	0	0	0	0	0	0	0	0	0	0	13	11	111	428	0	0	0	0	0	0
A31	0	0	0	0	0	0	0	1	0	0	12	14	9	83	48	97	97	0	0	43
A11	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	941	941	307	378	358
A35	0	0	0	0	0	0	0	0	1	1	0	0	0	2	16	0	1000	307	324	307
A13	0	0	0	0	0	0	0	0	1	1	0	0	0	2	16	17	0	307	324	307
A24	5	3	3	2	1	7	0	0	0	0	0	0	0	0	6	6	6	45	523	181
A10	5	1	1	1	1	1	1	1	0	0	0	0	0	0	7	6	6	11	250	190
A4	0	0	0	0	0	1	0	0	4	2	0	0	0	1	7	6	6	4	4	318
A9	1	1	1	1	1	1	0	0	0	1	1	1	3	0	0	0	0	1	0	0
A26	1	1	1	1	1	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0
A5	1	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0
A8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A14	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0
A15	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
A25	1	0	0	0	0	0	2	3	1	0	1	1	1	4	1	1	1	0	0	0
A23	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
A43	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
A27	0	0	0	0	0	0	1	2	4	2	0	0	1	2	0	0	0	0	0	0
TOTAL	21	17	17	16	11	19	17	20	19	23	18	16	18	24	17	17	17	22	20	22

	Pod A5												
	A9	A26	A5	A8	A42	A28	A14	A15	A25	A23	A43	A27	
A2	46	50	47	0	0	0	0	0	37	0	0	0	A2
A30	51	55	52	0	0	0	0	0	0	0	0	0	A30
A40	51	55	52	0	0	0	0	0	0	0	0	0	A40
A39	52	57	54	0	0	0	0	0	0	0	0	0	A39
A38	60	66	62	0	0	0	0	0	0	0	0	0	A38
A6	48	0	50	0	0	0	0	0	0	0	0	0	A6
A36	0	0	0	0	0	0	0	0	80	54	54	47	A36
A37	0	0	0	0	0	0	0	0	113	50	50	88	A37
A32	0	0	0	0	0	0	0	0	38	51	51	181	A32
A20	44	0	0	0	0	0	85	81	0	0	0	83	A20
A12	50	54	0	0	0	0	0	0	39	0	0	0	A12
A34	52	57	0	0	0	0	0	0	40	0	0	0	A34
A33	150	54	0	0	0	0	0	0	39	0	0	46	A33
A31	0	0	44	0	0	0	41	0	140	0	0	81	A31
A11	0	0	0	0	0	0	0	0	40	0	0	0	A11
A35	0	0	0	0	0	0	0	0	40	0	0	0	A35
A13	0	0	0	0	0	0	0	0	40	0	0	0	A13
A24	45	48	46	0	0	0	0	0	0	0	0	0	A24
A10	0	0	0	0	0	0	0	0	0	0	0	0	A10
A4	0	0	0	0	0	0	0	0	0	0	0	0	A4
A9	90	829	418	0	0	0	0	0	0	0	0	0	A9
A26	17	105	450	0	0	0	0	0	0	0	0	0	A26
A5	9	9	476	0	0	0	44	42	0	0	0	0	A5
A8	0	0	0	0	977	857	43	41	36	95	95	85	A8
A42	0	0	0	22	0	880	42	81	71	93	93	83	A42
A28	0	0	0	21	22	0	78	188	233	85	85	115	A28
A14	0	0	1	1	1	2	83	840	491	90	90	81	A14
A15	0	0	1	1	2	5	21	0	644	86	86	78	A15
A25	0	0	0	1	2	7	14	19	60	150	150	275	A25
A23	0	0	0	2	2	2	2	2	4	0	0	666	A23
A43	0	0	0	2	2	2	2	2	4	20	0	666	A43
A27	0	0	0	2	2	3	2	2	8	15	15	0	A27
TOTAL	22	19	21	22	23	27	24	26	33	20	20	25	

Table 8. 1982 association indices among A-pod individuals (above diagonal), solo indices (underlined, along diagonal), pair totals (below diagonal), and individual totals (along bottom).

	Pod A2						Pod A36					Pod A12				Pod A4						Pod A5												
	A2	A30	A40	A39	A38	A6	A36	A46	A37	A32	A20	A12	A34	A33	A31	A11	A35	A13	A24	A10	A4	A9	A26	A5	A8	A42	A28	A14	A15	A25	A23	A43	A27	
A2	230	336	285	170	285	295	38	38	38	19	24	48	24	50	0	146	0	30	191	166	80	0	0	0	0	0	0	0	22	20	25	25	0	A2
A30	16	53	684	646	592	723	32	33	33	33	20	40	20	41	0	20	0	0	22	22	43	21	0	20	0	0	0	19	38	34	20	21	0	A30
A40	13	48	0	694	673	653	33	34	34	34	20	21	63	21	0	0	0	0	0	0	0	22	0	21	0	0	24	19	20	17	21	21	0	A40
A39	7	32	33	69	652	630	36	37	55	37	22	0	23	0	25	0	0	0	0	0	25	25	0	24	26	26	54	21	65	58	23	24	21	A39
A38	13	32	35	31	115	554	33	34	66	34	20	21	85	21	0	0	24	0	0	0	22	22	0	21	0	0	48	19	100	71	43	43	60	A38
A6	13	38	33	29	28	183	17	17	17	17	21	43	21	44	0	21	0	0	24	24	70	23	0	22	0	0	0	20	41	36	22	22	0	A6
A36	2	2	2	2	2	1	60	830	641	553	145	0	0	0	0	165	61	21	80	80	39	0	0	0	0	0	0	34	52	47	37	38	35	A36
A46	2	2	2	2	2	1	54	0	713	593	148	0	18	0	0	130	147	133	61	20	60	0	0	0	0	0	0	35	53	48	57	77	53	A46
A37	2	2	2	3	4	1	42	46	46	434	238	0	18	0	0	111	187	175	60	20	59	0	20	0	0	0	0	0	0	16	54	38	53	A37
A32	1	2	2	2	2	1	36	38	28	140	148	0	0	0	0	74	42	22	0	20	100	0	0	38	0	0	0	53	53	60	38	58	125	A32
A20	1	1	1	1	1	1	8	8	13	8	340	0	0	0	0	22	26	0	25	25	100	0	25	23	26	26	53	43	65	96	94	72	86	A20
A12	2	2	1	0	1	2	0	0	0	0	0	116	705	714	538	0	0	0	0	0	0	0	26	0	0	0	0	0	0	19	71	48	65	A12
A34	1	1	3	1	4	1	0	1	1	0	0	30	71	650	493	0	27	29	0	0	0	0	0	0	0	0	0	21	88	19	48	49	66	A34
A33	2	2	1	0	1	2	0	0	0	0	0	30	27	195	473	0	0	0	0	0	0	0	27	0	0	0	0	0	0	19	48	25	44	A33
A31	0	0	0	1	0	0	0	0	0	0	0	21	19	18	257	0	0	0	0	0	0	0	0	0	0	0	30	0	24	63	78	54	96	A31
A11	6	1	0	0	0	1	9	7	6	4	1	0	0	0	0	116	378	347	623	500	278	0	0	0	0	0	0	0	0	58	0	0	0	A11
A35	0	0	0	0	1	0	3	7	9	2	1	0	1	0	0	14	96	561	307	250	268	0	0	0	0	0	32	0	25	45	0	0	0	A35
A13	1	0	0	0	0	0	1	6	8	1	0	0	1	0	0	12	16	0	300	237	322	0	0	0	0	0	0	0	0	23	0	0	0	A13
A24	7	1	0	0	0	1	4	3	3	0	1	0	0	0	0	24	10	9	147	597	171	0	0	0	0	0	0	0	0	21	0	0	0	A24
A10	6	1	0	0	0	1	4	1	1	1	1	0	0	0	0	19	8	7	20	272	202	0	0	0	0	0	0	0	0	21	0	0	0	A10
A4	3	2	0	1	1	3	2	3	3	5	4	0	0	0	0	11	9	10	6	7	305	0	0	0	0	0	0	0	23	20	0	0	0	A4
A9	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	252	647	506	0	0	0	23	24	63	26	27	24	A9
A26	0	0	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	22	181	465	30	0	0	0	24	43	27	27	24	A26
A5	0	1	1	1	1	1	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	19	17	375	27	0	0	22	22	60	74	50	68	A5
A8	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	62	843	507	98	75	65	82	56	75	A8
A42	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0	539	98	150	130	54	56	50	A42
A28	0	0	1	2	2	0	0	0	0	0	2	0	0	0	1	0	1	0	0	0	0	0	0	0	16	17	44	100	177	197	138	114	177	A28
A14	0	1	1	1	1	1	2	2	0	3	2	0	1	0	0	0	0	0	0	0	0	1	0	1	4	4	4	102	639	513	111	90	82	A14
A15	1	2	1	3	5	2	3	3	0	3	3	0	4	0	1	0	1	0	0	0	1	1	1	1	3	6	7	31	20	500	134	91	166	A15
A25	1	2	1	3	4	2	3	3	1	5	5	1	1	1	3	3	3	1	1	1	1	3	2	3	3	6	9	28	27	66	178	141	203	A25
A23	1	1	1	1	2	1	2	3	3	2	4	3	2	2	3	0	0	0	0	0	0	1	1	3	3	2	5	5	6	9	24	850	696	A23
A43	1	1	1	1	2	1	2	4	2	3	3	2	2	1	2	0	0	0	0	0	0	1	1	2	2	2	4	4	4	7	34	22	735	A43
A27	0	0	0	1	1	0	2	3	3	7	4	3	4	2	4	0	0	0	0	0	0	1	1	3	3	2	7	4	8	11	31	32	41	A27
TOTAL	39	56	52	43	52	49	66	64	65	64	44	43	42	41	35	43	31	26	34	33	36	35	33	40	32	32	31	49	48	60	41	39	48	

Table 9. 1983 association indices among A-pod individuals (above diagonal), solo indices (underlined, along diagonal), pair totals (below diagonal), and individual totals (along bottom).

	Pod A2						Pod A36					Pod A12				Pod A4										Pod A5												
	A2	A30	A40	A39	A38	A6	A36	A46	A37	A32	A20	A12	A34	A33	A31	A11	A48	A35	A13	A24	A45	A10	A47	A4	A9	A26	A5	A8	A42	A28	A14	A15	A25	A23	A43	A27	
A2	105	242	555	58	388	102	86	86	81	78	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	51	0	0	0	A2
A30	4	0	709	482	516	294	48	48	45	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117	0	0	0	A30
A40	10	11	0	250	352	162	45	45	42	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	108	0	0	0	A40
A39	1	7	4	66	312	628	0	0	0	0	93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	114	0	0	0	A39
A38	7	8	6	5	117	270	45	45	42	40	44	0	0	0	0	0	0	0	0	0	0	0	0	0	66	66	0	0	0	0	0	0	54	0	0	0	A38
A6	2	5	3	11	5	150	0	0	0	38	43	0	0	0	0	0	0	0	0	0	0	62	62	54	0	0	0	0	0	0	0	0	100	0	0	0	A6
A36	2	1	1	0	1	0	37	962	526	542	145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0	0	A36
A46	2	1	1	0	1	0	26	0	561	576	181	0	0	0	0	0	0	0	0	0	0	0	0	0	50	50	0	0	0	0	0	0	0	0	0	51	A46
A37	2	1	1	0	1	0	15	16	66	483	448	0	0	45	0	0	0	0	45	0	0	0	0	0	46	46	0	0	0	0	0	0	0	0	0	47	A37
A32	2	1	1	0	1	1	16	17	15	210	166	0	0	43	0	0	0	0	0	0	0	0	0	0	44	44	41	0	0	0	0	0	0	0	0	136	A32
A20	1	0	0	2	1	1	4	5	13	5	392	0	0	0	0	0	0	0	0	0	0	0	0	0	48	0	0	0	0	0	0	0	0	0	0	50	A20
A12	0	0	0	0	0	0	0	0	0	0	0	0	941	782	823	0	0	95	0	100	100	0	0	0	0	0	0	0	0	0	0	0	68	0	0	0	A12
A34	0	0	0	0	0	0	0	0	0	0	0	8	0	727	750	0	0	100	0	105	105	0	0	0	0	0	0	0	0	0	0	0	71	0	0	0	A34
A33	0	0	0	0	0	0	0	0	1	1	0	9	8	0	636	0	0	76	0	80	80	0	0	0	0	74	0	0	0	0	0	0	117	0	0	0	A33
A31	0	0	0	0	0	0	0	0	0	0	0	7	6	7	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A31
A11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	956	695	240	181	181	86	86	0	0	0	0	0	0	0	0	0	0	0	0	0	A11
A48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	750	230	173	173	83	83	0	0	0	0	0	0	0	0	0	0	0	0	0	A48
A35	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	8	9	0	153	434	434	83	83	68	0	0	0	0	0	0	0	0	62	0	0	0	A35
A13	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	3	2	0	0	0	76	76	645	0	0	0	0	0	0	0	0	0	0	0	0	A13
A24	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	2	2	5	0	0	1000	86	86	142	0	0	0	0	0	0	0	0	64	0	0	0	A24
A45	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	2	2	5	0	11	0	86	86	142	0	0	0	0	0	0	0	0	64	0	0	0	A45
A10	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1000	137	0	0	0	0	0	0	0	0	0	0	0	0	A10
A47	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	12	0	137	0	0	0	0	0	0	0	0	0	0	0	0	A47
A4	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	10	2	2	2	2	176	0	0	0	0	0	0	0	0	0	0	0	0	A4
A9	0	0	0	0	1	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	615	689	0	0	0	0	0	60	0	0	80	A9
A26	0	0	0	0	1	0	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	8	76	482	86	86	86	0	0	121	0	0	80	A26
A5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	7	187	76	76	76	0	0	55	80	80	71	A5
A8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1000	800	0	0	66	0	0	0	A8
A42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	10	0	800	0	0	66	0	0	0	A42
A28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	8	8	100	0	0	133	0	0	0	A28
A14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	451	200	200	173	A14
A15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	451	200	200	173	A15
A25	1	2	2	2	1	2	0	0	0	0	0	1	1	2	0	0	0	1	0	1	1	0	0	0	1	2	1	1	1	2	7	7	50	206	206	187	A25
A23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	2	3	0	1000	666	A23
A43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	2	2	3	7	7	83	A43
A27	0	0	0	0	0	0	0	1	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	2	2	3	9	9	12	A27
TOTAL	19	14	17	15	17	20	27	27	30	32	28	9	8	14	8	11	12	12	14	11	11	12	12	17	13	13	16	10	10	10	11	11	20	9	9	12	

Table 10. 1984 association indices among A-pod individuals (above diagonal), solo indices (underlined, along diagonal), pair totals (below diagonal), and individual totals (along bottom).

	Pod A2					Pod A36					Pod A12				Pod A4							Pod A5												
	A2	A30	A50	A39	A38	A6	A36	A46	A37	A32	A20	A12	A34	A33	A31	A11	A48	A35	A13	A24	A45	A4	A9	A26	A5	A8	A42	A28	A14	A15	A25	A23	A43	A27	
A2	259	240	240	83	400	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	95	95	46	0	0	41	48	47	0	A2
A30	6	86	913	454	274	318	0	0	0	0	0	52	0	0	51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	0	0	A30
A50	6	21	0	500	313	318	0	0	0	0	0	105	0	0	102	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	0	0	A50
A39	2	10	11	47	244	714	0	41	0	0	0	111	0	52	108	0	0	0	0	0	0	0	47	52	0	0	0	0	0	0	47	0	0	0	A39
A38	11	7	8	6	71	244	0	36	0	0	0	0	0	0	45	60	60	64	58	0	0	60	0	0	80	46	46	0	0	47	122	0	0	95	A38
A6	3	7	7	15	6	47	0	41	0	0	0	0	0	52	0	0	0	83	74	0	0	0	0	52	0	0	0	0	0	0	47	0	0	0	A6
A36	0	0	0	0	0	0	0	920	612	723	244	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	0	0	A36
A46	0	0	0	1	1	1	23	0	641	705	226	0	0	0	0	0	0	66	60	0	0	0	0	0	0	0	0	0	0	0	41	0	0	0	A46
A37	0	0	0	0	0	0	15	17	0	560	384	0	0	0	0	0	0	68	62	0	0	0	0	0	0	0	0	0	0	0	42	0	0	100	A37
A32	0	0	0	0	0	0	17	18	14	166	160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44	0	0	52	A32
A20	0	0	0	0	0	0	6	6	10	4	538	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47	0	0	0	0	0	0	A20
A12	0	1	2	2	0	0	0	0	0	0	0	0	814	500	774	100	100	0	0	0	0	0	0	0	0	66	66	0	0	0	0	0	0	0	A12
A34	0	0	0	0	0	0	0	0	0	0	0	11	0	482	785	0	0	0	0	0	0	0	0	0	0	74	74	0	0	0	0	0	0	0	A34
A33	0	0	0	1	0	1	0	0	0	0	0	8	7	117	424	0	0	100	86	0	0	90	157	176	51	0	0	60	0	0	52	0	0	0	A33
A31	0	1	2	2	1	0	0	0	0	0	0	12	11	7	125	0	0	0	0	0	0	0	0	0	0	64	64	0	0	0	0	0	0	0	A31
A11	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1000	0	0	200	200	0	0	0	0	0	0	0	0	0	0	0	0	0	A11
A48	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	5	0	0	0	200	200	0	0	0	0	0	0	0	0	0	0	0	0	0	A48
A35	0	0	0	0	1	1	0	1	1	0	0	0	0	1	0	0	0	0	666	0	0	0	0	100	80	0	0	0	0	0	0	0	0	0	A35
A13	0	0	0	0	1	1	0	1	1	0	0	0	0	1	0	0	0	3	0	0	0	545	0	86	71	0	0	0	0	0	0	0	0	0	A13
A24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	A24
A45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A45
A4	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A4
A9	0	0	0	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	190	736	604	222	222	216	0	0	47	0	0	0	A9
A26	0	0	0	1	0	1	0	0	0	0	0	0	0	3	0	0	0	1	1	0	0	0	14	58	564	250	250	242	0	0	0	0	0	0	A26
A5	0	0	0	0	2	0	0	0	0	0	0	0	0	3	0	0	0	1	1	0	0	0	13	11	181	270	270	315	0	0	0	0	0	55	A5
A8	2	0	0	0	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	4	4	5	0	1000	709	0	0	0	0	0	0	A8
A42	2	0	0	0	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	4	4	5	15	0	709	0	0	0	0	0	0	A42
A28	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	4	4	6	11	11	0	0	0	0	0	0	0	A28
A14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	923	545	230	222	230	A14
A15	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	571	214	275	285	A15
A25	1	1	1	1	3	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	9	10	0	171	222	342	A25
A23	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	0	965	500	A23
A43	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	4	14	0	551	A43
A27	0	0	0	0	2	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	4	6	7	8	0	A27
TOTAL	27	23	23	21	28	21	23	27	26	24	26	15	12	17	16	5	5	3	6	5	5	5	21	17	22	15	15	16	12	14	21	14	15	14	

Table 11. 1985 association indices among A-pod individuals (above diagonal), solo indices (underlined, along diagonal), pair totals (below diagonal), and individual totals (along bottom).

	Pod A2						Pod A36					Pod A12			
	A2	A30	A50	A39	A38	A6	A36	A46	A37	A32	A20	A12	A34	A33	A31
A2	400	311	279	243	255	285	52	52	52	52	105	62	66	57	64
A30	7	0	958	652	538	595	0	0	0	0	0	108	114	50	111
A50	6	23	0	681	560	577	0	0	0	0	0	114	121	52	117
A39	5	15	15	95	583	511	0	0	0	0	0	121	129	111	125
A38	6	14	14	14	111	530	0	0	0	0	0	102	108	47	105
A6	6	14	13	11	13	90	0	0	0	0	0	58	62	108	60
A36	1	0	0	0	0	0	0	1000	666	833	333	0	0	0	0
A46	1	0	0	0	0	0	18	0	666	833	333	0	0	0	0
A37	1	0	0	0	0	0	12	12	0	722	388	0	0	0	0
A32	1	0	0	0	0	0	15	15	13	55	277	0	0	0	0
A20	2	0	0	0	0	0	6	6	7	5	111	0	0	0	0
A12	1	2	2	2	2	1	0	0	0	0	0	0	909	740	782
A34	1	2	2	2	2	1	0	0	0	0	0	10	0	640	761
A33	1	1	1	2	1	2	0	0	0	0	0	10	8	66	692
A31	1	2	2	2	2	1	0	0	0	0	0	9	8	9	90
A11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A9	0	3	3	1	1	1	0	0	0	0	0	0	0	0	0
A26	0	2	2	2	4	2	0	0	2	1	0	0	0	0	0
A5	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0
A8	0	3	3	2	0	0	0	0	0	0	2	0	0	0	0
A42	0	3	3	2	0	0	0	0	1	0	2	0	0	0	0
A28	0	3	3	1	0	1	0	0	0	0	6	0	0	0	0
A14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A15	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
A25	0	2	2	0	0	1	0	0	1	0	1	0	0	0	0
A23	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0
A43	2	0	0	0	0	0	0	0	1	0	2	0	0	0	0
A27	1	1	1	1	2	1	0	0	0	0	2	0	0	1	0
TOTAL	20	25	23	21	27	22	18	18	18	18	18	12	10	15	11

	Pod A4						Pod A5											
	A11	A48	A35	A13	A24	A49	A45	A9	A26	A5	A8	A42	A28	A14	A15	A25	A23	A43	A27
A2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	171	117	52
A30	0	0	0	0	0	0	0	157	95	48	146	150	125	0	0	88	0	0	46
A50	0	0	0	0	0	0	0	166	100	51	153	157	130	0	0	93	0	0	48
A39	0	0	0	0	0	0	0	58	105	54	108	111	45	0	0	0	0	0	51
A38	0	0	0	0	0	0	0	50	181	0	0	0	0	0	0	0	0	0	88
A6	0	0	0	0	0	0	0	57	102	0	0	0	44	0	0	47	0	0	50
A36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A37	0	0	0	0	0	0	0	0	114	0	0	60	0	0	66	52	0	62	0
A32	0	0	0	0	0	0	0	0	57	0	0	0	0	0	66	0	0	0	0
A20	0	0	0	0	0	0	0	0	0	58	117	121	292	0	0	52	121	125	111
A12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60
A31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A11	0	1000	666	461	333	333	363	0	0	0	0	0	0	0	0	0	0	0	0
A48	6	0	666	461	333	333	363	0	0	0	0	0	0	0	0	0	0	0	0
A35	4	4	166	615	500	500	363	0	0	0	0	0	68	0	0	76	0	0	0
A13	3	3	4	0	461	461	333	0	0	0	0	0	266	0	0	296	0	0	0
A24	2	2	3	3	0	1000	909	0	0	0	0	0	68	0	111	76	0	0	0
A49	2	2	3	3	6	0	909	0	0	0	0	0	68	0	111	76	0	0	0
A45	2	2	2	2	5	5	0	0	0	0	0	0	71	0	117	80	0	0	0
A9	0	0	0	0	0	0	0	0	666	620	206	142	166	80	0	121	0	0	64
A26	0	0	0	0	0	0	0	10	58	464	181	187	150	68	68	162	0	64	114
A5	0	0	0	0	0	0	0	9	8	187	250	193	102	71	0	55	64	66	117
A8	0	0	0	0	0	0	0	3	3	4	0	903	615	142	71	222	64	66	58
A42	0	0	0	0	0	0	0	2	3	3	14	0	578	74	74	228	66	137	60
A28	0	0	1	4	1	1	1	3	3	2	12	11	0	57	57	511	105	108	146
A14	0	0	0	0	0	0	0	1	1	1	2	1	1	0	833	437	148	76	133
A15	0	0	0	0	1	1	1	0	1	0	1	1	1	10	0	312	148	76	133
A25	0	0	1	4	1	1	1	2	3	1	4	4	11	7	5	0	228	294	263
A23	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2	2	4	0	727
A43	0	0	0	0	0	0	0	0	1	1	1	2	2	1	1	5	13	0	687
A27	0	0	0	0	0	0	0	1	2	2	1	1	3	2	2	5	12	11	0
TOTAL	6	6	6	7	6	6	5	13	17	16	16	15	23	12	12	20	15	14	18

Table 12. 1986 association indices among A-pod individuals (above diagonal), solo indices (underlined, along diagonal), pair totals (below diagonal), and individual totals (along bottom).

	Pod A2						Pod A36					Pod A12				Pod A4							Pod A9						Pod A14							
	A2	A30	A50	A39	A38	A6	A36	A46	A37	A32	A20	A12	A34	A33	A31	A11	A48	A35	A13	A24	A49	A45	A9	A26	A5	A8	A42	A28	A14	A15	A25	A51	A23	A43	A27	
A2	192	285	280	290	416	235	40	40	42	39	37	125	81	81	80	0	0	0	0	0	0	0	44	0	0	0	0	0	0	0	0	0	280	285	145	A2
A30	8	0	950	474	461	581	0	0	0	0	0	38	188	37	37	0	0	0	0	0	0	0	0	41	0	37	37	38	76	72	72	72	37	37	33	A30
A50	8	29	0	466	452	535	0	0	0	0	0	75	259	37	36	0	0	0	0	0	0	0	0	40	0	37	37	37	75	71	71	71	36	37	33	A50
A39	8	14	14	137	392	518	0	0	0	37	0	39	76	230	37	0	0	0	0	0	0	0	0	42	0	0	0	0	78	74	37	37	37	38	68	A39
A38	10	12	12	10	90	425	0	0	46	0	0	45	88	88	86	0	0	0	0	0	0	0	0	0	0	0	0	0	45	85	42	42	43	44	117	A38
A6	6	16	15	14	10	120	0	0	86	0	0	42	83	83	40	0	0	0	0	0	0	0	0	0	0	41	41	42	85	120	40	40	0	0	74	A6
A36	1	0	0	0	0	0	0	956	727	791	156	0	0	0	0	0	0	76	0	71	71	71	0	0	0	0	0	0	44	0	0	0	85	86	38	A36
A46	1	0	0	0	0	0	22	0	727	750	156	0	0	0	0	0	0	76	0	71	71	71	0	0	0	0	0	0	44	41	0	0	85	86	115	A46
A37	1	0	0	0	1	2	16	16	47	652	163	0	0	45	0	0	0	83	0	76	76	76	0	51	0	0	0	0	0	66	0	0	88	90	120	A37
A32	1	0	0	1	0	0	19	18	15	80	150	0	0	0	0	0	0	71	0	66	66	66	0	0	0	0	0	0	42	0	0	0	122	83	74	A32
A20	1	0	0	0	0	0	4	4	4	4	392	0	0	0	0	0	0	0	0	0	0	0	0	0	0	196	196	320	40	37	37	37	76	117	105	A20
A12	3	1	2	1	1	1	0	0	0	0	0	45	755	577	652	0	0	0	0	0	0	0	0	0	0	44	44	0	0	0	0	0	0	0	0	A12
A34	2	5	7	2	2	2	0	0	0	0	0	17	0	521	553	0	0	0	0	0	0	0	0	0	0	43	43	0	0	0	0	0	0	0	0	A34
A33	2	1	1	6	2	2	0	0	1	0	0	13	12	43	638	0	0	0	0	0	0	0	0	0	0	43	43	0	0	0	0	0	0	0	0	A33
A31	2	1	1	1	2	1	0	0	0	0	0	15	13	15	125	0	0	0	0	0	0	0	0	0	0	42	42	0	0	0	0	0	0	0	37	A31
A11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	333	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A11
A48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	333	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A48
A35	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	0	333	500	500	500	0	0	0	0	0	0	0	0	0	0	0	0	0	A35
A13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A13
A24	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	2	0	0	1000	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	A24
A49	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	2	0	5	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	A49
A45	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	2	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A45
A9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	105	756	700	190	190	146	0	0	0	0	46	47	0	A9
A26	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	14	55	615	195	195	150	0	46	0	0	47	46	42	A26
A5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	12	238	227	227	186	46	43	43	43	44	45	0	A5
A8	0	1	1	0	0	1	0	0	0	0	5	1	1	1	1	0	0	0	0	0	0	0	4	4	5	0	956	800	0	0	0	0	0	0	0	A8
A42	0	1	1	0	0	1	0	0	0	0	5	1	1	1	1	0	0	0	0	0	0	0	4	4	5	22	0	800	0	0	0	0	0	0	0	A42
A28	0	1	1	0	0	1	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	3	3	4	18	18	0	0	42	0	0	0	0	0	A28
A14	0	2	2	2	1	2	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	227	595	638	638	260	266	196	A14
A15	0	2	2	2	2	3	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	14	0	760	760	204	250	370	A15
A25	0	2	2	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	15	19	0	1000	244	291	222	A25
A51	0	2	2	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	15	19	25	0	244	291	222	A51
A23	7	1	1	1	1	0	2	2	2	3	2	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	6	5	6	6	83	936	803	A23
A43	7	1	1	1	1	0	2	2	2	2	3	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	6	6	7	7	22	0	653	A43
A27	4	1	1	2	3	2	1	3	3	2	3	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	5	10	6	6	16	17	0	A27
TOTAL	26	30	31	29	22	25	23	23	21	25	28	22	23	23	24	3	3	3	3	5	5	5	19	18	21	23	23	22	22	25	25	25	24	23	29	

APPENDIX 2

Annual Indices of Association and Single-Linkage Cluster-Analysis Dendrograms for A-Pod Individuals During Foraging

(Note: see Appendix 1, page 93, for description of matrix format.)

Table 13. 1980 association indices among A-pod individuals during foraging (above diagonal), solo indices (underlined, along diagonal), pair totals (below diagonal), and individual totals (along bottom) (pods A2, A12, and A36 were omitted due to only one sighting).

	Pod A4						Pod A5												
	A11	A35	A13	A24	A10	A4	A9	A26	A5	A8	A42	A28	A14	A15	A25	A23	A29	A27	
A11	0	800	1000	1000	400	333	0	0	0	0	0	0	0	0	0	0	0	0	A11
A35	2	0	800	800	500	400	0	0	0	0	0	0	133	133	142	0	0	0	A35
A13	3	2	0	1000	400	333	0	0	0	0	0	0	0	0	0	0	0	0	A13
A24	3	2	3	0	400	333	0	0	0	0	0	0	0	0	0	0	0	0	A24
A10	1	1	1	1	500	400	0	0	111	0	0	0	0	0	0	0	0	0	A10
A4	1	1	1	1	1	666	0	0	0	0	0	0	0	0	0	0	0	0	A4
A9	0	0	0	0	0	0	0	965	645	0	0	0	0	0	0	0	0	0	A9
A26	0	0	0	0	0	0	14	0	600	0	0	0	0	0	0	0	0	0	A26
A5	0	0	0	0	1	0	10	9	312	0	0	0	0	0	0	0	0	0	A5
A8	0	0	0	0	0	0	0	0	0	0	1000	1000	166	166	173	0	0	0	A8
A42	0	0	0	0	0	0	0	0	0	11	0	1000	166	166	173	0	0	0	A42
A28	0	0	0	0	0	0	0	0	0	11	11	0	166	166	173	0	0	0	A28
A14	0	1	0	0	0	0	0	0	0	2	2	2	0	1000	960	0	0	0	A14
A15	0	1	0	0	0	0	0	0	0	2	2	2	13	0	960	0	0	0	A15
A25	0	1	0	0	0	0	0	0	0	2	2	2	12	12	0	0	0	0	A25
A23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	923	923	A23
A29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	1000	A29
A27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	7	0	A27
TOTAL	3	2	3	3	2	3	15	14	16	11	11	11	13	13	12	6	7	7	

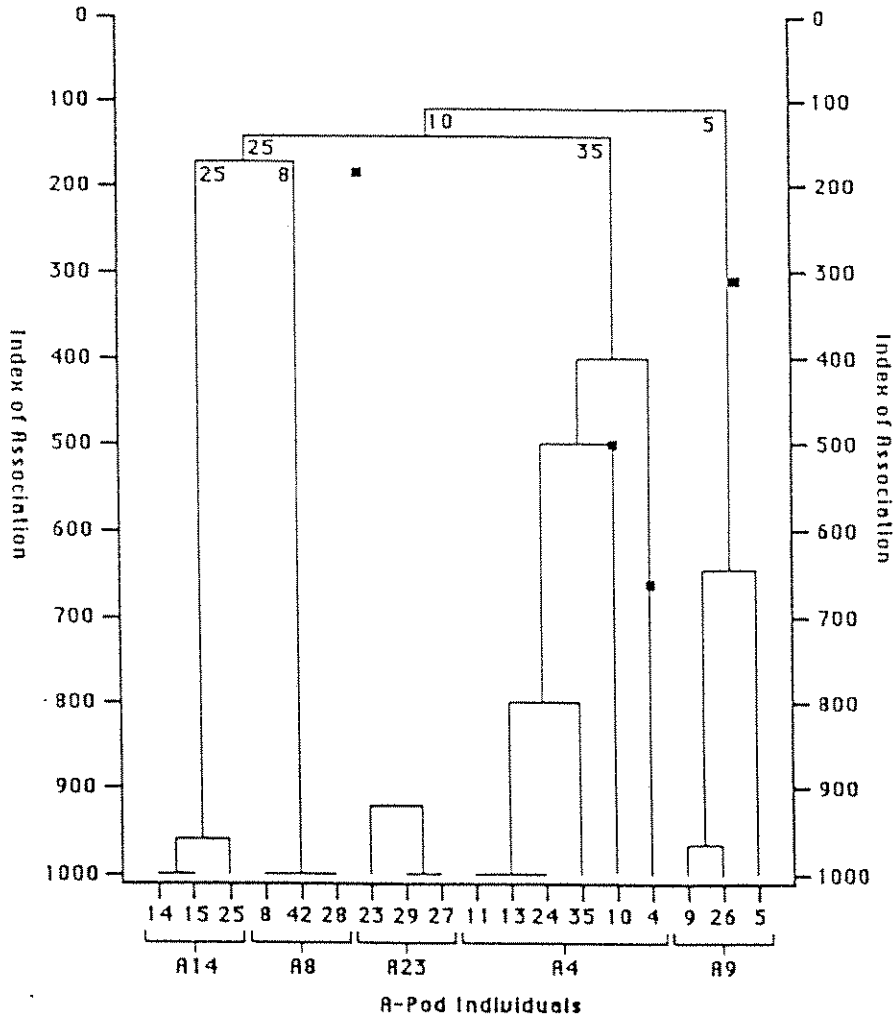

Figure 26. Cluster-analysis dendrogram of 1980 associations among A-pod individuals during foraging (pods A2, A12, and A36 were omitted due to only one sighting), and solo indices (squares). Identity numbers of individuals linking clusters are shown.

Table 14. 1981 association indices among A-pod individuals during foraging (above diagonal), solo indices (underlined, along diagonal), pair totals (below diagonal), and individual totals (along bottom).

	Pod A2						Pod A36				Pod A12				Pod A4						Pod A5												
	A2	A30	A40	A39	A38	A6	A34	A37	A32	A20	A12	A34	A33	A31	A11	A35	A13	A24	A10	A4	A9	A26	A5	A8	A42	A28	A14	A15	A25	A23	A43	A27	
A2	400	133	133	133	266	250	0	0	0	0	0	0	0	0	0	0	0	300	200	0	95	100	66	0	0	0	0	0	0	0	0	0	A2
A30	1	0	1000	800	600	363	0	0	0	0	0	0	0	0	0	0	0	0	0	0	125	133	111	0	0	0	0	0	0	0	0	0	A30
A40	1	5	0	800	600	363	0	0	0	0	0	0	0	0	0	0	0	0	0	0	125	133	111	0	0	0	0	0	0	0	0	0	A40
A39	1	4	4	0	600	363	0	166	0	166	0	0	0	0	0	0	0	0	0	0	125	133	111	0	0	0	0	0	0	0	0	0	A39
A38	2	3	3	3	200	363	0	0	0	0	0	0	0	0	0	0	0	0	0	0	125	133	111	0	0	0	0	0	0	0	0	0	A38
A6	2	2	2	2	2	166	0	0	0	0	0	0	0	0	0	0	0	250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A6
A36	0	0	0	0	0	0	0	923	727	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A36
A37	0	0	0	1	0	0	4	0	666	142	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A37
A32	0	0	0	0	0	0	4	4	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A32
A20	0	0	0	1	0	0	0	1	0	714	0	0	0	0	0	0	0	0	0	133	0	0	0	0	0	0	0	0	0	0	0	0	A20
A12	0	0	0	0	0	0	0	0	0	0	200	666	631	666	0	0	0	0	0	0	0	0	0	0	0	0	0	0	83	0	0	0	A12
A34	0	0	0	0	0	0	0	0	0	0	6	0	588	842	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90	0	0	0	A34
A33	0	0	0	0	0	0	0	0	0	0	6	5	222	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84	0	0	0	A33
A31	0	0	0	0	0	0	0	0	0	0	7	8	5	90	0	0	0	0	0	0	0	0	0	0	0	0	83	0	80	0	0	0	A31
A11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	1000	500	500	285	0	0	0	0	0	0	0	0	0	0	0	0	A11
A35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	1000	500	500	285	0	0	0	0	0	0	0	0	0	0	0	0	A35
A13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	0	500	500	285	0	0	0	0	0	0	0	0	0	0	0	0	A13
A24	3	0	0	0	0	2	0	0	0	0	0	0	0	0	4	4	4	100	400	111	95	100	66	0	0	0	0	0	0	0	0	0	A24
A10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	4	400	111	0	0	0	0	0	0	0	0	0	0	0	0	A10
A4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	2	2	1	1	625	0	0	0	0	0	0	0	0	0	0	0	0	A4
A9	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	161	761	250	0	0	0	0	0	0	0	0	0	A9
A26	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	8	200	260	0	0	0	0	0	0	0	0	0	A26
A5	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	3	615	0	0	0	76	76	0	0	0	0	A5
A8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	956	860	0	0	0	100	100	100	A8
A42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	923	0	80	74	95	95	95	A42
A28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	12	0	74	148	214	86	86	86	A28
A14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	76	646	592	181	181	181	A14
A15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	11	0	740	181	181	181	A15
A25	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	3	8	10	71	260	260	260	A25
A23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	3	0	1000	1000	A23
A43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	3	9	0	1000	A43
A27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	3	9	9	0	A27
TOTAL	10	5	5	5	5	6	6	7	5	7	10	8	9	11	6	6	6	10	10	8	11	10	13	11	12	14	13	13	14	9	9	9	

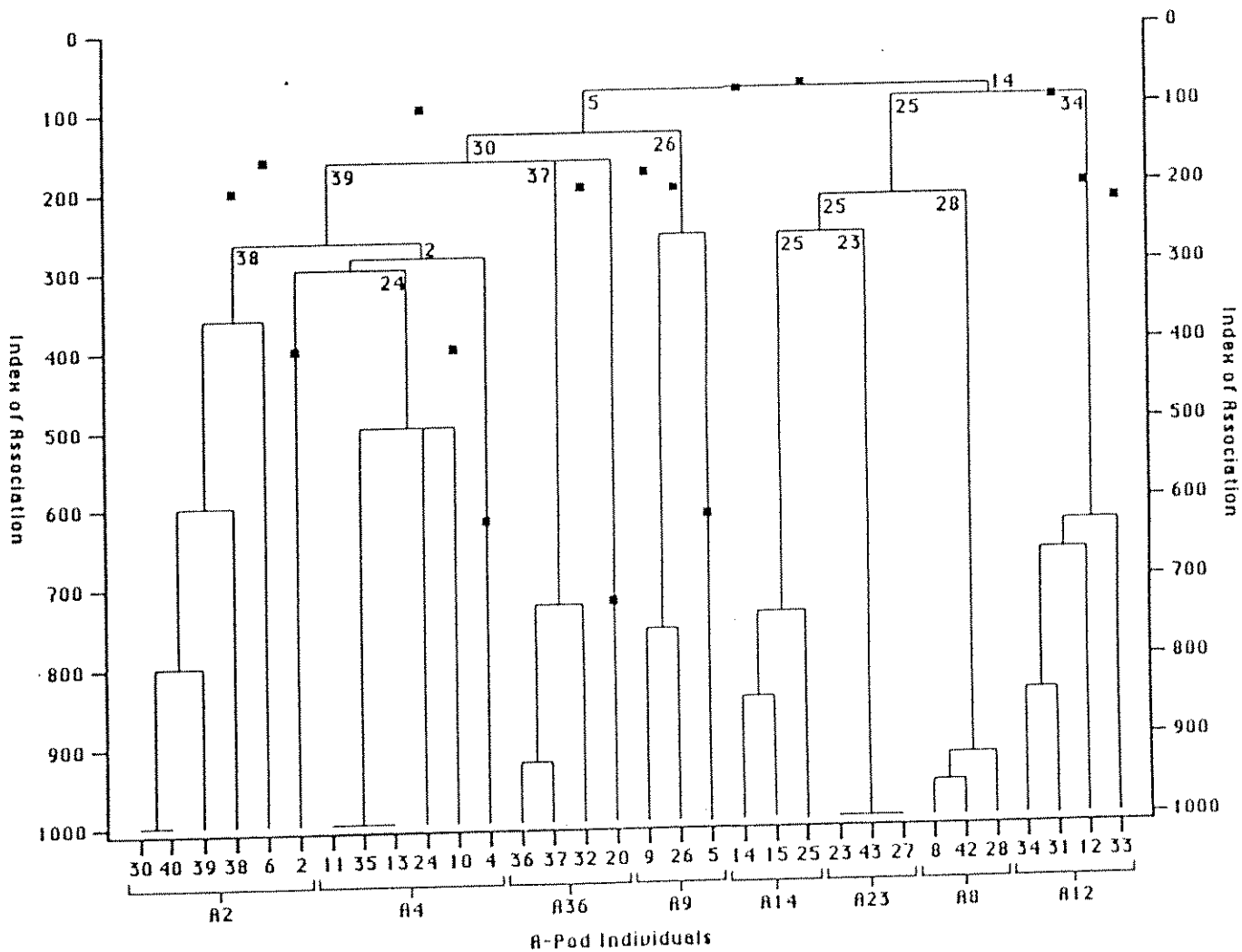

Figure 27. Cluster-analysis dendrogram of 1981 associations among A-pod individuals during foraging and solo indices (squares). Identity numbers of individuals linking clusters are shown.

Table 15. 1982 association indices among A-pod individuals during foraging (above diagonal), solo indices (underlined, along diagonal), pair totals (below diagonal), and individual totals (along bottom).

	Pod A2						Pod A36					Pod A12				Pod A4						Pod A5												
	A2	A30	A40	A39	A38	A6	A36	A46	A37	A32	A20	A12	A34	A33	A31	A11	A35	A13	A24	A10	A4	A9	A26	A5	A8	A42	A28	A14	A15	A25	A23	A43	A27	
A2	250	250	205	171	294	210	48	52	48	51	0	100	55	102	0	148	0	86	206	214	0	0	0	0	0	0	0	0	0	0	0	0	0	A2
A30	5	41	936	556	571	652	0	0	0	0	0	83	45	85	0	0	0	0	0	0	0	55	0	57	0	0	0	57	55	47	0	0	0	A30
A40	4	22	0	571	634	622	0	0	0	0	0	42	46	43	0	0	0	0	0	0	0	57	0	58	0	0	0	58	57	48	0	0	0	A40
A39	3	12	12	152	540	585	0	0	0	0	0	0	0	0	55	0	0	0	0	0	0	64	0	66	66	68	68	66	64	54	0	0	0	A39
A38	5	12	13	10	166	550	0	0	0	0	0	47	52	48	0	0	0	0	0	0	0	66	0	68	0	0	0	68	66	55	0	0	0	A38
A6	4	15	14	12	11	272	0	0	0	0	0	86	47	88	0	0	0	0	0	0	0	58	0	60	0	0	0	60	58	50	0	0	0	A6
A36	1	0	0	0	0	0	40	851	680	375	93	0	0	0	0	111	58	62	105	162	0	0	0	0	0	0	0	0	0	0	100	108	102	A36
A46	1	0	0	0	0	0	20	0	680	466	100	0	0	0	0	60	64	68	57	58	0	0	0	0	0	0	0	0	0	0	104	117	111	A46
A37	1	0	0	0	0	0	17	16	120	333	279	0	0	0	0	55	56	62	52	54	0	0	54	0	0	0	0	0	0	46	150	108	153	A37
A32	1	0	0	0	0	0	9	11	8	260	146	0	0	0	0	0	0	0	0	0	62	0	0	0	0	0	0	0	0	97	105	114	162	A32
A20	0	0	0	0	0	0	2	2	6	3	500	0	0	0	0	0	0	0	0	0	0	0	66	68	0	0	0	0	0	0	183	133	125	A20
A12	2	2	1	0	1	2	0	0	0	0	0	164	636	638	439	0	0	0	0	0	0	0	55	0	0	0	0	0	0	47	153	111	157	A12
A34	1	1	1	0	1	1	0	0	0	0	0	14	150	604	378	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	114	125	117	A34
A33	2	2	1	0	1	2	0	0	0	0	0	15	13	260	350	0	0	0	0	0	0	0	57	0	0	0	0	0	0	48	105	57	108	A33
A31	0	0	0	1	0	0	0	0	0	0	0	9	7	7	294	0	0	0	0	0	0	0	0	0	0	0	0	0	0	114	187	137	193	A31
A11	2	0	0	0	0	0	2	1	1	0	0	0	0	0	0	90	500	333	666	521	100	0	0	0	0	0	0	0	0	0	0	0	0	A11
A35	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	5	222	500	363	190	111	0	0	0	0	0	0	0	0	0	0	0	0	A35
A13	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	3	4	0	300	210	250	0	0	0	0	0	0	0	0	0	0	0	0	A13
A24	3	0	0	0	0	0	2	1	1	0	0	0	0	0	0	8	4	3	153	640	0	0	0	0	0	0	0	0	0	0	0	0	0	A24
A10	3	0	0	0	0	0	3	1	1	0	0	0	0	0	0	6	2	2	8	250	0	0	0	0	0	0	0	0	0	0	0	0	0	A10
A4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	2	0	0	555	0	0	0	0	0	0	0	0	0	0	0	0	A4
A9	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	500	500	434	0	0	0	0	0	66	0	0	0	A9
A26	0	0	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	8	250	608	0	0	0	0	0	44	0	0	0	A26
A5	0	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5	7	163	0	0	0	0	0	68	0	0	0	A5
A8	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90	857	571	90	86	68	0	0	0	A8
A42	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	500	95	181	142	0	0	0	A42
A28	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	5	0	190	363	357	80	0	83	A28
A14	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	181	608	413	0	0	0	A14
A15	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	4	7	8	533	74	0	76	A15
A25	0	1	1	1	1	1	0	0	1	2	0	1	0	1	2	0	0	0	0	0	0	1	1	1	1	2	5	6	8	55	181	66	250	A25
A23	0	0	0	0	0	0	2	2	3	2	3	3	2	2	3	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3	0	814	827	A23
A43	0	0	0	0	0	0	2	2	2	2	2	2	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	11	63	769	A43
A27	0	0	0	0	0	0	2	2	3	3	2	3	2	2	3	0	0	0	0	0	0	0	0	0	0	0	1	0	1	4	12	10	0	A27
TOTAL	16	24	23	19	18	22	25	22	25	23	18	24	20	23	17	11	9	7	13	12	9	12	12	11	11	10	10	11	12	18	15	12	14	

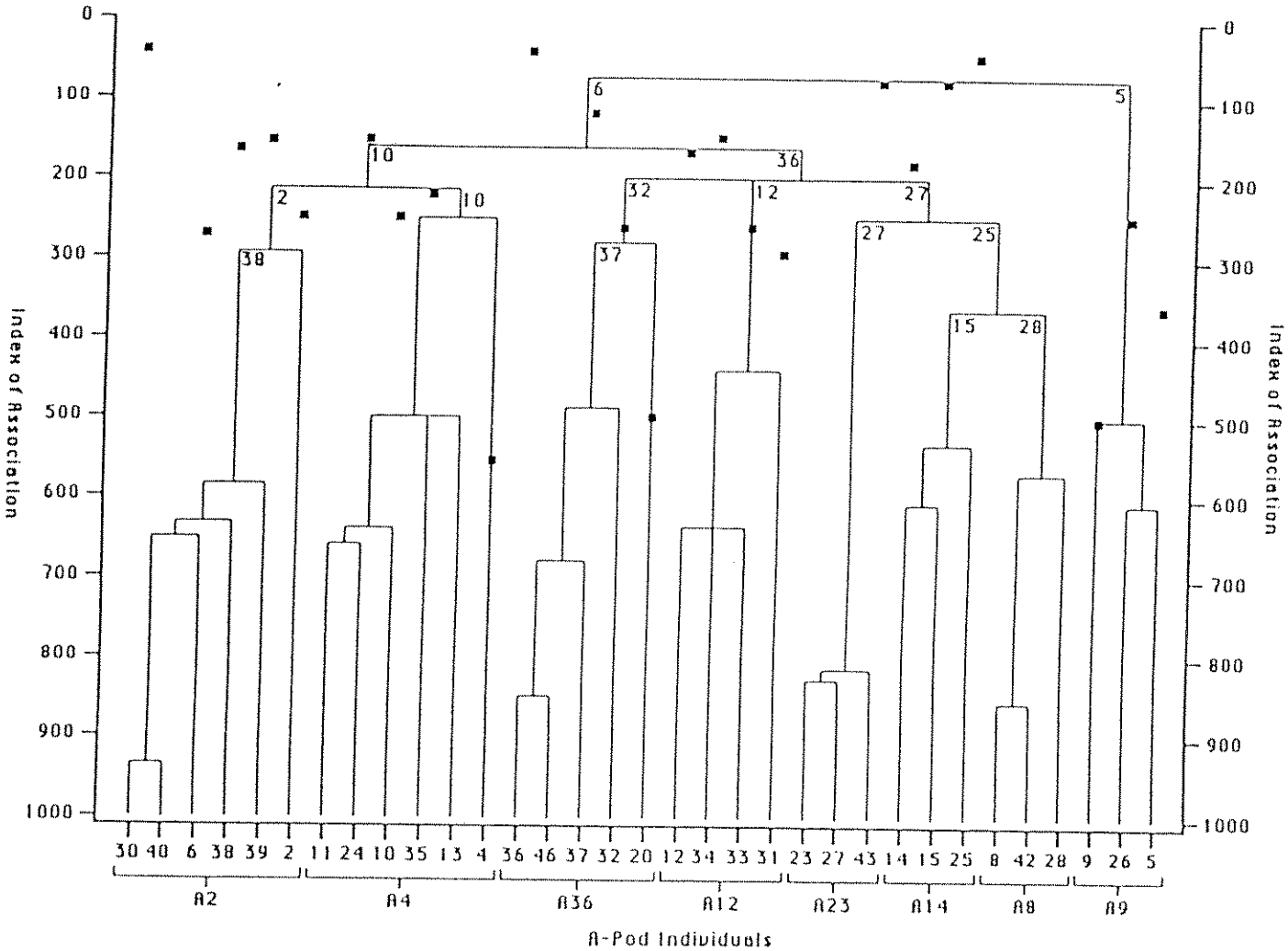

Figure 28. Cluster-analysis dendrogram of 1982 associations among A-pod individuals during foraging and solo indices (squares). Identity numbers of individuals linking clusters are shown.

Table 16. 1983 association indices among A-pod individuals during foraging (above diagonal), solo indices (underlined, along diagonal), pair totals (below diagonal), and individual totals (along bottom).

	Pod A2						Pod A36					Pod A12				Pod A4										Pod A5												
	A2	A30	A40	A39	A38	A6	A36	A46	A37	A32	A20	A12	A34	A33	A31	A11	A48	A35	A13	A24	A45	A10	A47	A4	A9	A26	A5	A8	A42	A28	A14	A15	A25	A23	A43	A27	
A2	125	0	266	0	375	111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A2
A30	0	0	769	615	428	250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	142	0	0	0	A30
A40	2	5	0	428	266	235	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	133	0	0	0	A40
A39	0	4	3	142	266	470	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	133	0	0	0	A39
A38	3	3	2	2	125	333	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A38
A6	1	2	2	4	3	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117	117	100	0	0	0	0	0	0	0	0	111	0	0	0	A6
A36	0	0	0	0	0	0	0	1000	560	592	160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	125	0	0	0	0	0	0	0	0	0	0	A36
A46	0	0	0	0	0	0	12	0	560	592	160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	125	0	0	0	0	0	0	0	0	0	0	A46
A37	0	0	0	0	0	0	7	7	74	428	461	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117	0	0	0	0	0	0	0	0	0	0	A37
A32	0	0	0	0	0	0	8	8	6	266	214	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	95	0	0	0	0	0	0	0	0	0	A32
A20	0	0	0	0	0	0	2	2	6	3	461	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A20
A12	0	0	0	0	0	0	0	0	0	0	0	0	888	1000	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A12
A34	0	0	0	0	0	0	0	0	0	0	0	4	0	888	888	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A34
A33	0	0	0	0	0	0	0	0	0	0	0	5	4	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A33
A31	0	0	0	0	0	0	0	0	0	0	0	5	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A31
A11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	923	769	142	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A11
A48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	857	133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A48
A35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	6	0	133	153	153	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A35
A13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	777	0	0	0	0	0	0	0	0	0	0	0	0	A13
A24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A24
A45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A45
A10	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	117	0	0	0	0	0	0	0	0	0	0	0	0	A10
A47	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	117	0	0	0	0	0	0	0	0	0	0	0	0	A47
A4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	3	1	200	0	0	0	0	0	0	0	0	0	0	0	0	A4
A9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	600	0	0	0	0	0	0	0	0	0	A9
A26	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	600	0	0	0	0	0	0	0	0	0	A26
A5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	166	0	0	0	0	0	0	200	200	200	A5
A8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	666	0	0	0	0	0	0	A8
A42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	666	0	0	0	0	0	0	A42
A28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	166	0	0	142	0	0	0	A28
A14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	571	0	0	0	A14
A15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	571	0	0	0	A15
A25	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	166	166	166	A25
A23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1000	750	A23
A43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	4	0	750	A43
A27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	3	3	250	A27
TOTAL	8	6	7	7	8	10	12	12	13	15	13	5	4	5	5	4	7	7	8	6	6	7	7	10	4	4	6	6	6	6	6	6	8	4	4	4	

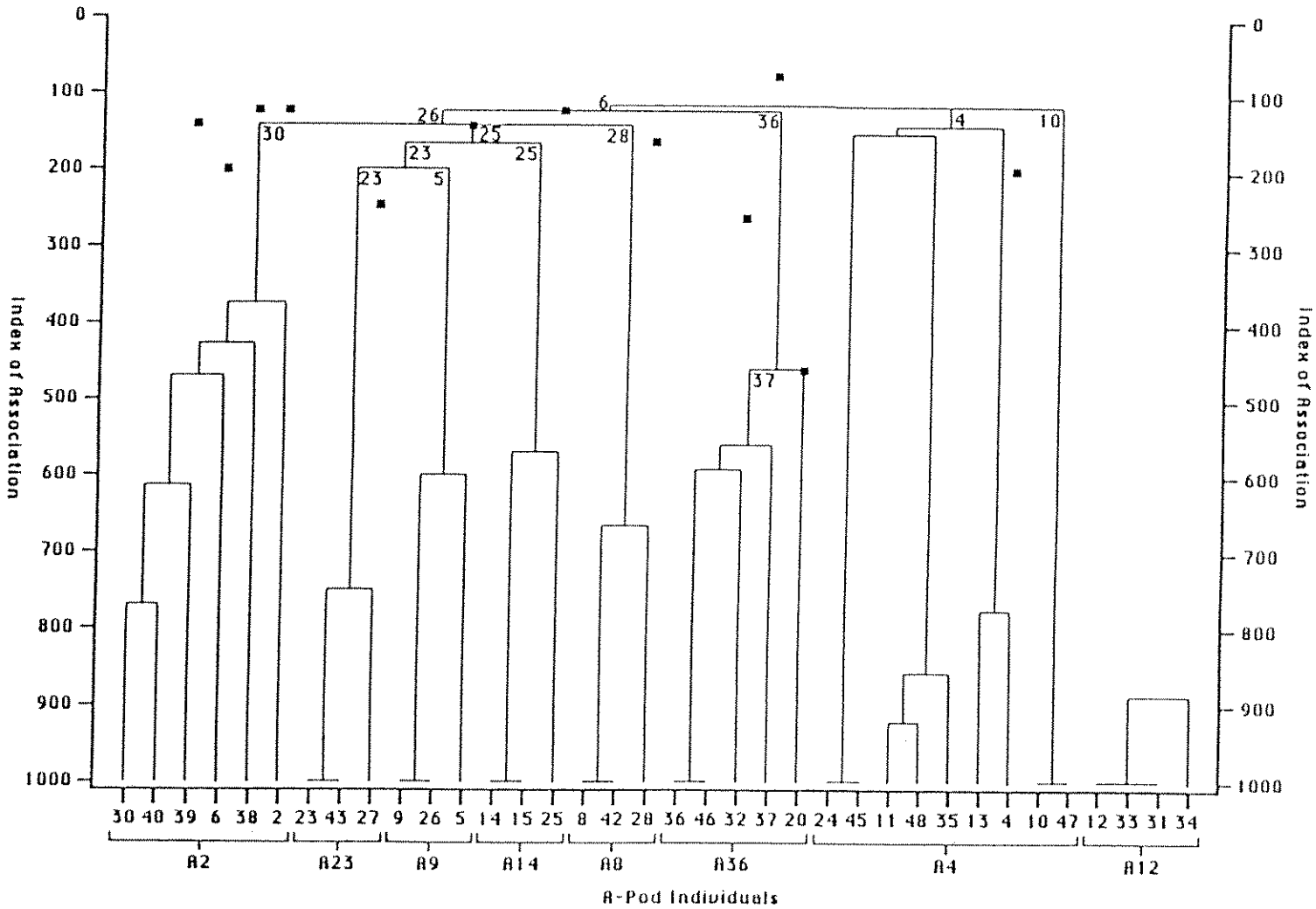

Figure 29. Cluster-analysis dendrogram of 1983 associations among A-pod individuals during foraging and solo indices (squares). Identity numbers of individuals linking clusters are shown.

Table 17. 1984 association indices among A-pod individuals during foraging (above diagonal), solo indices (underlined, along diagonal), pair totals (below diagonal), and individual totals (along bottom).

	Pod A2						Pod A36					Pod A12				Pod A4								Pod A5												
	A2	A30	A50	A39	A38	A6	A36	A46	A37	A32	A20	A12	A34	A33	A31	A11	A48	A35	A13	A24	A45	A4	A9	A26	A5	A8	A42	A28	A14	A15	A25	A23	A43	A27	
A2	272	300	300	111	380	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A2
A30	3	0	1000	375	315	352	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A30
A50	3	9	0	375	315	352	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A50
A39	1	3	3	0	235	933	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A39
A38	4	3	3	2	200	333	0	0	0	0	0	0	0	0	111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A38
A6	1	3	3	7	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A6
A36	0	0	0	0	0	0	0	1000	444	666	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A36
A46	0	0	0	0	0	0	9	0	444	666	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A46
A37	0	0	0	0	0	0	4	4	0	444	380	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A37
A32	0	0	0	0	0	0	6	6	4	222	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A32
A20	0	0	0	0	0	0	1	1	4	1	666	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A20
A12	0	0	0	0	0	0	0	0	0	0	0	0	1000	769	800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A12
A34	0	0	0	0	0	0	0	0	0	0	0	7	0	769	800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A34
A33	0	0	0	0	0	0	0	0	0	0	0	5	5	166	714	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A33
A31	0	0	0	0	1	0	0	0	0	0	0	6	6	5	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A31
A11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A11
A48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A48
A35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A35
A13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A13
A24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A24
A45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A45
A4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A4
A9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	125	800	875	266	266	307	0	0	0	0	0	0	A9
A26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	142	800	285	285	333	0	0	0	0	0	0	A26
A5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	6	125	266	266	307	0	0	0	0	0	0	A5
A8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	1000	833	0	0	0	0	0	0	A8
A42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	7	0	833	0	0	0	0	0	0	A42
A28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	5	5	0	0	0	0	0	0	0	A28
A14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	1000	200	200	250	A14
A15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	1000	200	200	250	A15
A25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	0	200	200	250	A25
A23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1000	666	A23
A43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	4	0	666	A43
A27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	0	A27
TOTAL	11	9	9	7	10	8	9	9	9	9	12	7	7	6	8	0	0	0	0	0	0	0	8	7	8	7	7	5	6	6	6	4	4	2	

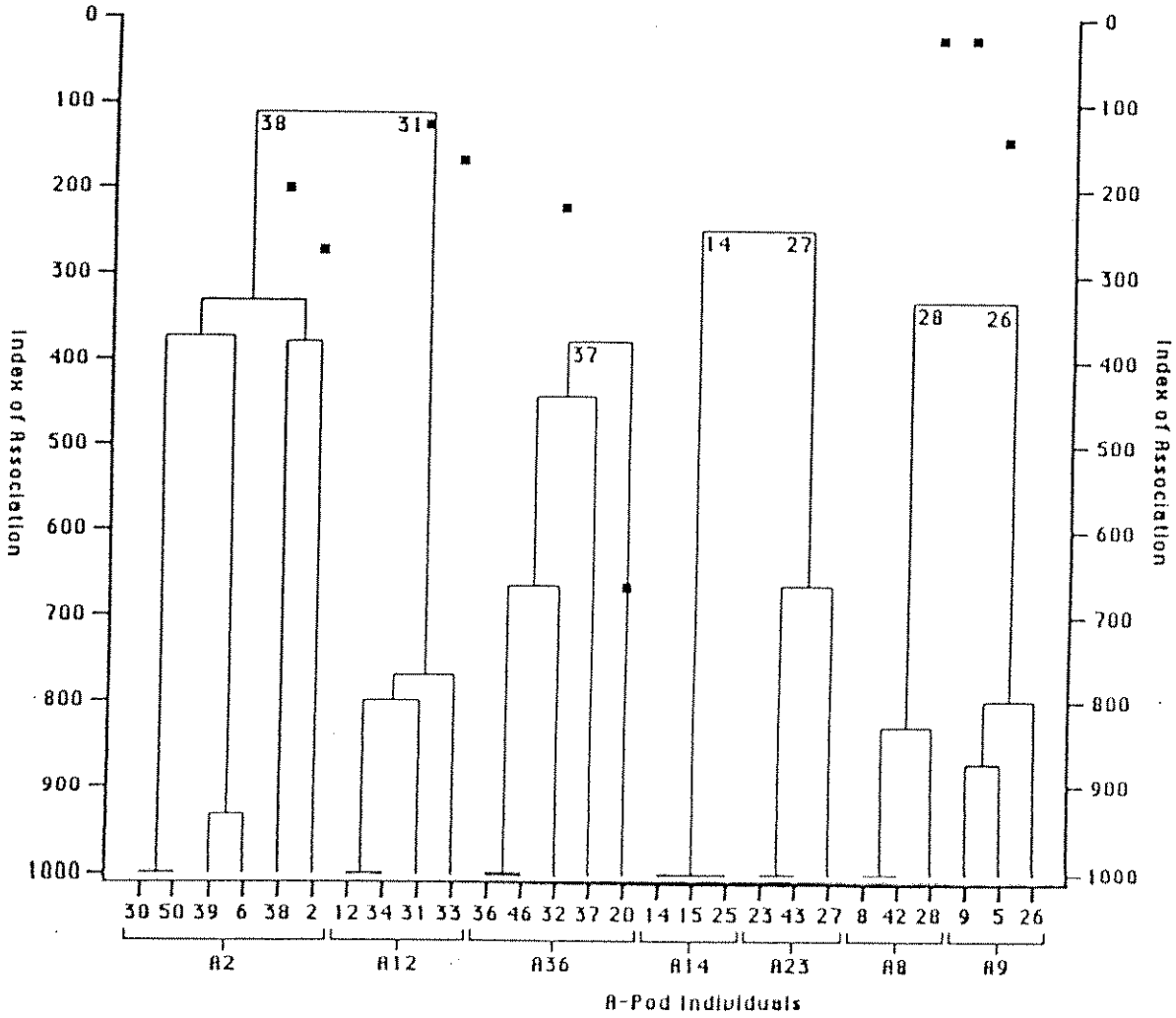

Figure 30. Cluster-analysis dendrogram of 1984 associations among A-pod individuals during foraging and solo indices (squares). Identity numbers of individuals linking clusters are shown.

Table 18. 1985 association indices among A-pod individuals during foraging (above diagonal), solo indices (underlined, along diagonal), pair totals (below diagonal), and individual totals (along bottom).

	Pod A2						Pod A36					Pod A12				Pod A4							Pod A5											
	A2	A30	A50	A39	A38	A6	A36	A46	A37	A32	A20	A12	A34	A33	A31	A11	A48	A35	A13	A24	A49	A45	A9	A26	A5	A8	A42	A28	A14	A15	A25	A23	A43	A27	
A2	625	190	100	117	105	117	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	153	0	0	A2
A30	2	0	960	636	666	363	0	0	0	0	0	111	117	0	105	0	0	0	0	0	0	0	125	0	0	200	200	190	0	0	117	0	0	0	A30
A50	1	12	0	666	695	380	0	0	0	0	0	117	125	0	111	0	0	0	0	0	0	0	133	0	0	210	210	200	0	0	125	0	0	0	A50
A39	1	7	7	111	600	555	0	0	0	0	0	142	153	0	133	0	0	0	0	0	0	0	0	0	0	125	125	117	0	0	0	0	0	0	A39
A38	1	8	8	6	90	600	0	0	0	0	0	125	133	0	117	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A38
A6	1	4	4	5	6	111	0	0	0	0	0	0	0	133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A6
A36	0	0	0	0	0	0	0	1000	666	705	400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A36
A46	0	0	0	0	0	0	9	0	666	705	400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A46
A37	0	0	0	0	0	0	6	6	0	705	400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A37
A32	0	0	0	0	0	0	6	6	6	125	285	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A32
A20	0	0	0	0	0	0	3	3	3	2	333	0	0	0	0	0	0	0	0	0	0	0	0	0	181	0	0	142	0	0	0	0	0	0	A20
A12	0	1	1	1	1	0	0	0	0	0	0	0	888	727	909	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A12
A34	0	1	1	1	1	0	0	0	0	0	0	4	0	600	800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A34
A33	0	0	0	0	0	1	0	0	0	0	0	4	3	0	833	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A33
A31	0	1	1	1	1	0	0	0	0	0	0	5	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A31
A11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	571	333	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A11
A48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	571	333	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A48
A35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	333	400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A35
A13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	200	0	0	333	0	0	0	A13
A24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	1000	0	0	0	0	0	0	0	0	0	0	0	0	A24
A49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	A49
A45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	A45
A9	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	400	500	200	200	181	0	0	0	0	0	0	A9
A26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	571	222	222	200	0	0	0	0	0	333	A26
A5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	2	400	166	166	153	0	0	0	0	0	222	A5
A8	0	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1000	800	0	0	363	0	0	0	A8
A42	0	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	7	0	800	0	0	363	0	0	0	A42
A28	0	2	2	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	1	6	6	0	0	0	666	0	0	0	A28
A14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	0	0	0	0	A14
A15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	A15
A25	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	2	4	0	0	0	0	0	0	A25
A23	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	888	666	A23
A43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	750	A43
A27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	3	3	0	A27
TOTAL	8	13	12	9	11	9	9	9	9	8	6	5	4	6	6	4	4	3	2	2	2	2	3	2	5	7	7	8	3	3	4	5	4	4	

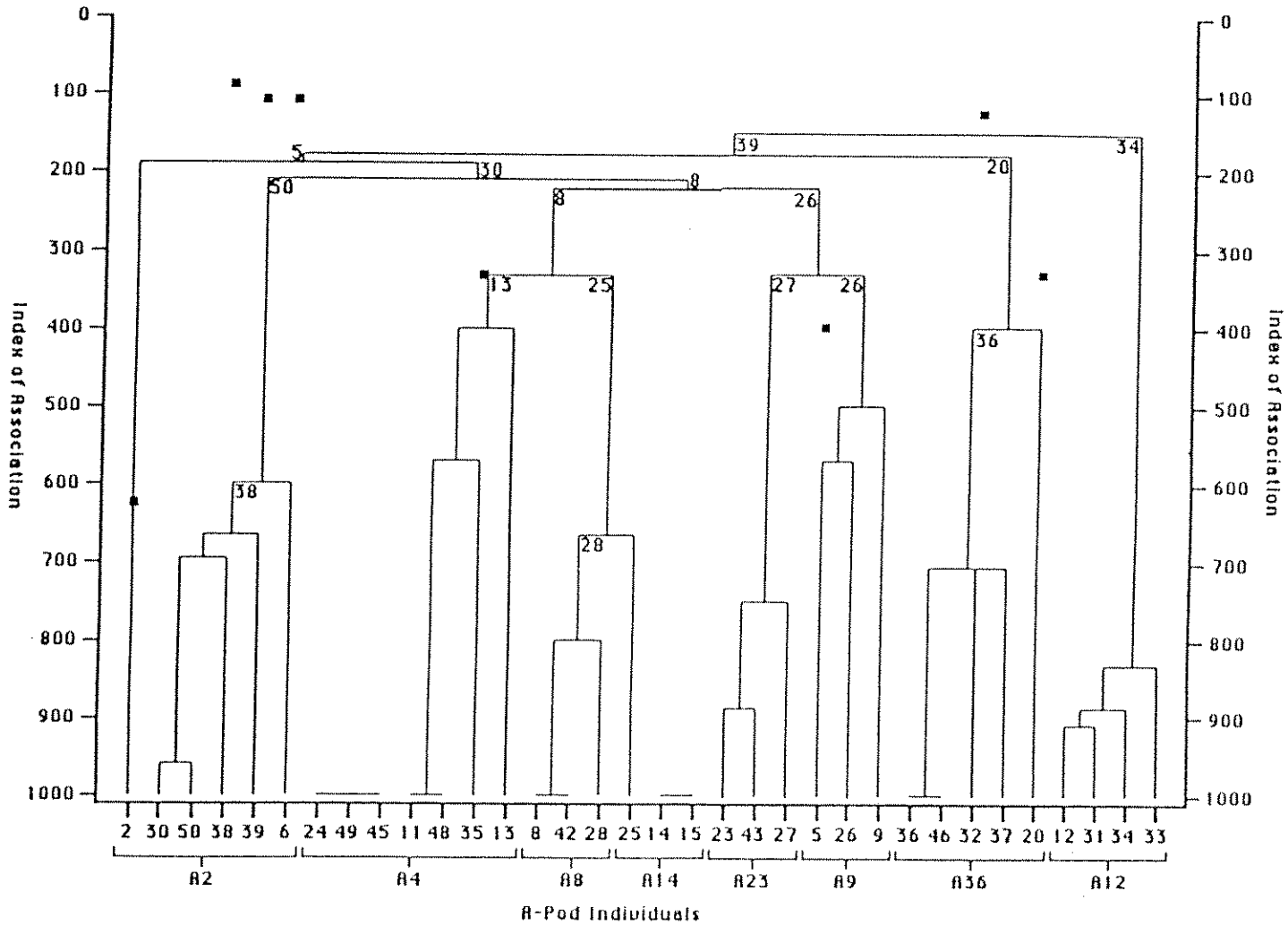

Figure 31. Cluster-analysis dendrogram of 1985 associations among A-pod individuals during foraging and solo indices (squares). Identity numbers of individuals linking clusters are shown.

Table 19. 1986 association indices among A-pod individuals during foraging (above diagonal), solo indices (underlined, along diagonal), pair totals (below diagonal), and individual totals (along bottom).

	Pod A2						Pod A36					Pod A12				Pod A4							Pod A9						Pod A14							
	A2	A30	A50	A39	A38	A6	A36	A46	A37	A32	A20	A12	A34	A33	A31	A11	A48	A35	A13	A24	A49	A45	A9	A26	A5	A8	A42	A28	A14	A15	A25	A51	A23	A43	A27	
A2	176	187	187	181	387	125	60	60	62	60	0	125	68	60	60	0	0	0	0	0	0	0	64	0	0	0	0	0	0	0	0	0	387	400	222	A2
A30	3	0	1000	387	482	600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	66	68	71	66	64	64	68	71	80	A30
A50	3	15	0	387	482	600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	66	68	71	66	64	64	68	71	80	A50
A39	3	6	6	250	333	451	0	0	0	0	0	0	0	187	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68	64	62	62	66	68	74	A39
A38	6	7	7	5	142	275	0	0	0	0	0	0	0	0	66	0	0	0	0	0	0	0	0	0	0	0	0	0	74	68	66	66	71	74	83	A38
A6	2	8	9	7	4	200	0	0	66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	66	68	71	66	64	64	0	0	0	A6
A36	1	0	0	0	0	0	0	1000	774	812	58	0	0	0	0	0	0	111	0	100	100	100	0	0	0	0	0	0	0	0	0	0	66	68	0	A36
A46	1	0	0	0	0	0	16	0	774	812	58	0	0	0	0	0	0	111	0	100	100	100	0	0	0	0	0	0	0	0	0	0	66	68	0	A46
A37	1	0	0	0	0	1	12	12	66	709	60	0	0	0	0	0	0	117	0	105	105	105	0	0	0	0	0	0	0	0	0	0	68	71	0	A37
A32	1	0	0	0	0	0	13	13	11	125	56	0	0	0	0	0	0	111	0	100	100	100	0	0	0	0	0	0	0	0	0	0	66	68	0	A32
A20	0	0	0	0	0	0	1	1	1	1	555	0	0	0	0	0	0	0	0	0	0	0	0	0	0	235	242	312	64	60	58	58	0	64	71	A20
A12	2	0	0	0	0	0	0	0	0	0	0	66	814	580	580	0	0	0	0	0	0	0	0	0	0	64	66	0	0	0	0	0	0	0	0	A12
A34	1	0	0	0	0	0	0	0	0	0	0	11	0	571	571	0	0	0	0	0	0	0	0	0	0	71	74	0	0	0	0	0	0	0	0	A34
A33	1	0	0	1	0	0	0	0	0	0	0	9	8	62	687	0	0	0	0	0	0	0	0	0	0	62	64	0	0	0	0	0	0	0	0	A33
A31	1	0	0	0	1	0	0	0	0	0	0	9	8	11	125	0	0	0	0	0	0	0	0	0	0	62	64	0	0	0	0	0	0	0	0	A31
A11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A11
A48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A48
A35	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	666	666	666	0	0	0	0	0	0	0	0	0	0	0	0	0	A35
A13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A13
A24	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	2	0	0	1000	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	A24
A49	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	2	0	4	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	A49
A45	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	2	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A45
A9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	71	846	689	133	137	71	0	0	0	0	71	74	0	A9
A26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	83	666	142	148	74	0	0	0	0	74	80	0	A26
A5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	9	266	193	200	137	0	0	0	0	68	71	0	A5
A8	0	1	1	0	0	1	0	0	0	0	4	1	1	1	1	0	0	0	0	0	0	0	2	2	3	0	947	800	0	0	0	0	0	0	0	A8
A42	0	1	1	0	0	1	0	0	0	0	4	1	1	1	1	0	0	0	0	0	0	0	2	2	3	15	0	758	0	0	0	0	0	0	0	A42
A28	0	1	1	0	0	1	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	1	1	2	12	11	0	0	68	0	0	0	0	0	A28
A14	0	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	107	571	620	620	222	230	260	A14
A15	0	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8	0	903	903	206	265	320	A15
A25	0	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	14	0	1000	200	275	307	A25
A51	0	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	14	16	0	200	275	307	A51
A23	6	1	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	3	3	3	3	142	868	750	A23
A43	6	1	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	3	4	4	4	12	0	869	A43
A27	3	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	4	4	9	10	0	A27
TOTAL	17	15	15	16	14	15	16	16	15	14	18	15	12	16	16	2	2	2	2	4	4	4	14	12	15	16	15	14	13	15	16	16	14	13	10	

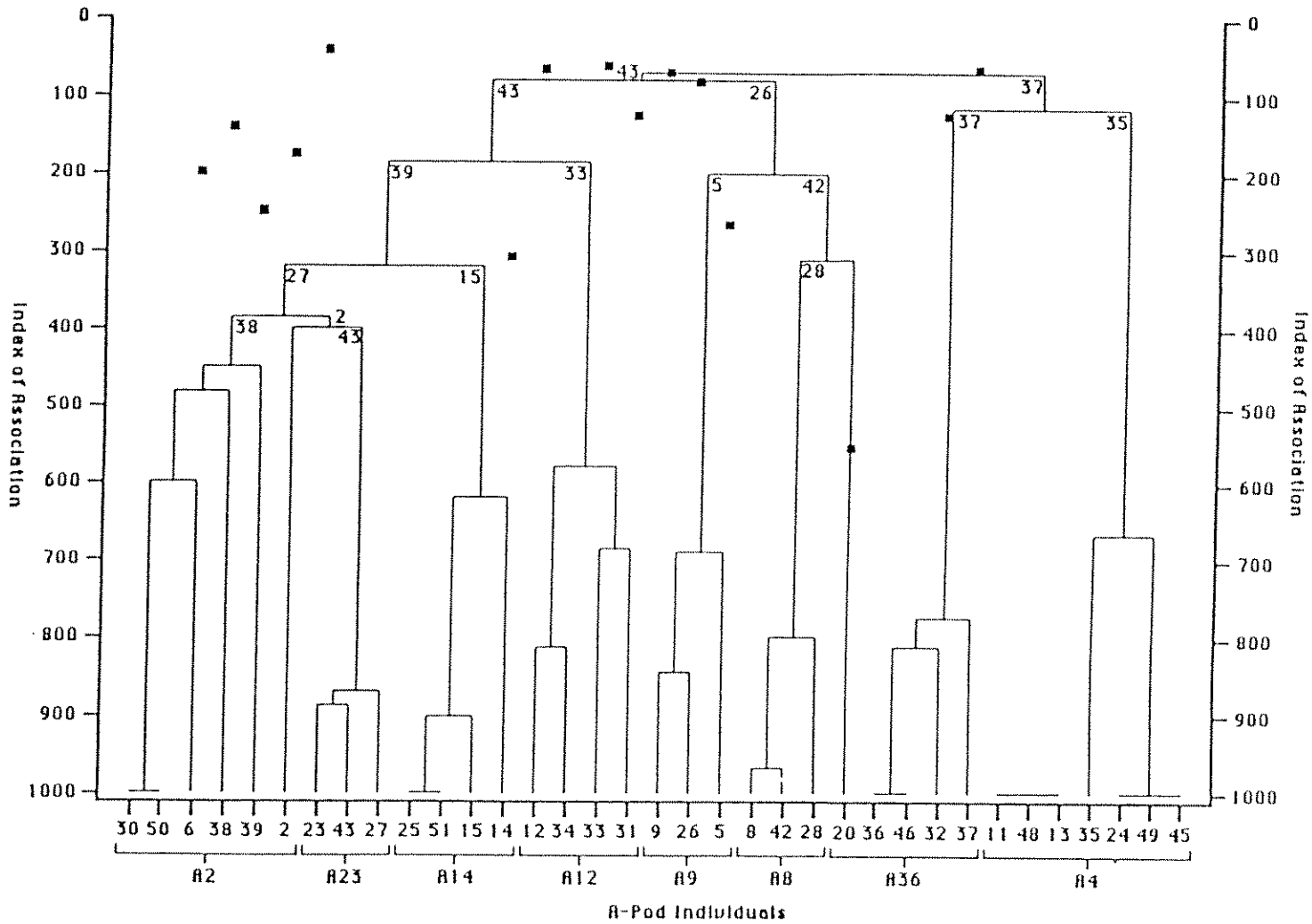

Figure 32. Cluster-analysis dendrogram of 1986 associations among A-pod individuals during foraging and solo indices (squares). Identity numbers of individuals linking clusters are shown.

APPENDIX 3:

Table 20. Correlation of northern resident pod names used in this paper with pod names used by Bigg et al. (1987). Bigg et al. organized individual orcas first into subpods (which equal my subgroups), then grouped subpods into pods.

Jacobsen	Bigg et al. (1987)	
Pod ID	Pod ID	Subpod(s) within pod
A2	A1	A2
A12	A1	A12
A36	A1	A1
A4	A4	A11, A24
A5	A5	A5, A14
A9 (1986)	A5	A5
A14 (1986)	A5	A14
B	B1	B1
C5	C1	C5
C6	C1	C4
D3	D1	D3
D7	D1	D7
G4	G1	G4
G2	G12	G3, G17, G18, G12
H	H1	H1
I1	I1	I1
I2	I2	I2
I11	I11	I11
I15	I11, I18	I15, I17, I18
I31	I31	I31, I33
R	R1	R2, R5, R9
W	W1	W1

Table 21. Daily pod sighting data, 1979-1986. Pod sighted = "1"; pod not sighted = "0"; day omitted from analysis = a line of X's; and "*" = see notes. Transient pod ("T") IDs listed in notes column. In 1986 the A5 pod was divided into A9 and A14 pods.

Pods:			A2	A12	A36	A4	A5	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	T	
YR	MO	DA																						Notes
79	07	01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	02	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	04	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
79	07	05	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
79	07	06	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	07	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
79	07	08	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	10	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	11	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	12	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	13	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	14	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	15	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	22	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	23	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	24	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	26	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	29	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	30	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	07	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	02	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	03	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	04	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	05	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	07	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	08	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	09	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	10	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Appendix 3, Table 21 (continued): Daily pod sighting records.

Pods:			A 2	A 12	A 36	A 4	A 5	B	C 5	C 6	D 3	D 7	G 4	G 2	H	I 1	I 2	I 11	I 15	I 31	R	W	T	
YR	MO	DA																						Notes
79	08	11	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	12	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	14	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	15	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	16	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	17	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	18	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	19	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	
79	08	20	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
79	08	21	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	07	12	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	07	13	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	07	14	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	07	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	07	16	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	07	17	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80	07	18	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
80	07	19	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
80	07	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80	07	21	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
80	07	22	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
80	07	23	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	07	24	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	07	25	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
80	07	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	07	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	07	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	07	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	07	30	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80	07	31	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	08	01	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	08	02	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80	08	03	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80	08	04	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80	08	05	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	08	06	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	08	07	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	08	08	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	08	09	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	08	10	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	08	11	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	08	12	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	08	13	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	08	14	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	08	15	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Appendix 3, Table 21 (continued): Daily pod sighting records.

Pods:	A2	A12	A36	A4	A5	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	T	
YR MO DA																						Notes
80 08 16	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80 08 17	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80 08 18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 08 19	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 08 20	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 08 21	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
80 08 22	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 08 23	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 08 24	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
80 08 25	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
80 08 26	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 08 27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 08 28	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 08 29	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 08 30	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
80 08 31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 02	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 05	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80 09 06	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80 09 07	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 08	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 09	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 10	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 11	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 12	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80 09 13	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80 09 14	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80 09 15	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 16	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
80 09 17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 20	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 21	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O5
80 09 23	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80 09 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80 09 27	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80 09 28	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80 09 29	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
80 09 30	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Appendix 3, Table 21 (continued): Daily pod sighting records.

Pods:			A	A	A	A	A	B	C	C	D	D	G	G	H	I	I	I	I	I	R	W	T	
			2	1	3	4	5		5	6	3	7	4	2		1	2	1	1	3				
YR	MO	DA		2	6													1	5	1				Notes
80	10	01	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	03	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	04	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	07	05	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	07	06	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	07	07	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	07	08	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	07	09	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	10	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O5
81	07	11	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	12	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	13	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	14	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	15	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	16	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	17	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	07	18	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	19	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	07	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	07	21	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	07	22	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	23	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	24	1	1	1	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	
81	07	25	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	07	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	27	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	07	28	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	07	29	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	30	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	07	31	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	08	01	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	02	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	03	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	04	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	08	05	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	06	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	07	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	08	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	09	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	08	11	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	12	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	13	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	14	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	15	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Appendix 3, Table 21 (continued): Daily pod sighting records.

Pods:			A 2	A 1 2	A 3 6	A 4	A 5	B	C 5	C 6	D 3	D 7	G 4	G 2	H	I 1	I 2	I 1 1	I 1 5	I 3 1	R	W	T	Notes
YR	MO	DA																						
81	08	17	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	18	1	1	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
81	08	19	1	1	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
81	08	20	1	1	1	1	1	1	0	0	1	1	0	0	1	0	0	1	1	1	0	0	0	
81	08	21	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
81	08	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	23	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	08	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	26	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	27	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	08	28	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	
81	08	29	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	
81	08	30	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	1	Q1+Q9
81	08	31	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	02	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	03	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	04	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	09	05	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	09	06	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	07	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	09	08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	09	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	10	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	13	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	15	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	16	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	09	17	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	19	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	09	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	22	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	23	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
81	09	26	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	09	27	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	09	28	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	09	29	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	09	30	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
81	10	01	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Appendix 3, Table 21 (continued): Daily pod sighting records.

Pods:			A 2	A 1 2	A 3 6	A 4	A 5	B	C 5	C 6	D 3	D 7	G 4	G 2	H	I 1	I 2	I 1 1	I 1 5	I 3 1	R	W	T	Notes
YR	MO	DA																						
82	07	05	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	07	06	0	1	0	0	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	
82	07	07	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	07	08	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
82	07	09	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
82	07	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	07	11	1	1	1	0	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	
82	07	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	07	13	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	07	14	1	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
82	07	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	07	16	1	0	1	0	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	
82	07	17	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
82	07	18	1	0	1	0	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	
82	07	19	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	07	20	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
82	07	21	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	07	22	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	07	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	07	24	1	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	
82	07	25	1	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
82	07	26	1	1	1	1	1	1	0	0	0	0	1	0	0	0	0	1	1	1	0	1	0	
82	07	27	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
82	07	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	07	29	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	07	30	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
82	07	31	1	1	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	
82	08	01	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	08	02	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
82	08	03	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	08	04	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	08	05	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
82	08	06	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
82	08	07	1	1	1	1	1	0	1	1	0	0	1	1	1	0	0	1	1	0	1	1	0	
82	08	08	1	0	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
82	08	09	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	08	10	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	08	11	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	08	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	08	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	08	14	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	08	15	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
82	08	16	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
82	08	17	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0	
82	08	18	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
82	08	19	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	

Appendix 3, Table 21 (continued): Daily pod sighting records.

Pods:			A 2	A 12	A 36	A 4	A 5	B	C 5	C 6	D 3	D 7	G 4	G 2	H	I 1	I 2	I 11	I 15	I 31	R	W	T	Notes
YR	MO	DA																						
82	08	20	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
82	08	21	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
82	08	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	08	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	08	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	08	25	1	1	1	1	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	08	26	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
82	08	27	1	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
82	08	28	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
82	08	29	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
82	08	30	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
82	08	31	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
82	09	01	1	1	1	1	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
82	09	02	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	09	03	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	09	04	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	09	05	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	09	06	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0	0	1	0	
82	09	07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	09	08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	09	09	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	09	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
82	09	11	1	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	
83	07	05	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O5
83	07	07	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	08	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	09	0	0	0	S	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
83	07	11	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
83	07	12	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	13	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	14	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
83	07	15	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	16	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
83	07	17	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	18	0	0	0	0	S	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	19	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	20	0	1	0	0	1	S	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	21	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	22	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	23	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	24	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	25	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	26	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
83	07	27	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Appendix 3, Table 21 (continued): Daily pod sighting records.

Pods:			A 2	A 1 2	A 3 6	A 4	A 5	B	C 5	C 6	D 3	D 7	G 4	G 2	H	I 1	I 2	I 1 1	I 1 5	I 3 1	R	W	T	Notes
YR	MO	DA																						
83	07	28	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
83	07	29	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	30	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	07	31	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	08	01	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	08	02	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	08	03	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	
83	08	04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	08	05	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	08	06	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	08	07	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	08	08	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	08	09	1	0	1	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	
83	08	10	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	08	11	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	08	12	1	0	1	1	0	0	0	0	0	0	1	0	0	1	1	1	1	1	0	1	0	
83	08	13	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	
83	08	14	1	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	
83	08	15	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
83	08	16	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
83	08	17	1	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
83	08	18	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	08	19	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
83	08	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
83	08	21	1	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
83	08	22	1	0	1	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
83	08	23	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
83	08	24	1	1	1	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
83	08	25	1	1	1	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
83	08	26	1	1	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	1	0	
83	08	27	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	08	28	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	08	29	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
83	08	30	1	1	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
83	08	31	1	1	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
83	09	01	1	1	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
83	09	02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S	0	0	0	
83	09	03	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
83	09	04	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
83	09	05	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	09	06	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
83	09	07	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	09	08	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	09	09	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	09	10	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	09	11	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Appendix 3, Table 21 (continued): Daily pod sighting records.

Pods:			A2	A12	A36	A4	A5	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	T	
YR	MO	DA																						Notes
83	09	12	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	09	13	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
83	09	14	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
83	09	15	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
83	09	16	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	01	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	02	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	03	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	04	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	05	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	08	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	10	0	S	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	11	0	S	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	12	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	14	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	
84	07	15	0	0	0	S	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
84	07	16	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
84	07	17	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	18	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	19	0	1	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
84	07	20	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	21	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	I33 absent
84	07	22	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O4 solo
84	07	23	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	24	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	25	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	26	1	1	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
84	07	27	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	07	28	1	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	I33 absent
84	07	29	1	0	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	1	0	1	0	I33 absent
84	07	30	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
84	07	31	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
84	08	01	1	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
84	08	02	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
84	08	03	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
84	08	04	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	05	1	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	06	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
84	08	07	1	1	1	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	
84	08	08	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
84	08	09	1	1	1	0	1	0	0	0	1	0	0	0	0	1	1	0	0	1	0	0	0	I33 absent
84	08	10	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Appendix 3, Table 21 (continued): Daily pod sighting records.

Pods:			A 2	A 1 2	A 3 6	A 4	A 5	B	C 5	C 6	D 3	D 7	G 4	G 2	H	I 1	I 2	I 1 1	I 1 5	I 3 1	R	W	T	Notes
YR	MO	DA																						
84	08	11	1	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	I33 absent
84	08	14	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	15	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	16	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
84	08	17	1	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	18	1	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	19	1	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	20	1	0	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	21	1	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	22	1	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	23	1	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	24	1	0	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	25	1	0	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
84	08	26	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	
84	08	27	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
84	08	28	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
84	08	29	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
84	08	30	1	1	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
84	08	31	1	1	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
84	09	01	1	1	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
84	09	02	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	I33 absent
84	09	03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O2+O3+O10+Q4
84	09	04	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	09	05	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
84	09	06	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	09	07	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
84	09	08	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
84	09	09	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	09	10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
84	09	11	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O21+Q4
84	09	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
84	09	13	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
84	09	14	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S	0	0	0	I33 absent
84	09	15	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	06	24	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	06	25	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	06	26	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	06	27	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	06	28	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	06	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	06	30	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	01	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	02	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	03	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	

Appendix 3, Table 21 (continued): Daily pod sighting records.

Pods:			A 2	A 1 2	A 3 6	A 4	A 5	B	C 5	C 6	D 3	D 7	G 4	G 2	H	I 1	I 2	I 1 1	I 1 5	I 3 1	R	W	T	Notes
YR	MO	DA																						
85	07	04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	05	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	06	0	0	0	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	07	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	08	1	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	09	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	10	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	11	1	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
85	07	12	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O10+Q3
85	07	13	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	14	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	1	1	0	1	0	
85	07	15	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
85	07	16	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	17	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	18	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	20	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	A20 absent
85	07	21	1	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
85	07	22	1	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
85	07	23	1	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
85	07	24	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A20 absent
85	07	25	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A20 absent
85	07	26	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	07	27	1	0	1	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
85	07	28	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
85	07	29	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
85	07	30	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
85	07	31	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	01	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	02	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	03	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	04	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
85	08	05	1	1	1	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	
85	08	06	1	1	1	0	1	0	1	1	0	0	1	1	1	0	0	0	1	1	0	1	0	
85	08	07	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	08	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	09	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	10	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	11	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
85	08	12	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	13	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	14	1	1	1	1	1	0	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	
85	08	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	16	1	1	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	17	1	1	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	18	1	1	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	

Appendix 3, Table 21 (continued): Daily pod sighting records.

Pods:			A	A	A	A	A	B	C	C	D	D	G	G	H	I	I	I	I	I	R	W	T	
			2	1	3	4	5		5	6	3	7	4	2		1	2	1	1	3				
YR	MO	DA		2	6													1	5	1				Notes
85	08	19	1	1	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	20	1	1	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	21	1	1	1	0	1	0	1	1	1	0	0	0	0	0	0	0	1	1	0	0	0	
85	08	22	1	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	
85	08	23	1	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	24	1	1	1	0	1	0	1	1	1	1	0	1	1	0	0	0	1	0	0	0	0	
85	08	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	26	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	27	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	28	1	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	29	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	30	1	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	08	31	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	09	01	1	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	09	02	1	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	09	03	1	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	A20 solo
85	09	04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	09	05	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	09	06	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	09	07	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	09	08	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	M1
85	09	09	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	
85	09	10	1	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	M1
85	09	11	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
85	09	12	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
85	09	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
85	09	14	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	
85	09	15	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	

Pods:			A	A	A	A	A	A	B	C	C	D	D	G	G	H	I	I	I	I	I	R	W	T	
			2	1	3	4	9	1		5	6	3	7	4	2		1	2	1	1	3				
YR	MO	DA		2	6			4											1	5	1				Notes
86	06	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	06	28	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	06	29	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	06	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	07	01	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	07	02	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	07	03	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	06	04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	07	05	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	07	06	1	0	1	1	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
86	07	07	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
86	07	08	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Appendix 3, Table 21 (continued): Daily pod sighting records.

Pods:			A2	A12	A36	A4	A9	A14	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	T	
YR	MO	DA																							Notes
86	07	09	0	0	0	0	0	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	
86	06	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	07	11	1	0	1	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
86	07	12	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	07	13	1	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
86	07	14	1	1	1	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
86	07	15	1	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	07	16	1	0	1	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	M1
86	07	17	1	0	1	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
86	07	18	0	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	07	19	0	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	M1
86	07	20	0	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	07	21	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	07	22	0	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	07	23	0	0	0	0	0	0	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	
86	07	24	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
86	07	25	0	1	0	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	
86	07	26	0	0	1	0	1	0	1	0	0	0	0	0	0	1	0	0	1	1	1	0	0	0	
86	07	27	1	1	1	0	1	1	0	1	1	1	1	0	0	1	0	0	1	1	1	0	0	0	
86	07	28	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
86	07	29	1	1	1	0	1	1	0	0	1	1	1	0	0	1	0	1	1	1	1	0	0	0	
86	07	30	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
86	07	31	1	0	0	1	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	
86	08	01	1	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	08	02	1	1	1	1	1	1	0	1	1	1	1	0	0	1	0	0	1	1	1	0	0	0	
86	08	03	1	1	1	0	1	1	0	0	0	1	1	0	0	0	0	0	1	1	1	0	0	0	
86	08	04	1	1	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
86	08	05	1	1	1	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
86	08	06	1	1	1	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
86	08	07	1	0	1	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	1	I33+I45 absent; P1
86	08	08	1	1	1	0	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	
86	08	09	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	08	10	1	0	1	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
86	08	11	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	I33+I45 absent
86	08	12	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	I33+I45 absent
86	08	13	1	1	1	0	1	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	
86	08	14	1	1	1	0	1	1	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	
86	08	15	1	1	1	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
86	08	16	1	1	1	0	1	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	
86	08	17	1	1	1	0	1	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	
86	08	18	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	08	19	1	1	1	0	1	1	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	
86	08	20	1	1	1	1	1	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	
86	08	21	1	0	1	1	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	
86	08	22	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	
86	08	23	1	1	1	0	1	1	1	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	

Appendix 3, Table 21 (continued): Daily pod sighting records.

Pods:			A2	A12	A36	A4	A9	A14	B	C5	C6	D3	D7	G4	G2	H	I1	I12	I11	I15	I31	R	W	T	Notes
YR	MO	DA																							
86	08	24	1	1	1	0	1	1	1	0	1	1	1	0	0	1	1	1	0	0	0	0	0	0	
86	08	25	1	1	1	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
86	08	26	1	1	1	0	1	1	1	0	0	0	0	0	0	1	0	0	1	1	*	0	0	0	I33+I45 only,I31=0
86	08	27	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	I33+I45 absent
86	08	28	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	I33+I45 absent
86	08	29	1	1	1	0	1	1	0	0	1	1	1	0	0	1	0	0	0	0	1	0	0	0	I33+I45 absent
86	08	30	1	1	1	0	1	1	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0	1	I33+I45 absent; M1
86	08	31	1	1	1	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
86	09	01	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0	0	0	0	0	1	0	0	
86	09	02	0	0	0	0	0	0	0	1	0	1	1	0	0	0	1	1	0	0	0	0	1	0	
86	09	03	1	1	1	1	0	1	0	1	0	1	1	0	0	0	0	0	0	0	1	1	0	0	I33+I45 absent
86	09	04	1	1	1	1	1	1	0	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0	I33+I45 absent
86	09	05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	09	06	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0	
86	09	07	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	I33+I45 unknown
86	09	08	1	1	0	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
86	09	09	1	1	1	0	1	1	0	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0	I33+I45 absent
86	09	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	09	11	1	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
86	09	12	0	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	09	13	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	09	14	0	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	*	0	0	R1 solo
86	09	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	0	0	R1 solo

APPENDIX 4

Annual Indices of Associations Among Pods

(Note: see Appendix 1, page 93, for description of matrix format.)

Table 22. 1979 association indices among pods (above diagonal), pod solo indices (underlined, along diagonal), pair totals (below diagonal), and pod totals (along bottom).

	A2	A12	A36	A4	A5	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	
A2	0	1000	1000	577	881	277	0	0	0	0	0	0	0	62	62	0	0	0	0	0	A2
A12	31	0	1000	577	881	277	0	0	0	0	0	0	0	62	62	0	0	0	0	0	A12
A36	31	31	0	577	881	277	0	0	0	0	0	0	0	62	62	0	0	0	0	0	A36
A4	13	13	13	0	666	315	0	0	0	0	0	0	0	133	133	0	0	0	0	0	A4
A5	26	26	26	14	35	303	0	0	0	0	0	0	0	68	68	0	0	0	0	0	A5
B	5	5	5	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B
C5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	C5
C6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	C6
D3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	D3
D7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	D7
G4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G4
G2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	H
I1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1000	0	0	0	0	0	I1
I2	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	I2
I11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I11
I15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I15
I31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I31
R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R
W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	W
TOTAL	31	31	31	14	28	5	0	0	0	0	0	0	0	1	1	0	0	0	0	0	

Table 23. 1980 association indices among pods (above diagonal), pod solo indices (underlined, along diagonal), pair totals (below diagonal), and pod totals (along bottom).

	A2	A12	A36	A4	A5	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	
A2	0	1000	1000	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A2
A12	1	0	1000	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A12
A36	1	1	0	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A36
A4	0	0	0	0	508	90	0	0	160	160	0	0	0	0	0	0	0	0	0	0	A4
A5	1	1	1	15	418	81	0	0	307	307	0	0	45	0	0	0	0	0	0	0	A5
B	0	0	0	1	2	500	0	0	266	266	0	0	0	0	0	0	0	0	0	0	B
C5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	C5
C6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	C6
D3	0	0	0	2	8	2	0	0	0	1000	0	0	0	0	0	0	0	0	0	0	D3
D7	0	0	0	2	8	2	0	0	9	0	0	0	0	0	0	0	0	0	0	0	D7
G4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G4
G2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
H	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	H
I1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I1
I2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I2
I11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I11
I15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I15
I31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I31
R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R
W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	W
TOTAL	1	1	1	16	43	6	0	0	9	9	0	0	1	0	0	0	0	0	0	0	

Table 24. 1981 association indices among pods (above diagonal), pod solo indices (underlined, along diagonal), pair totals (below diagonal), and pod totals (along bottom).

	A2	A12	A36	A4	A5	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	
A2	0	1000	1000	945	831	133	0	0	190	190	51	51	50	48	48	95	95	51	0	0	A2
A12	38	0	1000	945	831	133	0	0	190	190	51	51	50	48	48	95	95	51	0	0	A12
A36	38	38	0	945	831	133	0	0	190	190	51	51	50	48	48	95	95	51	0	0	A36
A4	35	35	35	27	773	139	0	0	200	200	54	54	52	51	51	100	100	54	0	0	A4
A5	32	32	32	29	128	173	0	0	186	186	50	50	97	95	95	139	139	50	0	0	A5
B	3	3	3	3	4	285	0	0	363	363	0	0	222	400	400	545	545	250	0	0	B
C5	0	0	0	0	0	0	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	C5
C6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	C6
D3	4	4	4	4	4	2	0	0	0	1000	0	0	333	0	0	250	250	400	0	0	D3
D7	4	4	4	4	4	2	0	0	4	0	0	0	333	0	0	250	250	400	0	0	D7
G4	1	1	1	1	1	0	0	0	0	0	0	1000	0	0	0	0	0	0	0	0	G4
G2	1	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	G2
H	1	1	1	1	2	1	0	0	1	1	0	0	0	400	400	666	666	666	0	0	H
I1	1	1	1	1	2	2	0	0	0	0	0	0	1	0	1000	857	857	0	0	0	I1
I2	1	1	1	1	2	2	0	0	0	0	0	0	1	3	0	857	857	0	0	0	I2
I11	2	2	2	2	3	3	0	0	1	1	0	0	2	3	3	0	1000	400	0	0	I11
I15	2	2	2	2	3	3	0	0	1	1	0	0	2	3	3	4	0	400	0	0	I15
I31	1	1	1	1	1	1	0	0	1	1	0	0	1	0	0	1	1	0	0	0	I31
R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R
W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	W
TOTAL	38	38	38	36	39	7	1	1	4	4	1	1	2	3	3	4	4	1	0	0	

Table 25. 1982 association indices among pods (above diagonal), pod solo indices (underlined, along diagonal), pair totals (below diagonal), and pod totals (along bottom).

	A2	A12	A36	A4	A5	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	
A2	0	788	962	816	800	339	431	260	0	0	285	47	421	139	139	90	90	95	95	444	A2
A12	28	32	771	709	757	318	285	324	60	60	300	60	416	58	58	114	114	121	121	311	A12
A36	38	27	25	800	810	346	360	266	0	0	291	48	428	142	142	93	93	97	97	377	A36
A4	29	22	28	32	696	363	333	216	60	60	300	60	291	0	0	114	114	121	60	444	A4
A5	30	25	30	23	28	375	130	243	54	54	363	54	500	105	105	153	153	108	108	325	A5
B	9	7	9	8	9	230	0	0	133	133	454	0	66	125	125	117	117	266	0	148	B
C5	11	6	9	7	3	0	0	235	0	0	100	153	285	142	142	133	133	0	153	640	C5
C6	6	6	6	4	5	0	2	0	0	0	133	250	86	0	0	200	200	0	500	100	C6
D3	0	1	0	1	1	1	0	0	0	1000	181	0	0	0	0	0	0	0	0	0	D3
D7	0	1	0	1	1	1	0	0	2	0	181	0	0	0	0	0	0	0	0	0	D7
G4	7	6	7	6	8	5	1	1	1	1	0	363	230	0	0	461	461	181	181	347	G4
G2	1	1	1	1	1	0	1	1	0	0	2	0	210	0	0	666	666	0	500	250	G2
H	12	10	12	7	13	1	4	1	0	0	3	2	0	300	300	285	285	0	105	322	H
I1	3	1	3	0	2	1	1	0	0	0	0	0	3	0	1000	0	0	0	0	117	I1
I2	3	1	3	0	2	1	1	0	0	0	0	0	3	3	0	0	0	0	0	117	I2
I11	2	2	2	2	3	1	1	1	0	0	3	2	3	0	0	0	1000	333	333	444	I11
I15	2	2	2	2	3	1	1	1	0	0	3	2	3	0	0	4	0	333	333	444	I15
I31	2	2	2	2	2	2	0	0	0	0	1	0	0	0	0	1	1	0	0	125	I31
R	2	2	2	1	2	0	1	2	0	0	1	1	1	0	0	1	1	0	0	125	R
W	12	7	10	10	8	2	8	1	0	0	4	2	5	1	1	4	4	1	1	0	W
TOTAL	40	31	39	31	35	13	11	5	2	2	9	2	17	3	3	4	4	2	2	14	

Table 26. 1983 association indices among pods (above diagonal), pod solo indices (underlined, along diagonal), pair totals (below diagonal), and pod totals (along bottom).

	A2	A12	A36	A4	A5	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	
A2	0	483	987	461	542	40	625	0	0	0	452	0	133	93	93	93	93	130	93	136	A2
A12	15	0	476	400	720	137	545	0	0	0	181	0	320	0	0	0	0	76	173	83	A12
A36	41	15	0	484	563	40	615	0	0	0	444	0	130	90	90	90	90	127	90	133	A36
A4	15	9	16	166	415	0	425	0	0	0	277	0	142	76	76	153	153	206	0	148	A4
A5	19	18	20	11	103	54	538	0	0	0	341	0	181	0	0	0	0	58	129	62	A5
B	1	2	1	0	1	750	64	0	0	0	0	0	166	0	0	0	0	0	0	0	B
C5	20	12	20	10	14	1	0	0	0	0	457	0	222	80	80	0	0	71	160	76	C5
C6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	C6
D3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	D3
D7	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	D7
G4	12	3	12	5	7	0	8	0	0	0	0	0	0	142	142	142	142	352	142	266	G4
G2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
H	3	4	3	2	3	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	H
I1	2	0	2	1	0	0	1	0	0	0	1	0	0	0	1000	500	500	285	0	400	I1
I2	2	0	2	1	0	0	1	0	0	0	1	0	0	2	0	500	500	285	0	400	I2
I11	2	0	2	2	0	0	0	0	0	0	1	0	0	1	1	0	1000	285	0	800	I11
I15	2	0	2	2	0	0	0	0	0	0	1	0	0	1	1	2	0	285	0	800	I15
I31	3	1	3	3	1	0	1	0	0	0	3	0	0	1	1	1	1	700	0	250	I31
R	2	2	2	0	2	0	2	0	0	0	1	0	0	0	0	0	0	0	0	400	R
W	3	1	3	2	1	0	1	0	0	0	2	0	0	1	1	2	2	1	1	0	W
TOTAL	41	21	42	24	29	8	23	0	0	0	12	0	4	2	2	2	2	5	2	3	

Table 27. 1984 association indices among pods (above diagonal), pod solo indices (underlined, along diagonal), pair totals (below diagonal), and pod totals (along bottom).

	A2	A12	A36	A4	A5	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	
A2	32	567	988	264	675	0	705	44	516	0	0	0	208	45	45	0	0	240	0	280	A2
A12	21	129	575	243	516	50	285	60	360	117	60	60	166	62	62	0	0	105	0	210	A12
A36	42	21	0	269	684	0	716	45	524	0	0	0	212	46	46	0	0	244	0	285	A36
A4	7	5	7	100	292	105	285	166	344	0	0	0	0	0	0	0	0	117	0	117	A4
A5	25	16	25	6	0	150	678	123	760	176	0	0	222	62	62	0	0	157	0	315	A5
B	0	1	0	1	3	444	0	181	142	333	181	181	0	0	0	0	0	0	0	0	B
C5	24	8	24	5	19	0	0	0	590	0	0	0	266	0	0	0	0	187	0	437	C5
C6	1	1	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	222	0	0	C6
D3	16	9	16	5	19	2	13	0	0	272	0	0	83	100	100	0	0	76	0	153	D3
D7	0	2	0	0	3	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	D7
G4	0	1	0	0	0	1	0	0	0	0	0	1000	0	0	0	0	0	0	0	0	G4
G2	0	1	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	G2
H	5	3	5	0	4	0	4	0	1	0	0	0	0	0	0	0	0	333	0	166	H
I1	1	1	1	0	1	0	0	0	1	0	0	0	0	0	1000	0	0	250	0	0	I1
I2	1	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	250	0	0	I2
I11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I11
I15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I15
I31	6	2	6	1	3	0	3	1	1	0	0	0	2	1	1	0	0	142	0	142	I31
R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R
W	7	4	7	1	6	0	7	0	2	0	0	0	1	0	0	0	0	1	0	0	W
TOTAL	43	31	42	10	31	9	25	2	19	3	2	2	5	1	1	0	0	7	0	7	

Table 28. 1985 association indices among pods (above diagonal), pod solo indices (underlined, along diagonal), pair totals (below diagonal), and pod totals (along bottom).

	A2	A12	A36	A4	A5	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	
A2	90	693	952	300	796	189	597	574	357	58	86	58	189	0	58	0	140	86	184	166	A2
A12	35	0	736	285	781	139	757	825	490	108	52	108	139	0	54	0	200	105	227	195	A12
A36	60	35	0	324	839	205	637	613	384	64	95	64	205	0	64	0	153	95	202	181	A36
A4	12	7	12	7	303	272	311	333	375	125	0	0	272	0	250	0	0	0	0	0	A4
A5	47	34	47	10	19	133	698	675	457	74	109	74	233	0	37	0	175	109	262	172	A5
B	7	3	7	3	4	125	205	222	0	0	0	0	0	0	200	0	0	0	117	142	B
C5	29	25	29	7	29	4	0	915	612	121	117	121	153	0	60	0	164	117	100	162	C5
C6	27	26	27	7	27	4	27	0	565	133	64	133	166	0	66	0	242	129	108	176	C6
D3	15	13	15	6	16	0	15	13	55	200	0	100	76	0	100	0	173	95	0	0	D3
D7	2	2	2	1	2	0	2	2	2	0	0	500	200	0	500	0	285	0	0	0	D7
G4	3	1	3	0	3	0	2	1	0	0	0	400	181	0	0	0	500	666	0	444	G4
G2	2	2	2	0	2	0	2	2	1	1	1	0	400	0	0	0	571	400	0	250	G2
H	7	3	7	3	7	0	3	3	1	1	1	2	0	0	0	0	307	181	0	142	H
I1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I1
I2	2	1	2	2	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	I2
I11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I11
I15	5	4	5	0	5	0	3	4	2	1	2	2	2	0	0	0	0	750	0	363	I15
I31	3	2	3	0	3	0	2	2	1	0	2	1	1	0	0	0	3	0	0	444	I31
R	7	5	7	0	8	1	2	2	0	0	0	0	0	0	0	0	0	0	0	400	R
W	6	4	6	0	5	1	3	3	0	0	2	1	1	0	0	0	2	2	3	0	W
TOTAL	64	35	60	14	52	8	33	26	18	2	3	2	8	0	2	0	5	3	9	6	

Table 29. 1986 association indices among pods (above diagonal), pod solo indices (underlined, along diagonal), pair totals (below diagonal), and pod totals (along bottom).

	A2	A12	A36	A4	A9	A14	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	
A2	18	808	871	444	651	884	329	635	533	651	597	35	35	506	35	101	163	163	366	70	0	A2
A12	38	0	776	392	800	840	317	550	576	684	619	50	50	539	48	139	222	222	436	97	0	A12
A36	44	33	0	380	847	905	371	552	575	600	589	42	42	600	41	120	230	230	419	83	0	A36
A4	16	11	12	0	380	393	97	638	378	313	285	111	111	292	0	0	86	86	352	210	0	A4
A9	43	34	39	12	0	926	400	500	575	600	538	42	42	571	41	120	230	230	451	41	0	A9
A14	46	37	43	13	44	0	356	531	550	650	592	40	40	547	39	113	181	181	430	78	0	A14
B	13	10	13	2	14	13	250	222	227	206	178	0	0	500	76	71	133	133	50	0	0	B
C5	27	19	21	15	19	21	6	0	480	531	483	64	64	370	62	117	111	111	255	125	64	C5
C6	20	17	19	7	19	19	5	12	0	407	423	0	0	545	90	250	230	230	324	0	0	C6
D3	29	25	24	8	24	27	6	17	11	0	939	57	57	413	111	157	200	200	431	111	57	D3
D7	26	22	23	7	21	24	5	15	11	31	31	60	60	428	117	166	210	210	448	117	60	D7
G4	1	1	1	1	1	1	0	1	0	1	1	0	1000	80	0	0	0	0	0	666	0	G4
G2	1	1	1	1	1	1	0	1	0	1	1	1	0	80	0	0	0	0	0	666	0	G2
H	20	17	21	6	20	20	12	10	12	12	12	1	1	0	76	142	333	333	292	76	0	H
I1	1	1	1	0	1	1	1	1	1	2	2	0	0	1	0	666	0	0	0	0	666	I1
I2	3	3	3	0	3	3	1	2	3	3	3	0	0	2	2	0	200	200	95	0	400	I2
I11	5	5	6	1	6	5	2	2	3	4	4	0	0	5	0	1	0	1000	454	0	0	I11
I15	5	5	6	1	6	5	2	2	3	4	4	0	0	5	0	1	6	0	454	0	0	I15
I31	14	13	14	6	15	15	2	6	6	11	11	0	0	6	0	1	5	6	0	105	0	I31
R	2	2	2	2	1	2	0	2	0	2	2	1	1	1	0	0	0	0	1	0	0	R
W	0	0	0	0	0	0	0	1	0	1	1	0	0	0	1	1	0	0	0	0	0	W
TOTAL	55	39	46	17	46	49	24	30	20	34	32	1	1	24	2	4	6	6	16	2	1	

Table 30. 1979 - 1986 association indices among pods (above diagonal), pod solo indices (underlined, along diagonal), pair totals (below diagonal), and pod totals (along bottom).

	A2	A12	A36	A4	A9	A14	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	
A2	25	763	960	532	724	731	192	509	290	319	174	139	30	255	55	78	66	95	160	78	161	A2
A12	207	27	764	524	705	712	201	402	352	332	222	101	51	263	41	65	74	104	153	90	124	A12
A36	295	201	3	533	734	743	200	490	297	306	165	146	32	272	57	82	76	106	168	82	157	A36
A4	127	102	123	49	520	521	173	310	173	209	140	136	35	170	34	56	78	76	131	33	134	A4
A9	224	187	221	121	0	968	219	396	294	370	219	120	32	274	44	62	75	104	142	81	119	A9
A14	227	190	225	122	301	0	212	402	292	382	234	119	31	272	44	62	68	97	141	87	118	A14
B	38	31	38	21	42	41	312	109	145	154	181	111	22	212	86	104	125	118	70	21	54	B
C5	111	70	103	44	84	86	11	0	471	434	196	161	62	263	45	72	43	84	153	102	283	C5
C6	54	50	53	19	53	53	10	42	0	335	238	47	92	271	28	109	109	205	195	111	90	C6
D3	64	52	59	26	72	75	13	45	24	11	739	35	42	204	61	98	98	130	231	39	51	D3
D7	32	31	29	15	39	42	12	17	13	51	19	50	66	247	62	117	147	164	275	59	24	D7
G4	24	13	24	13	20	20	6	12	2	2	2	0	388	112	50	45	181	244	190	139	271	G4
G2	5	6	5	3	5	5	1	4	3	2	2	7	0	144	0	0	166	275	46	173	153	G2
H	48	38	49	19	50	50	15	24	16	15	14	5	5	0	136	155	259	292	208	52	152	H
I1	9	5	9	3	7	7	4	3	1	3	2	1	0	5	0	857	285	242	85	0	139	I1
I2	13	8	13	5	10	10	5	5	4	5	4	1	0	6	12	0	312	270	117	0	127	I2
I11	11	9	12	7	12	11	6	3	4	5	5	4	2	10	4	5	0	864	320	64	255	I11
I15	16	13	17	7	17	16	6	6	8	7	6	6	4	12	4	5	16	0	400	55	307	I15
I31	29	21	29	13	25	25	5	12	9	14	12	6	1	10	2	3	9	12	57	40	151	I31
R	13	11	13	3	13	14	1	7	4	2	2	3	2	2	0	0	1	1	1	0	217	R
W	28	16	26	13	20	20	3	20	4	3	1	8	3	7	3	3	6	8	5	5	0	W
TOTAL	315	227	299	162	303	306	80	121	57	86	52	28	8	61	12	16	16	21	34	15	31	

ADDENDUM

Associations Among Pods of Killer Whales (Orcinus orca) in the Johnstone Strait, British Columbia, 1987 and 1988.

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ACKNOWLEDGEMENTS

Two more years brought many new faces to Boat Bay camp, all of whom had a significant effect on my life and work there. My field partners were Joe Zimmerman and Kirsten VonKugelgen. Fellow camp partners included Robin Taylor and her assistants. Fellow researchers were Linda Nichol and Naomi Rose and their assistants, all of whom shared sighting data, logistical work, and spirited enthusiasum. Hiroya Minakuchi returned with Chihiro Ito (who delighted everyone), and then with their film partners Hitoshi Ashigaki, Masazo Kusakabe, and Yoichi Yudo, all of whom deserve my endless thanks for their support, cooperation, and excellent documentary that resulted from our collaboration. A second round of gratitude is in order for Mike Bigg, Graeme Ellis, John Ford, Louise Goulet, Claude and Stacia and Morgan and Travis and Katie and Fiona Kennedy, Paul Spong and Helena Symonds, Jim Borrowman and Bill McKay, all my family members, and especially Linda Miller. And as I say farewell to my annual long term stays in the Johnstone Strait, I must acknowledge the place (the Tsitika watershed in particular) and the orcas, for they have become an essential part of my being and identity.

INTRODUCTION

The data presented in this addendum was collected during 1987 and 1988, my last two field seasons in the Johnstone Strait. As of this writing the association data for A-pod individuals is not yet complete, so only the pod sighting and association data are presented.

METHODS

The same data collection methods described in the thesis were used during 1987 and 1988. Field season dates are listed in Table 31. Data analysis methods were also identical.

Table 31. Observation effort for 1987 and 1988: extension of field season for pod sightings from other researchers (see text); dates of field season; number of days in field season including extension; number of observer days (see text); number of hours of recorded observations; and totals for 1979-1988 (see Table 1).

Year	Extension of Season	Dates of Field Season	Days	Observer Days	Hours
1987	Sept. 18	July 13 - Sept. 2	68	59	277
1988	7/6 - 9/24	July 11 - Sept. 5	81	80	293
		TOTALS (1979 - 1988):	759	675	2336

The nomenclature problem of lumping maternal subgroups into a pod versus identifying them separately become more prevalent during the last two years. As pods continued to grow and divide, keeping track of maternal groups (and in some cases (ie A20) individuals) instead of pods, became necessary. However, to simplify comparisons with the first eight years of data, the same pod designations were maintained. The principal problem was that for a few pods (A4, G2, I15, I31, and R) when only a portion of a pod was sighted, the entire pod was represented. This situation occured 17 times for the above pods, and 9 times for individual A20. These exceptions are noted with the pod sighting data.

One additional method to display the gradual division of four pods into their component maternal subgroups during the ten year study period is included here. The index of association of one subgroup (or in the case of pod A1, two subgroups) with the other subgroup in the pod was plotted by year.

RESULTS

Table 32. Daily pod sighting data, 1987 and 1988. Pod sighted = "1"; pod not sighted = "0"; day omitted from analysis = "X"; and "*" = pod counted, but see notes column; "(*)" = see notes at end of table. Transient pod ("T") IDs listed in notes column.

YR	MO	DA	A2	A12	A36	A4	A9	A14	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	T	Notes
87	07	13	1	0	1	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	*	0	0	R14+R15 only
87	07	14	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0	
87	07	15	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	*	0	0	R14+R15 only
87	07	16	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
87	07	17	1	1	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
87	07	18	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	A20 present
87	07	19	0	0	0	0	0	0	0	0	0	0	0	0	0	S	0	0	0	0	0	0	0	0	
87	07	20	1	0	1	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
87	07	21	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	07	22	1	1	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	A20 present
87	07	23	1	1	1	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	*	0	0	0	no I33+I35+I45
87	07	24	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	07	25	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	07	26	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	07	27	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	07	28	1	1	1	1	1	1	1	0	0	1	1	1	*	1	0	1	0	*	0	*	0	0	(*)
87	07	29	1	1	0	0	0	0	1	0	0	0	0	1	1	1	0	1	0	0	0	*	0	0	R2 subpod
87	07	30	1	0	0	*	0	0	1	0	0	1	1	0	0	0	0	0	1	0	*	0	0	0	(*)
87	07	31	1	1	0	*	0	0	1	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	A11 subpod
87	08	01	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	08	02	1	0	1	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
87	08	03	1	1	1	*	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	A11 subpod
87	08	04	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	08	05	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	
87	08	06	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	08	07	1	0	1	1	1	1	0	0	0	0	0	0	*	1	0	0	0	0	0	0	0	0	G17 subpod
87	08	08	1	0	1	1	1	1	0	0	0	1	1	0	*	1	0	0	0	1	0	0	0	0	G17 subpod
87	08	09	1	0	0	1	1	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	A20 present
87	08	10	1	0	0	1	1	1	0	1	1	1	1	0	0	1	0	0	0	1	0	0	1	0	A20 present
87	08	11	1	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	
87	08	12	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	(*)
87	08	13	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	A20 present
87	08	14	0	0	1	0	0	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	
87	08	15	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
87	08	16	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
87	08	17	1	0	1	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	
87	08	18	0	0	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	08	19	1	0	1	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0	
87	08	20	1	0	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	*	1	0	No R2 subpod
87	08	21	1	0	0	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	*	1	0	No R2 subpod
87	08	22	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	1	1	0	
87	08	23	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
87	08	24	1	0	1	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	

Table 32 (continued).

YR	MO	DA	A2	A12	A36	A4	A9	A14	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	T	Notes
87	08	25	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	
87	08	26	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	08	27	1	0	0	0	1	1	0	0	1	1	1	0	0	1	0	0	1	0	0	0	0	0	
87	08	28	1	1	0	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	
87	08	29	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0	
87	08	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O5+O10
87	08	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	09	01	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	09	02	1	1	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	09	03	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	09	04	1	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	09	05	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
87	09	06	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
87	09	07	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	09	08	1	1	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	09	09	1	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	09	10	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
87	09	12	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	09	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	09	14	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
87	09	15	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X(1)	(*)
87	09	16	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A20 absent
87	09	17	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
87	09	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	06	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	08	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	09	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	11	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	12	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	13	1	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	14	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O4+O5
88	07	15	1	0	0	1	1	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	
88	07	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	17	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
88	07	18	1	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
88	07	19	1	0	1	0	0	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	
88	07	20	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
88	07	21	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	O4+O5
88	07	22	0	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	23	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	24	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O5, Q1, Q4
88	07	25	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	26	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	27	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	28	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	07	29	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	
88	07	30	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	A20 present

Table 32 (continued).

YR	MO	DA	A2	A12	A36	A4	A9	A14	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	T	Notes
88	07	31	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	08	01	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	A20; Q9, Y1
88	08	02	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	*	0	0	0	(*)
88	08	03	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	
88	08	04	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	
88	08	05	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	08	06	0	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	08	07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O5, Q1
88	08	08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O5, Q1
88	08	09	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	08	10	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
88	08	11	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
88	08	12	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	08	13	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	08	14	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	08	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	08	16	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	08	17	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	08	18	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	08	19	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	08	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O10, M2, M3
88	08	21	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	0	0	0	
88	08	22	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
88	08	23	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
88	08	24	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O5+Q1+Q9+Y1
88	08	25	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	08	26	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	A20 present
88	08	27	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	
88	08	28	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	M2+M4
88	08	29	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	
88	08	30	1	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	08	31	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	M1
88	09	01	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	03	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	04	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	05	1	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	06	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	07	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	08	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	09	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	10	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	11	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	O2?+O21
88	09	12	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	13	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	14	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	16	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	P1+Q1+Q3+Y1
88	09	17	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Table 32 (continued).

YR	MO	DA	A2	A12	A36	A4	A9	A14	B	C5	C6	D3	D7	G4	G2	H	I1	I2	I11	I15	I31	R	W	T	Notes
88	09	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S	0	1	O21
88	09	20	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	21	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
88	09	22	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	23	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
88	09	24	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Additional notes:

87 07 28 G12 and G18 subgroups; R2+R3+R12 only
87 07 30 A11 subgroup only; I33+I35+I45 only
87 08 12 A20 present; I33+I35+I45 absent
87 09 15 M pod sighted, but day omitted for resident pods
88 08 02 A20 present; I33+I35+I45 absent

Table 33. Number of observer days, resident pod sightings, colletive transient pod sightings, and days no orcas were sighted for 1987, 1988, and 1979-1988.

Year:	1987	1988	79-88 Total
# days:	59	80	675
A-2	48	52	415
A-12	19	42	288
A-36	27	27	353
A-4	33	15	210
A-9	35	15	353
A-14	38	18	362
B	4	8	92
C-5	16	23	160
C-6	15	10	82
D-3	19	0	105
D-9	19	0	71
G-4	3	0	31
G-2	5	0	13
H	14	5	80
I-1	0	0	12
I-2	2	4	22
I-11	4	0	20
I-15	6	5	32
I-31	7	6	47
R	7	6	28
W	6	2	39
Trans.	1	15	31
totals	328	253	2846
None	4	7	96

The average number of resident pods sighted in the Johnstone Strait decreased significantly in 1988, to a level almost as low as in 1980 (Figure 33). A four year cycle seems to be emerging in these data.

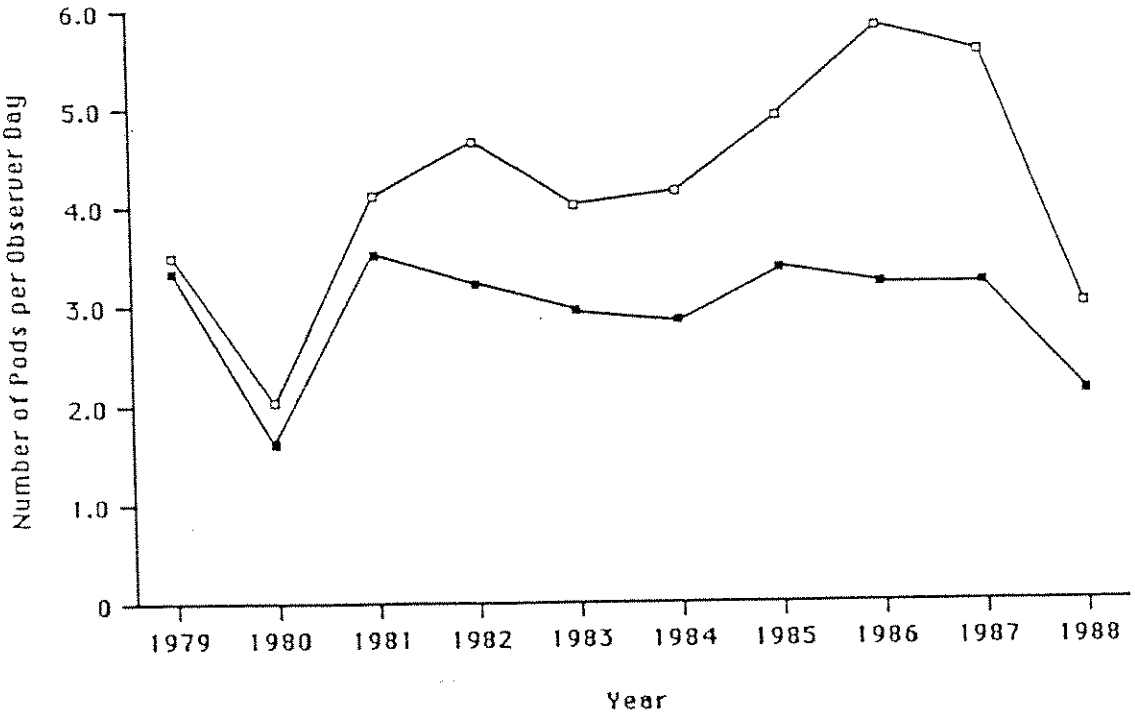

Figure 33. Number of resident pods sighted annually per observer day (open squares), and number of A-pods sighted annually per observer day (closed squares), 1979-1988.

The number of pod pairs observered in 1987 was similar to 1986 and 1985, and the cumulative pairing reached 100% (Figure 34). In 1988 fewer pods were sighted and the amount of pairing decreased accordingly.

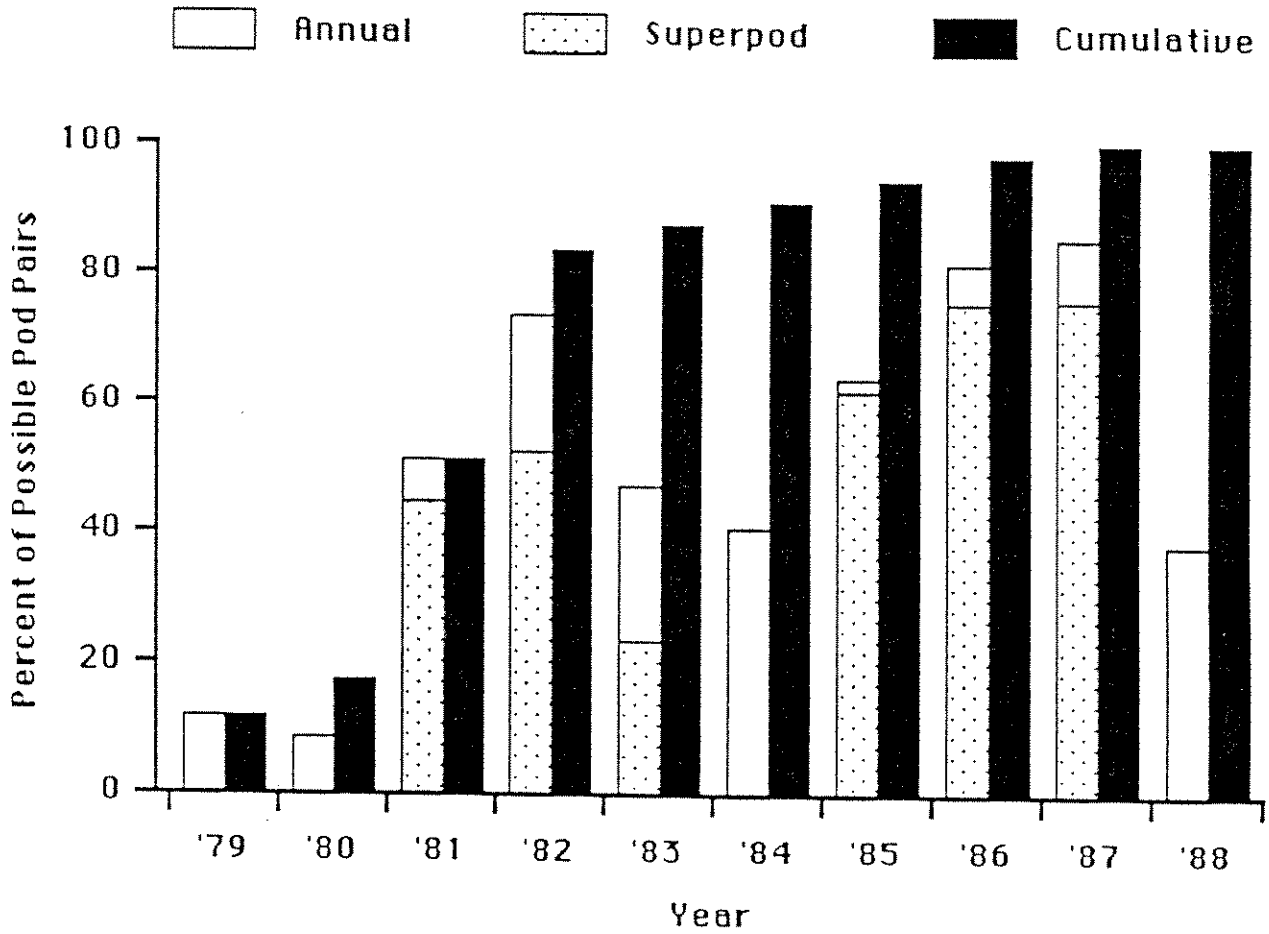

Figure 34. Annual and cumulative by year percentages of possible resident pod pairs sighted, and annual percentage of possible resident pod pairs sighted on days when at least 9 resident pods were present.

Pod A2 continued to be the most frequently sighted resident pod in the study area, followed by the other A-pods (Table 32, Figure 35). Pod D was sighted as often as pod A12 in 1987, and in 1988 pod C5 was present more than pods A4, A9 and A14.

In 1988 there were 13 sightings of transient pods (Table 32, Figure 35), which was 10.8 times the previous annual average. No encounters between residents and transients were observed, however. The transient pods were sighted in parts of the study area distant from the resident pods, or the transients traveled through the area at times during the day when the residents were not present. On eight of the days transients were sighted there were two or less resident pods sighted, including three days no resident pods were sighted. For the entire study period 25% of all transient pod sightings occurred on days no resident pods were sighted.

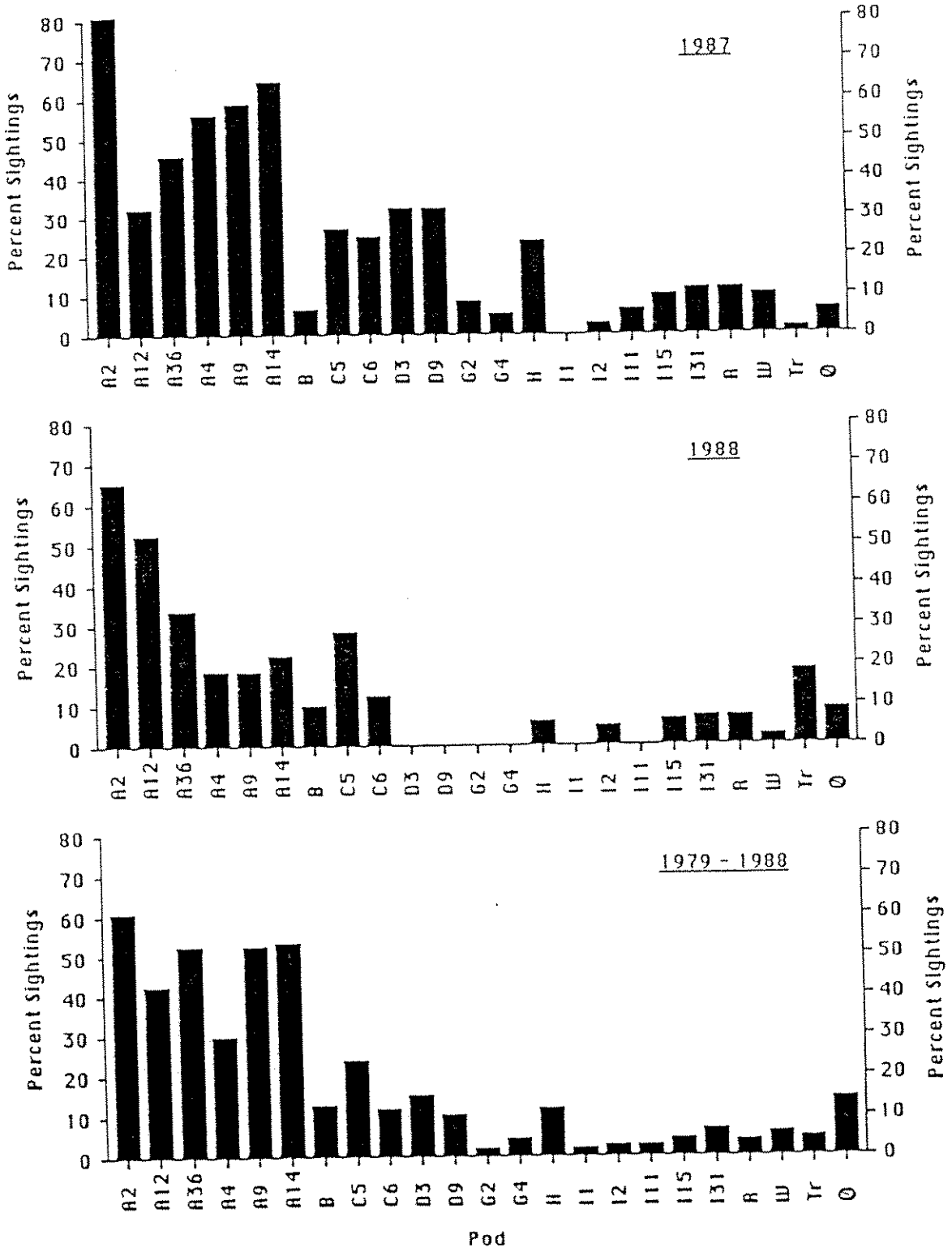

Figure 35. Normalized (see thesis text) annual pod sighting data for 1987, 1988, and 1979-1988. Tr=transient pods, 0=days no whales sighted.

Associations Among Pods

In 1987 the A11 subgroup of pod A4 was sighted three times without the A24 subgroup (Table 31). The 1987 association index of these two subgroups was 952. In 1988 the A4 pod was sighted 15 times (Tables 32 and 34), and both subgroups were always present.

The adult male, A20, of the A36 pod continued to travel independently in 1987 and 1988. In 1987 he was sighted six times without pod A36, and on one occasion pod A36 was sighted without A20 (Table 31). A20's 1987 association index with pod A36 was 677. In 1988 A20 was sighted four times without pod A36 (Table 31), so his association index was 931.

I33 and her calf I45 continued to travel independently of the I31 pod, and they were joined by I35. In 1987 the three whales were sighted once by themselves (Table 31), and pod I31 was sighted twice without them, resulting in an association index of 727. In 1988 the I33 subpod was absent from pod I31 once, and their association index was 909.

Table 34. 1987 association indices among pods (above diagonal), pod solo indices (underlined, along diagonal), pair totals (below diagonal), and pod totals (along bottom).

	A2	A12	A36	A4	A9	A14	B	C5	C6	D3	D9	G4	G2	H	I1	I2	I11	I15	I31	R	W	
A2	104	507	613	716	746	767	153	437	380	537	537	117	188	387	0	80	153	222	218	254	185	A2
A12	17	0	391	538	481	491	260	228	176	210	210	181	166	303	0	190	173	160	230	153	0	A12
A36	23	9	0	600	645	707	64	558	333	391	391	66	187	292	0	68	64	181	117	176	60	A36
A4	29	14	18	0	882	873	162	408	416	500	500	55	157	382	0	57	162	307	300	200	256	A4
A9	31	13	20	30	0	958	51	431	440	444	444	52	150	448	0	54	51	243	238	238	243	A9
A14	33	14	23	31	35	0	47	481	452	491	491	48	139	423	0	50	95	227	266	222	227	A14
B	4	3	1	3	1	1	0	0	0	260	260	571	444	222	0	666	500	400	181	363	0	B
C5	14	4	12	10	11	13	0	0	709	457	457	0	0	200	0	0	0	90	173	173	272	C5
C6	12	3	7	10	11	12	0	11	0	529	529	0	0	137	0	0	105	95	90	272	476	C6
D3	18	4	9	13	12	14	3	8	9	0	1000	181	250	303	0	95	260	400	230	307	320	D3
D9	18	4	9	13	12	14	3	8	9	19	0	181	250	303	0	95	260	400	230	307	320	D9
G4	3	2	1	1	1	1	2	0	0	2	2	0	750	235	0	800	0	222	0	600	222	G4
G2	5	2	3	3	3	3	2	0	0	3	3	3	0	421	0	571	0	363	0	500	181	G2
H	12	5	6	9	11	11	2	3	2	5	5	2	4	71	0	250	111	400	95	190	100	H
I1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I1
I2	2	2	1	1	1	1	2	0	0	1	1	2	2	2	0	0	0	250	0	444	0	I2
I11	4	2	1	3	1	2	2	0	1	3	3	0	0	1	0	0	0	200	181	0	0	I11
I15	6	2	3	6	5	5	2	1	1	5	5	1	2	4	0	1	1	0	0	153	166	I15
I31	6	3	2	6	5	6	1	2	1	3	3	0	0	1	0	0	1	0	0	0	153	I31
R	7	2	3	4	5	5	2	2	3	4	4	3	3	2	0	2	0	1	0	0	461	R
W	5	0	1	5	5	5	0	3	5	4	4	1	1	1	0	0	0	1	1	3	0	W
TOTAL	48	19	27	33	35	38	4	16	15	19	19	3	5	14	0	2	4	6	7	7	6	

Table 35. 1988 association indices among pods (above diagonal), pod solo indices (underlined, along diagonal), pair totals (below diagonal), and pod totals (along bottom).

	A2	A12	A36	A4	A9	A14	B	C5	C6	D3	D9	G4	G2	H	I1	I2	I11	I15	I31	R	W	
A2	38	659	506	358	358	428	166	453	290	0	0	0	0	140	0	107	0	140	137	103	74	A2
A12	31	119	434	350	350	300	40	338	192	0	0	0	0	0	0	173	0	212	250	208	90	A12
A36	20	15	74	333	285	355	57	760	378	0	0	0	0	125	0	193	0	125	121	60	68	A36
A4	12	10	7	0	866	727	86	315	400	0	0	0	0	100	0	421	0	100	380	0	0	A4
A9	12	10	6	13	0	848	173	263	400	0	0	0	0	100	0	315	0	0	285	95	0	A9
A14	15	9	8	12	14	0	230	292	428	0	0	0	0	347	0	272	0	0	250	83	0	A14
B	5	1	1	1	2	3	125	129	111	0	0	0	0	307	0	0	0	0	142	0	0	B
C5	17	11	19	6	5	6	2	0	545	0	0	0	0	142	0	148	0	142	68	68	80	C5
C6	9	5	7	5	5	6	1	9	0	0	0	0	0	266	0	142	0	0	0	0	0	C6
D3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	D3
D9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	D9
G4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G4
G2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
H	4	0	2	1	1	4	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	H
I1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I1
I2	3	4	3	4	3	3	0	2	1	0	0	0	0	0	0	0	0	222	400	0	0	I2
I11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I11
I15	4	5	2	1	0	0	0	2	0	0	0	0	0	0	0	1	0	0	181	545	0	I15
I31	4	6	2	4	3	3	1	1	0	0	0	0	0	0	0	2	0	1	0	166	0	I31
R	3	5	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	3	1	166	0	R
W	2	2	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	W
TOTAL	52	42	27	15	15	18	8	23	10	0	0	0	0	5	0	4	0	5	6	5	2	

Table 36. 1979 - 1988 association indices among pods (above diagonal), pod solo indices (underlined, along diagonal), pair totals (below diagonal), and pod totals (along bottom).

	A2	A12	A36	A4	A9	A14	B	C5	C6	D3	D9	G4	G2	H	I1	I2	I11	I15	I31	R	W	
A2	36	725	880	537	695	707	185	493	301	315	205	121	46	258	42	82	68	116	168	103	154	A2
A12	255	34	702	506	655	655	184	379	313	284	194	94	53	233	33	90	71	125	178	113	110	A12
A36	338	225	8	525	699	716	179	522	308	296	179	130	43	263	49	90	69	114	164	89	142	A36
A4	168	126	148	38	582	576	165	324	232	247	199	116	53	200	27	86	86	115	178	58	144	A4
A9	267	210	247	164	0	979	202	389	317	366	240	109	43	286	38	74	69	114	164	99	127	A9
A14	275	213	256	165	350	0	198	402	319	381	258	106	42	294	37	72	68	106	165	102	124	A14
B	47	35	40	25	45	45	271	103	126	162	184	130	57	220	76	122	142	129	100	50	45	B
C5	142	85	134	60	100	105	13	0	512	400	216	125	46	241	34	76	33	93	144	106	241	C5
C6	75	58	67	34	69	71	11	62	0	352	287	35	63	246	21	96	98	157	153	127	148	C6
D3	82	56	68	39	84	89	16	53	33	9	795	58	84	216	51	94	128	175	222	90	97	D3
D9	50	35	38	28	51	56	15	25	22	70	14	78	119	251	48	107	175	213	252	121	90	D9
G4	27	15	25	14	21	21	8	12	2	4	4	0	454	126	46	113	156	222	151	203	257	G4
G2	10	8	8	6	8	8	3	4	3	5	5	10	0	193	0	114	121	266	32	243	153	G2
H	64	43	57	29	62	65	19	29	20	20	19	7	9	12	108	156	220	285	171	74	134	H
I1	9	5	9	3	7	7	4	3	1	3	2	1	0	5	0	705	250	181	66	0	117	I1
I2	18	14	17	10	14	14	7	7	5	6	5	3	2	8	12	0	238	259	142	80	98	I2
I11	15	11	13	10	13	13	8	3	5	8	8	4	2	11	4	5	0	653	294	41	203	I11
I15	26	20	22	14	22	21	8	9	9	12	11	7	6	16	4	7	17	0	325	166	253	I15
I31	39	30	33	23	33	34	7	15	10	17	15	6	1	11	2	5	10	13	41	52	137	I31
R	23	18	17	7	19	20	3	10	7	6	6	6	5	4	0	2	1	5	2	35	238	R
W	35	18	28	18	25	25	3	24	9	7	5	9	4	8	3	3	6	9	6	8	0	W
TOTAL	415	288	353	210	353	362	92	160	82	105	71	31	13	80	12	22	20	32	48	28	39	

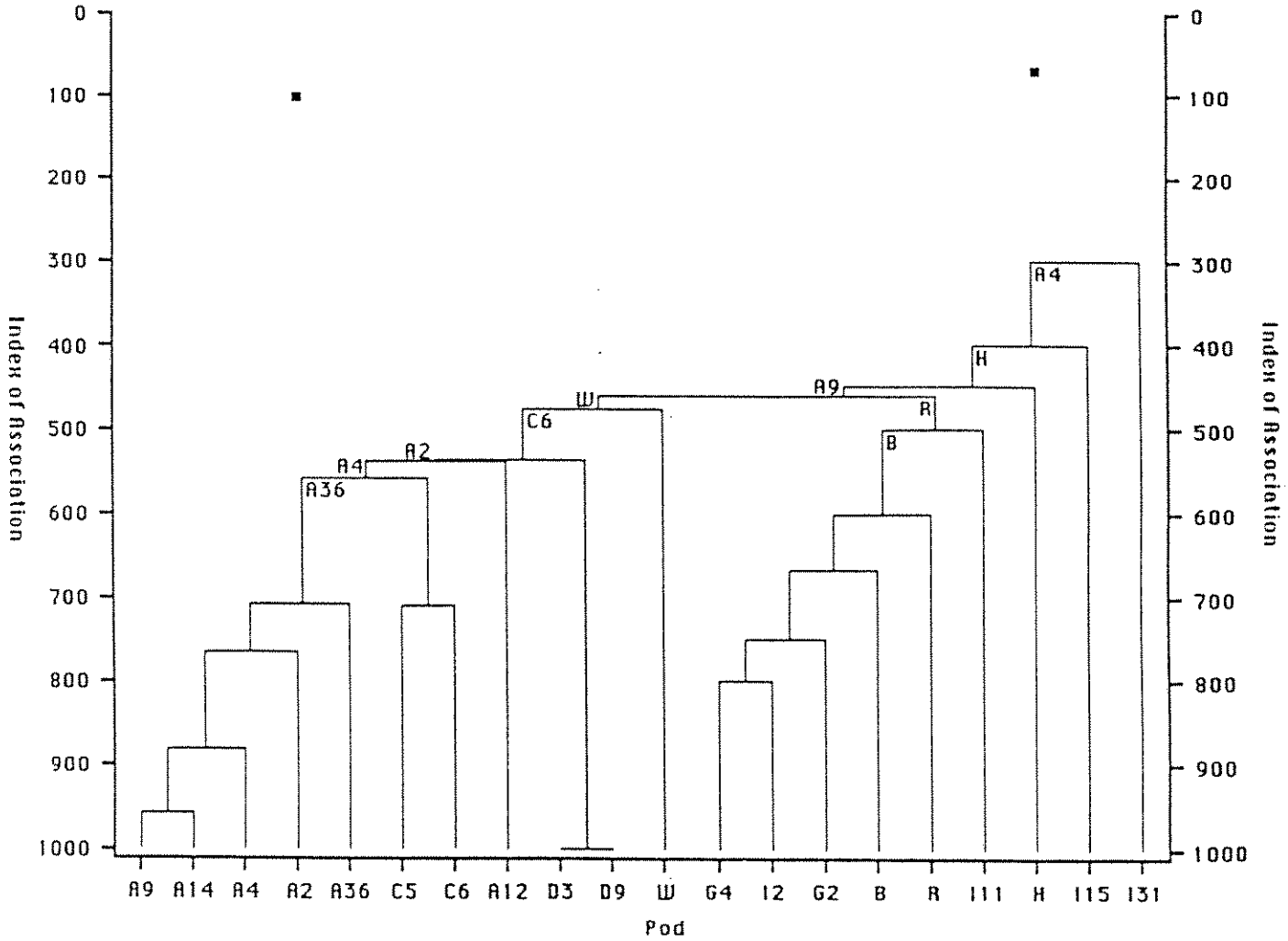

Figure 36. Cluster-analysis dendrogram of 1987 associations among pods and solo indices (squares). Pod associations linking clusters are shown.

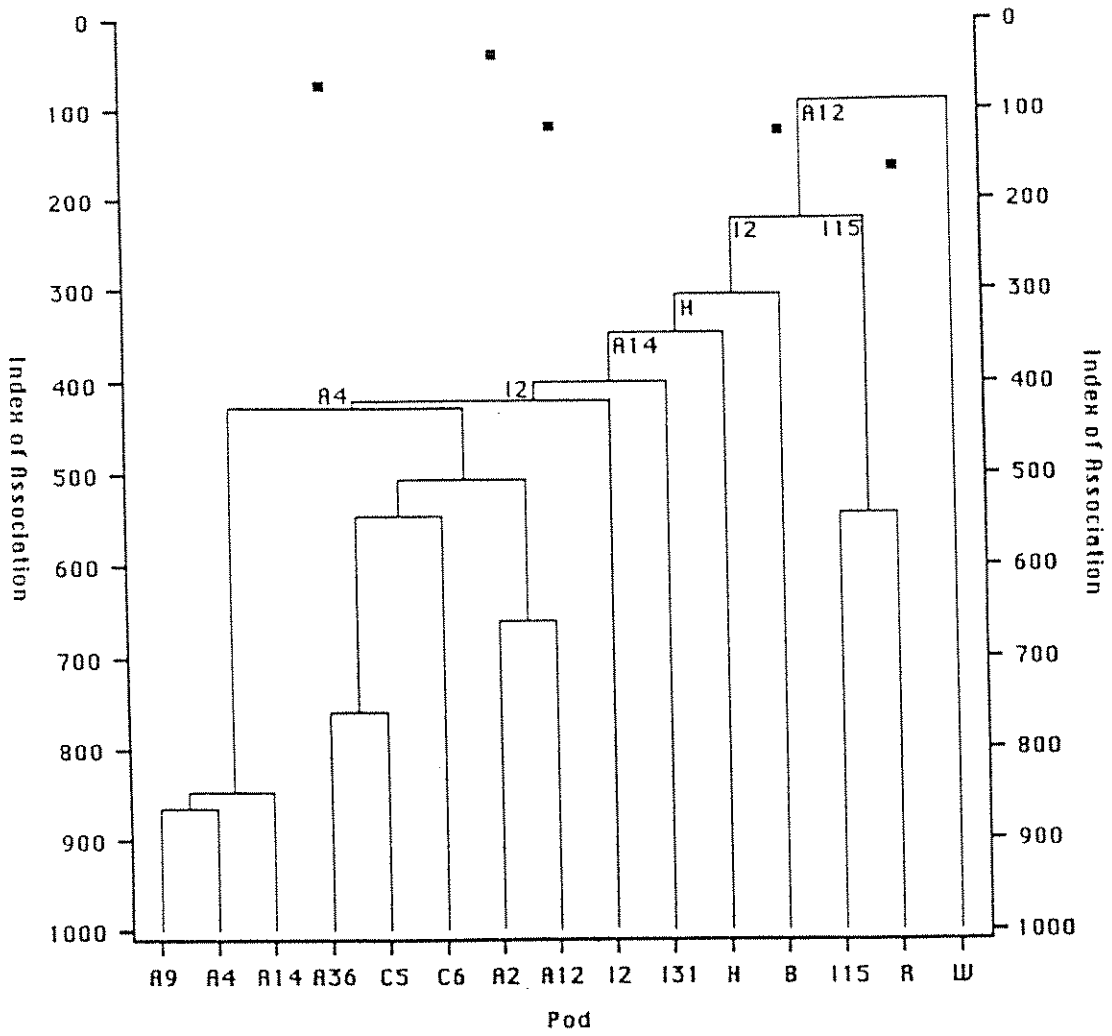

Figure 37. Cluster-analysis dendrogram of 1988 associations among pods and solo indices (squares). Pod associations linking clusters are shown.

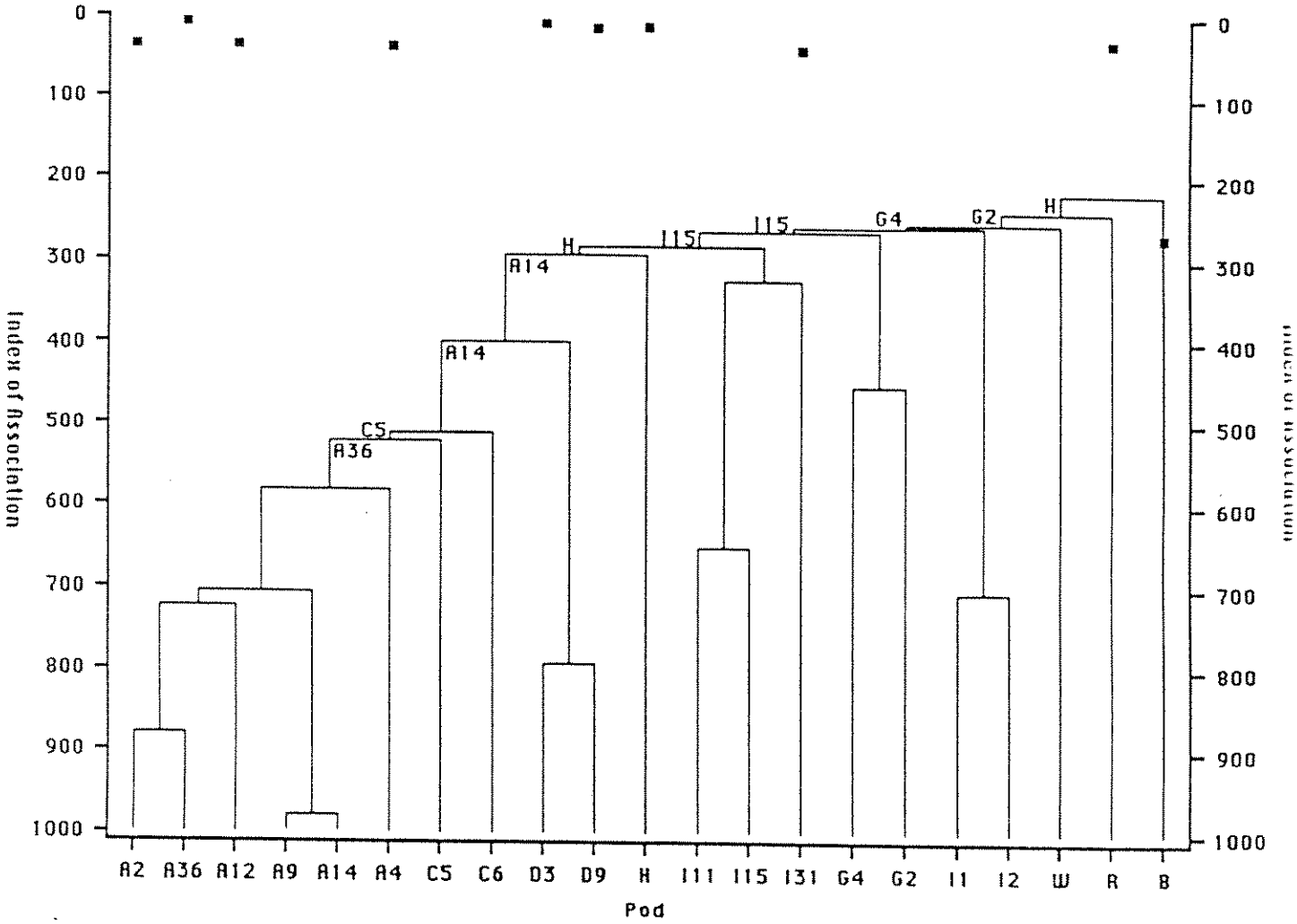

Figure 38. Cluster-analysis dendrogram of 1979 - 1988 associations among pods and solo indices (squares). Pod associations linking clusters are shown.

Pod Divisions, 1979 - 1988

The component subgroups of four pods (A1, A5, C, and D) started to travel independently of one another during the course of this study (Figure 39). The degree of division among the subgroups varied greatly (ie pod C), and in the case of pod D returned to 1000.

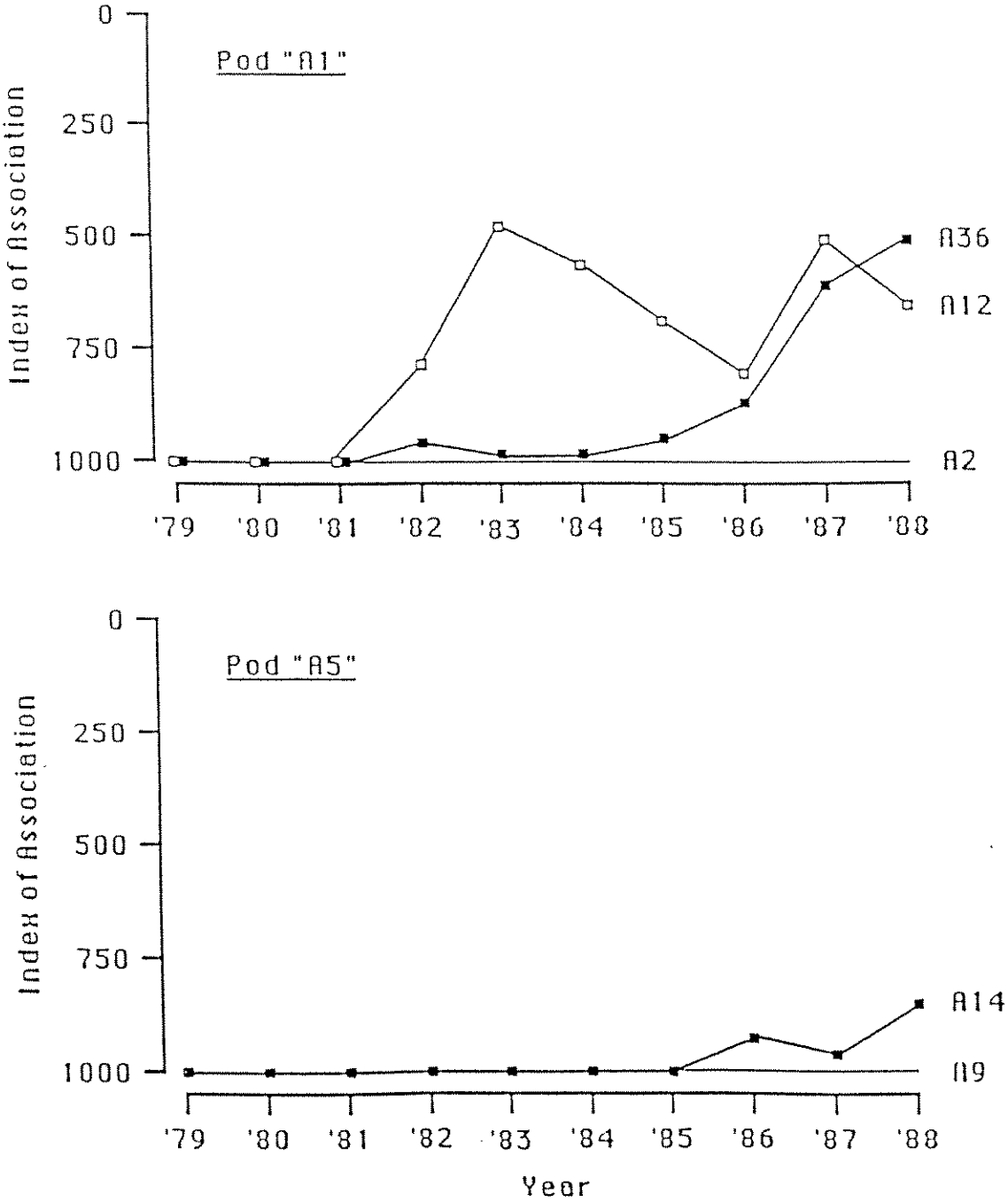

Figure 39. Annual changes in association among subgroups within pod A1 (subgroups A36 and A12 relative to subgroup A2) and pod A5 (subgroups A14 and A9).

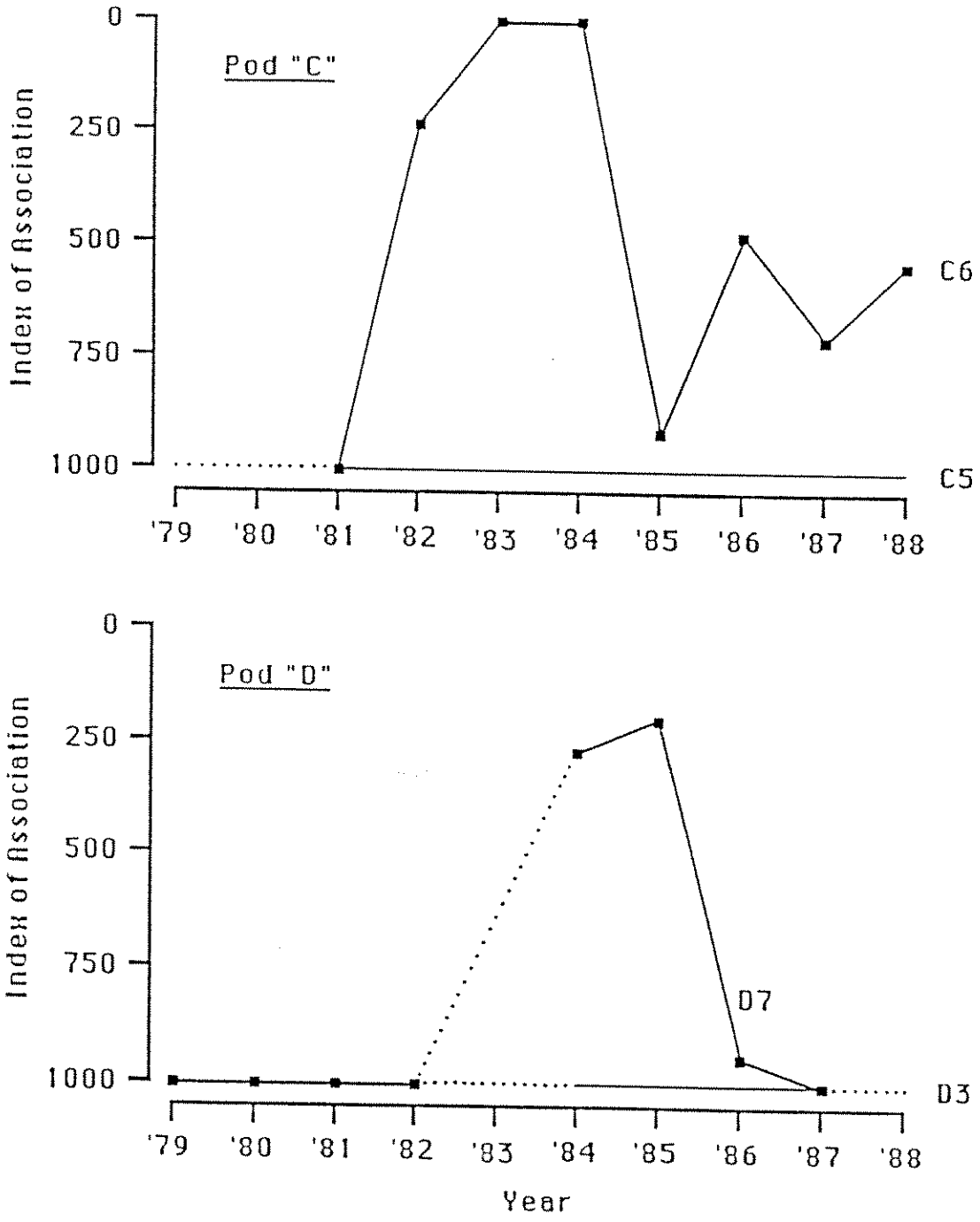

Figure 39 (continued). Annual changes in association among subgroups within pod C (subgroups C6 and C5) and pod D (subgroups D7 and D3). Dotted lines signify no sightings for those years.

DISCUSSION

The decade of data presented in this study described several stable aspects of orca social behavior - maternal subgroup fidelity, core areas, superpod events, male-male interactions, resident-transient interactions, and allomaternal associations - that might be considered basic rules. There have been several possible exceptions to these rules - the behavior of I33 and A20 for example - that indicate that ten years are still insufficient for describing the social behaviors of these long lived cetaceans adequately. The next decade may present many new surprises, perhaps on the order of Goodall's (1986) experiences with the chimpanzees.

One of the primary questions I have of this study and of the next decade is why do pods disassociate into subgroups? Simmilarly, what is it that motivates a subgroup from one pod to associate with a subgroup of another pod, even one of a different dialect? My first hypothesis is that associations among subgroups is related to subgroup age and sex class compositions. For example, pod B was composed primarily of males and was seen solo more often than with any other pod, whereas pods composed mostly of females and calves tended to associate closely. Subgroups that tended to wander about tended to be composed of an older, probably postreproductive, female and her adult sons (ie pods W, G4, R2, and perhaps even A12). The methods presented in this paper were a bit too cautious to describe this relationship sufficiently, due to the lumping of all daily pod sightings in the study area. A time-based proximity method of analysis would address this question better. My field notes should yield this type of data should the motivation arise to dig it out.

Despite the slow rate of dispersal of subgroups (and a few individuals) from one another, future long term studies must take this into account. It is therefore important that all sighting and association data should be collected at the level of the individual (the splitters win once again). The labeling problem will only get worse as pods continue to change in membership and composition. The pod "A4" at the begining of this study was very different from the pod "A4" at the end. Long term compilations of data, such as the pod association dendrogram for 1979-1988 (Figure 38), will therefore represent general trends only.

LITERATURE CITED

Goodall, J. 1986. The Chimpanzees of Gombe. Harvard University Press, Cambridge, Massachusetts, 673 pp.