State of Oregon
Department of Geology and Mineral Industries
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Portland, Oregon 97201

OPEN-FILE REPORT O-87-04

DISTRIBUTION AND ABUNDANCE OF SEABIRDS IN THE VICINITY OF THE GORDA RIDGE, OFF EUREKA, CALIFORNIA, DURING JULY 1986

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Final Report for Contract No. 63-630-8510

Submitted to:

Oregon Department of Geology and Mineral Industries

and the

Gorda Ridge Technical Task Force

Released December 1987

NOTICE

This report is based on results of a research program directed by the joint federal-state Gorda Ridge Technical Task Force, managed by the Oregon Department of Geology and Mineral Industries and funded by the Minerals Management Service, U.S. Department of the Interior, through Cooperative Agreement. Opinions expressed are those of the author and do not constitute endorsement by the sponsoring agencies or the Task Force.

The Oregon Department of Geology and Mineral Industries is publishing this paper because the subject matter is consistent with the mission of the Department. To facilitate timely distribution of information, camera-ready copy submitted by the author has not been edited by the staff of the Oregon Department of Geology and Mineral Industries.

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INTRODUCTION

In July and August of 1986, geologic studies were conducted in the vicinity of the Gorda Ridge, about 150 nautical miles due west of Eureka, California, by the Gorda Ridge Task Force. Although the primary goal of the expedition was to collect and assess polymetallic sulfide deposits found near active submarine vent sites, the expedition presented a unique opportunity to assess the abundance and distribution of seabirds in this area. No studies of seabird utilization of this area have been conducted (Krasnow, 1986). The area included in the region east of 126 degrees west longitude was part of an earlier aerial survey (Briggs et al, 1983), but the present study area is well outside the region covered by Briggs.

METHODS

Transects were conducted along a predetermined route, due west from Eureka along the 40°45' north latitude line to the dive site at 127°30' west longitude, a distance of approximately 150 nautical miles offshore (see Figure 1). Observations were made from the deck of the _Transquest_, support ship for the Naval submersible vessel _Sea Cliff_. All observations were done visually, with the aid of binoculars. Birds sighted within a distance of 300 meters of the vessel were recorded. Time spent during each observation session varied, from 30 minutes to three hours. Observer height for all observations en route was approximately 4 meters off the sea surface in calm seas. Speed of the vessel varied, from 2.8 to 5.4 knots. Since this speed is too slow to allow accurate censusing for density estimates (Powers, 1982), it was necessary to census in terms of relative abundance, i.e., number of individuals per hour of observation time. This value was obtained by dividing the number of individuals sighted during an observation session by the time of the session in hours. Counts were made both of birds resting in the water and birds flying. Direction of flight was noted for all flying birds. The census area was limited to within 300 meters of the vessel. Due to wind, swell and sun conditions, observation was limited to a 180 degree arc, and the side of the vessel from which observations were made varied with time of day, weather conditions and direction of travel.

Once the dive station was reached, observation was limited to only those birds flying through the census area. Originally, it was planned to conduct census transects away from the support vessel in a 20-foot skiff, within a radius of 5 km from the support vesssel. Unfortunately, high winds and heavy seas prevailed after the first day at the dive site, and only one transect of this type was attempted. Observer fatigue during the time spent at the dive site was also higher than anticipated, and much effort was expended in responding to the bodily demands of state five seas.

A forced early return to port on 23 July made it possible to survey the nearshore area a second time. The second trip to the dive site, on 25 July, was aborted about 100 nautical miles out to sea due to persistence of the wind and sea conditions which necessitated the first return to port. Therefore, further surveying of the study area was impossible.

RESULTS

DISTRIBUTION AND ABUNDANCE AT THE DIVE SITE

Of the species whose range was reported by Krasnow to include the study area, only five were found on a regular basis during the expedition. The species with the highest abundance was the Blackfooted Albatross (Diomedea albatrus), with an average abundance of 2.1 individuals per hour of observation. Second in abundance was the Leach's Storm Petrel (Oceanodroma leucorhoa), with an average abundance of 1.3 individuals per hour, followed by Red-Necked Phalaropes (Phalaropus lobatus), Jaegers (Stercorarius spp.) and Northern Fulmars (Fulmarus glacialis), with an average abundance of .83, .35 and .04 individuals per hour respectively (see Table 1).

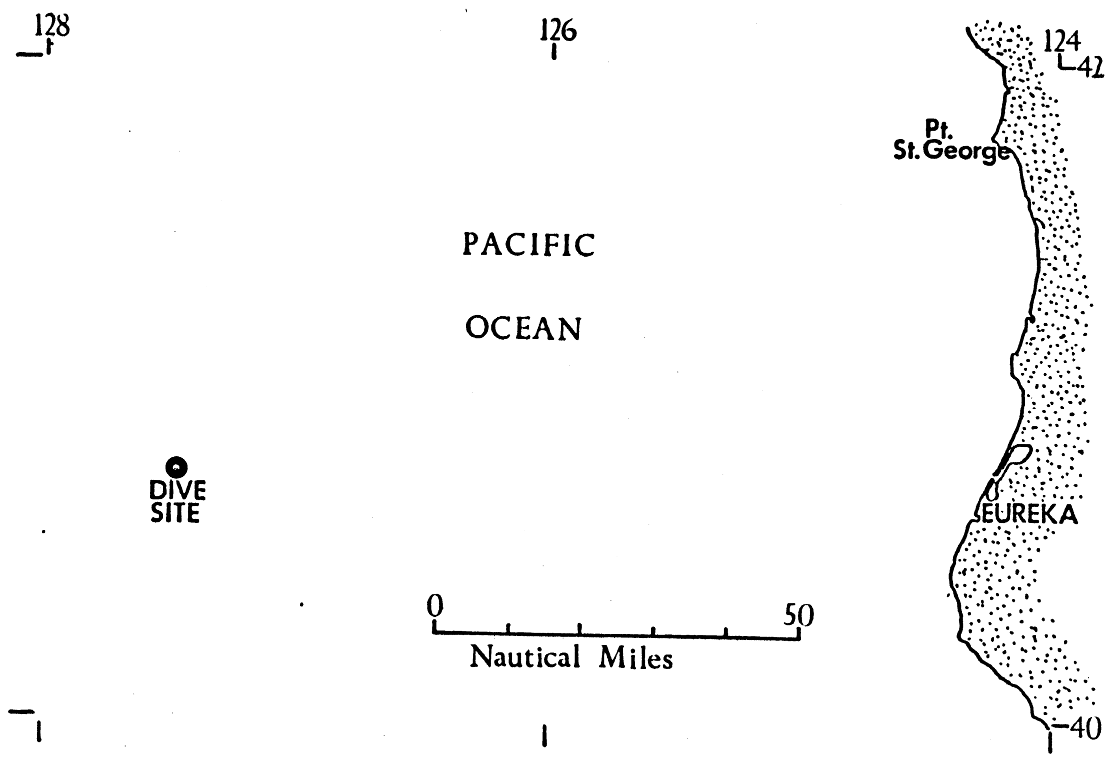


Figure 1. The Gorda Ridge study area, off Eureka, California. Seabirds were censused en route to the dive site indicated, and while on station at the dive site.

Table 1 Relative Abundance of Seabirds, 150 nautical miles off Eureka, California, August 1986.

SPECIES	RELATIVE ABUNDANCE no./hr
Blackfooted Albatross	2.1
Leach's Storm Petrel	1.3
Red-Necked Phalarope	.83
Jaegers	.35
Northern Fulmar	.04

BLACKFOOTED ALBATROSS

Blackfooted Albatross were observed flying through the study area, consistently in a northerly to northwesterly direction, due to the northwesterly winds which blew during the entire study. In only two instances were individuals observed resting on the water or actively following the vessel. In all other sightings, the presence of the vessel seemed to make no difference to the flight behavior or direction of travel of the birds, and they flew in a constant direction from the moment of first sighting until they were lost to visibility through the binoculars. The first sighting of Blackfooted Albatross was 12 nautical miles offshore on the first transect to the dive site, and the highest abundance was observed at 25 miles offshore, with a relative abundance of 15 per hour. Abundance was lower at the dive site, ranging from 10 per hour to zero. At the dive site, albatross were seen throughout the day, with the highest abundance being about 1400 hours, with an abundance of 10 per hour (see Appendix A).

Albatross were usually seen as solitary individuals. However, in a few cases two or three were flying through the study area, apparently together.

LEACH'S STORM PETREL

Leach's Storm Petrel is a small tubenose rarely seen within sight of land, except on breeding colonies. The first offshore sightings were 20 nautical miles from land. The highest abundance estimates were obtained from sightings at 32 miles offshore, and 150 miles offshore at the dive site. At both these distances the relative abundance was 18 individuals per hour. They were observed on a regular basis both on the outward transect and at the study area. There seemed to be little correlation between abundance and time of sighting at the dive site, with all but one abundance estimate being 3 per hour or less. No Leach's Storm Petrels were seen resting on the water, and all were travelling in a north to northwesterly direction. There were none sighted in obvious groups, but all travelled as individuals.

Abundance estimates of Leach's Storm Petrels may be lower than the actual numbers present, due to the small size and dark color of the birds. This would be especially noteworthy during periods of heavy seas, over 12 feet, when they tend to stay in the troughs between swells.

RED-NECKED PHALAROPE

Although abundance of Red-Necked Phalaropes appears to be relatively high, both Jaegers and Northern Fulmars were sighted on a more regular basis. This is due in part to the small size of the Phalaropes, and their associated habits of flying low to the water for short flights, and spending long periods of time resting or feeding on the surface. This makes phalaropes easier to miss during censusing.

The only phalaropes that were sighted offshore at the study area were seen in a single group on the sole transect that was conducted away from the support vessel, and during ideal viewing conditions of clear sky with the sun at the back, no wind and a two-foot swell. No other Phalaropes were counted in the area of the dive site, and only one other was seen offshore past 25 nautical miles offshore, when one was found on deck after dark, injured after it had flown or been blown into the rigging. It is not known how abundant Red-Necked Phalaropes may actually be in the area, but it is assumed that their abundance is probably higher than that shown on Table 1, for the same reasons of size and color as those pertaining to the Leach's Storm Petrel.

JAEGERS

Although their appearance was sporadic, both Jaegers and Northern Fulmars appeared in the area of the dive site on a regular basis. Average abundance of Jaegers was .34 individuals per hour at the dive site, and they appeared at every sighting in small groups. Jaegers were not sighted within 125 nautical miles of shore, although they are known to be in this area. Highest abundance was 4 individuals per hour, and all were sighted during the morning hours.

NORTHERN FULMAR

Northern Fulmars were sighted from ten to 150 nautical miles offshore, with an average abundance of .04 individuals per hour at the dive site. They appeared singly or in groups no larger than three individuals. Highest abundance, 9 per hour, was estimated for observations 20 miles offshore, and abundance was higher nearshore than at the study site, where only one individual was observed.

INCIDENTAL SIGHTINGS

Two species were sighted offshore which are not commonly found in the study area. On 25 July, at 1307 hours, two Buller's Shearwaters (Puffinus bulleri) were observed, 32 nautical miles offshore, flying in a northwesterly direction. They passed within 50 meters of the vessel, and were observed with binoculars.

On 18 July, at 0854 hours, at a distance of 108 nautical miles offshore, a petrel was sighted about 100 meters off the vessel, travelling in a northeasterly direction. The description in the field notes is as follows: all dark upper coverts, white body with dark wings lower side, slightly larger than Leach's, with higher wing stroke. A sketch was quickly made on a field sheet of seabird outline line drawings, showing a dark head and wings, with a white body and tail on the lower side. Referring to Harrison's Seabirds, identification was proposed as Phoenix Petrel, (*Pterodroma alba*)

MAMMAL SIGHTINGS

Three times during the expedition, cetaceans were sighted. On 17 July, at 2010 hours, a distance of 38 nautical miles offshore, two Dall's Porpoise (*Phocoenoides dalli*) were seen riding the bow wave of the vessel. They travelled with the vessel for about 30 minutes, then left, travelling in a southerly direction.

Later the same day, at 2029 hours, a distance of 42 nautical miles offshore, four more Dall's Porpoise were sighted riding the bow wave. It is not known whether any of these included animals from the first group.

On 18 July, at 1450 hours, a distance of 137 nautical miles offshore, two killer whales (*Orcinus orca*) were sighted about 50 meters north of the vessel, travelling in an easterly direction. One of the pair was an adult male. The second was a subadult animal.

Although on previous survey trips to the dive site sightings were reported of sperm whales and northern fur seals, the above animals were the only sightings for this expedition.

SEABIRD ABUNDANCE EN ROUTE TO THE DIVE SITE

Seabirds were censused en route to the dive site. Some species were sighted only within 100 nautical miles of shore and not at all at the dive site. Although relative abundance of all seabirds sighted is presented in Appendices A and B, species seen only within 100 nautical miles are discussed separately. The Appendix tables indicate only numbers of individuals sighted, and do not differentiate between birds resting on the water and birds flying. Of birds seen within 50 nautical miles of shore, the two species with highest relative abundance were Red-Necked Phalaropes and Fork-tailed Storm Petrels (*Oceanodroma Furcata*), with relative abundances of 930 and 140 individuals per hour, respectively. Relative abundance was highest for these species because in both cases large feeding aggregations were sighted. Outside the large rafts of birds, numbers of both species were relatively low. Cassin's Auklet (_Ptychoramphus aleuticus_) was third in abundance, with 87 individuals per hour, followed by Common Murres (_Uria aalga_) with a relative abundance of 57 birds per hour. Other species were much lower in abundance (see Table 2).

Table 2. Seabird abundance within 50 nautical miles west of Eureka, California, July 1986.

SPECIES	RELATIVE ABUNDANCE			
	17 JULY [A]		25 JULY [B]	
	no.	no./hr	no.	no./hr
Red-necked Phalarope	11	2.4	2000	930
Fork-tailed Storm Petrel	0	0	300	140
Cassin's Auklet	0	0	187	87
Common Murre	73	16.2	27	57
Blackfooted Albatross	8	1.8	20	9.3
Sooty Shearwater	1	.2	18	8.4
Gull spp.	22	4.9	12	5.6
Northern Fulmar	3	.7	8	3.7
Leach's Storm Petrel	12	2.6	3	1.4
Rhinoceros Auklet (_Cerorhinca monocerata_)	2	.4	0	0
Loon spp. (_Gavia_ spp.)	2	.4	0	0
Brown Pelican	1	.2	1	.5

A: Includes observations from 4 to 42 nautical miles offshore, total census time of 4.5 hours.
B: Includes observations from 6 to 25 nautical miles offshore, total census time of 2.14 hours.

COMMON MURRES

Common Murres were highest in abundance within a few nautical miles of the mouth of Humbolt Bay. On the first transect to the dive site, over 90% of the murres sighted were in parent-chick feeding pairs. Those censused during the second transect included about 75% adult-chick pairs. Abundance fell off rather quickly with distance from shore, with abundance being highest, 136 birds per hour, 5 nautical miles from shore and dropping to zero by the time a distance of 20 nautical miles had been reached. See Appendix tables A and B.

Most of the birds censused were resting on the surface or feeding, although little active feeding behavior was noted. Of the birds flying, Table 3 shows that 57% of the flying birds were headed in a northerly direction. This may be related to the time of sighting, and to the distance offshore.

RED-NECKED PHALAROPE

Although highest in relative abundance, Red-Necked Phalaropes were not seen in large numbers outside a large group, exceeding 2000 individuals, actively feeding a distance of 2 nautical miles offshore, at 0930 hours on 25 July. Most birds outside this group were seen flying, with 68% of the birds sighted flying in a southerly direction. They were seen from 9 nautical miles offshore to the dive site, with relative abundance within 50 nautical miles being 3.7 individuals per hour, excluding those counted in the feeding aggregation.

FORK-TAILED STORM PETREL

No Fork-tailed Storm Petrels were sighted on the first offshore transect. However, on the second transect, they were seen in higher abundances. Most of the sightings were of solitary birds or birds in small groups. The largest number of birds was seen in a group of approximately 300 individuals, actively feeding at a distance of 22 nautical miles offshore, 25 July . The presence of this large group raised the average relative abundance to 140 per hour.

Table 3. Direction of flight of seabirds censused off Eureka, California, July 1986, within 50 nautical miles of shore.

SPECIES	DIRECTION OF FLIGHT NUMBER COUNTED*			
	N	S	E	W
Common Murre	13	9	1	
Cassin's Auklet	14	74		
Gull spp.	9	4	3	14
Fork-tailed Storm Petrel		6		
Rhinoceros Auklet				
Loon spp.	1	1		
Red-necked Phalarope	6	13		
Blackfooted Albatross	18	8	2	
Leach's Storm Petrel	15			
Northern Fulmar	9	2		
Sooty Shearwater	18	1		
Brown Pelican	1	1		

*Indicates total number counted during two census intervals, 17 July and 25 July, en route to the dive site. Total censusing time was 6.64 hours. Total distance covered was 64 nautical miles. Total area censused was 19.2 square miles.

CASSIN'S AUKLET

It is interesting to note that no Cassin's Auklets were sighted during the first transect offshore, July 17, but that large numbers were seen on the second transect. The highest abundance, 358 birds per hour, was recorded a distance of 7 nautical miles offshore, with the abundance dropping to zero at a distance of 27 nautical miles. Nearly half of the birds counted were flying, 40% in a southerly direction, and 7.5% to the north.

GULLS

Members of the gull species were counted together, with only the appearance of Heerman's Gull (Larus heermanii) noted separately. Gulls appeared singly or in small groups, and appeared to have little interest in the presence of the vessel. Most of the gulls were in flight, with the few exceptions being those sighted very near the mouth of Humbolt Bay. Most of the gulls were seen flying past the vessel in a westerly direction, but probably were making large circular paths. In some cases gulls were observed with binoculars executing a wide circular path, estimated to be about 0.5 km in diameter.

Abundance was high near shore, 144 birds per hour at a distance of 4 and 7 nautical miles from shore. No gulls were seen farther offshore than 25 nautical miles.

BLACKFOOTED ALBATROSS

Blackfooted Albatross were first sighted a distance of 12 nautical miles offshore, and were seen consistently out to the dive site. Relative abundance was 9.3 individuals per hour, but was as high as 15 per hour. Most of the birds were flying as individuals or in small groups, with 64% of the birds flying in a northerly direction.

SOOTY SHEARWATER

Sooty Shearwaters were first sighted a distance of 6 nautical miles offshore. Average relative abundance was 8.4 individuals per hour, with the highest abundance being 13 individuals per hour. None were sighted farther offshore than 25 nautical miles.

Since Sooty Shearwaters appear in larger numbers later in the summer, it is very likely that abundances would be higher during the time following the 25 July census. In fact, abundance rose from .22 per hour to 8.4 per hour between 17 July and 25 July.

NORTHERN FULMAR

Northern Fulmars were seen from 10 nautical miles offshore to the dive site, with abundance being low but consistent offshore. Abundance was 3.7 individuals per hour within 50 miles of shore. All of the birds seen were flying, with 82% flying north.

LEACH'S STORM PETREL

Leach's Storm Petrels were also sighted from 18 miles offshore to the dive site on a regular basis, with relative abundance being 2.6 birds per hour on the average, and as high as 18 per hour. All of the birds sighted were flying north.

RHINOCEROS AUKLET

Rhinoceros Auklets were seen in very low abundance. Only two individuals were sighted, singly, on the water, at distances of 18 and 38 nautical miles offshore. Both were within 50 meters of the vessel.

CORMORANTS

No cormorants were sighted farther offshore than one nautical mile, and are therefore excluded from this survey.

CASPIAN TERN

The only member of the terns sighted offshore was the Caspian Tern. All sightings were of individual birds, and all were in flight. Since none were sighted farther offshore than one nautical mile, they are not included here.

LOONS

Members of the loon species were censused together. Abundances were low. Only two indivuduals were sighted, at a distance of 3 nautical miles offshore.

BROWN PELICAN

One Brown Pelican was sighted offshore, at a distance of 2 nautical miles, flying north.

DISCUSSION

Of the 29 species listed by Krasnow (1986) as known or thought to be in the Gorda Ridge lease area, only five were actually sited during July of 1986. It is possible that many other species utilize the area during other parts of the year, primarily other species of albatross, other petrels and shearwaters, and red phalapropes (Harrison, 1984).

Since gulls were found in rather high abundances in the area within 50 nautical miles of shore, and there was a definite decrease in numbers with distance offshore, it is unlikely that gull species utilize the study area in any significant numbers.

The Anseriformes mentioned by Krasnow as known to occur in the study area may appear during the months following July, when they are migrating south, even though none were observed during the present study.

Of the alcids, the author has not observed any species farther offshore than those which were sighted during the present study. Since the alcids are all wing- propelled pursuit divers feeding on prey taxa found predominantly in the offshore zone of upwelling (Tuck, 1961, Scott, 1976, Matthews, 1983, Harrison, 1984), it is not to be expected to find them in the outer shelf zone during summer months, when the water in this zone is of remarkable clarity, and therefore low in both available nutrients and prey taxa associated with nearshore upwelling and high turbidity.

Since conditions of water clarity during the study were strikingly similar to the conditions seen in tropical waters, it is possible that members of the tropical and/or highly pelagic Pterodroma petrel genus could utilize the area of the Gorda Ridge. Many of this genus have been recorded farther north than the study area, but far offshore (Harrison, 1984). The proposed sighting of Phoenix Petrel may simply be a case of vagrancy, but use of the Gorda Ridge area by Pterodroma petrels may in fact be common, since no long term studies of seabirds in the area have been conducted (Krasnow).

Briggs et al.(1985) discussed briefly the problems of observing small, dark birds at sea, especially when they rest on the water. This may have been a problem, especially concerning the observations made during the periods of high winds and seas, when large areas of the surface were behind chop for several seconds, or behind huge swells for a large fraction of a minute. This effectively decreased the useful range of observation to probably 200 meters, when dealing with birds such as phalaropes, but probably had a negligible effect on the sighting of albatrossses, shearwaters and storm petrels. This is due to the flight characteristics of these species during periods of high winds and swells, when their dynamic soaring reaches its most aerial limits, and even the small storm petrels reach heights many meters above the swells as the wind and swell size increases, and in so doing become more conspicuous than they would be during times of low wind velocity.

Observer fatigue was mentioned in the methods, and may have led to observed values differing somewhat from the actual abundances. However, a determined effort was made to keep fatigue to a minimum by avoiding protracted observation sessions, resting between sessions, and by making observations from the side of the vessel facing away from the surface glare of the sun as much as possible.

Powers (1982) discussed some of the problems associated with using abundance estimates to calculate density when birds were sighted both on the water and flying. He suggested that a 1:1 ratio existed between abundance of birds seen flying and density, and a minimum of 2:1 for sitting birds. Since in this study abundance estimates were made during two observer conditions, i.e., in transect and at rest on station, no attempt has been made to calculate actual density of seabirds. A relative abundance estimate would be a more realistic assessment of seabird use of the area when comparing the birds counted when on station to those counted on transect, because of the vessel speed of less than 5 knots (Powers). Had the vessel been travelling at a higher speed, an estimate of density would have been possible, but the low speed more closely approximated the conditions of a vessel at rest. Birds such as gulls, which often follow moving vessels, evidently did not interpret the condition of the vessel in transect as a moving condition, because they made no attempt to follow.

Furthermore, while on station, the relative abundance estimates do not take into account the movement of the birds through the observation zone. To convert the abundance data to density data would require information about the speed of flight of the birds, and it was not possible to obtain this information.

Briggs also suggested that for low vessel speeds, abundance is very nearly equal to that obtained by a stationary vessel. This would only be true if observations were made in similar environments. By moving through areas of differing trophic dynamics, as from the nearshore zone of high upwelling and high turbidity to the offshore zone of low upwelling and turbidity, it would be expected that not only different abundances would be observed, but also different species utilization. Separate presentations of data for the en route observations and those obtained at the dive site addresses this problem.

RECOMMENDATIONS

It is recommended that seabird ecology in the vicinity of the Gorda Ridge continue in conjunction with studies conducted by the United States Geologic Service, Minerals Management Service, Oregon Department of Geology and Mineral Industries, or any other agency involved with surveys of this area which may affect utilization of this area by marine birds and mammals. Since submarine mining of this region is a possibility, further studies providing baseline data about the distribution and abundance of marine birds and mammals will be necesssary in order to assess the extent of influence that any industrial activities may have on this habitat, and to prepare long range environmental impact statements that are realistic and meaningful.

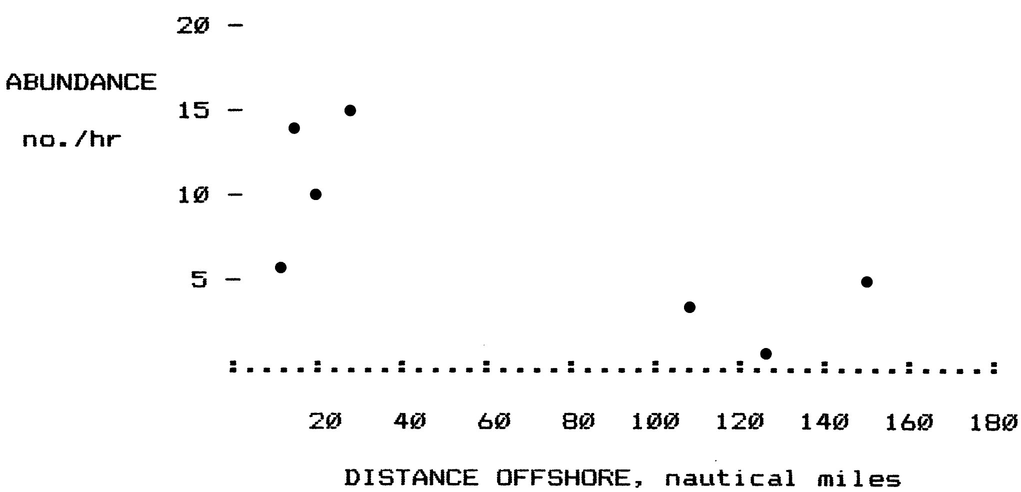
More specifically, it is recommended that: 1. seabird and mammal abundance and distribution be continued as an integral part of any mineral studies, 2. distribution studies be extended to include earlier and later parts of the year, which is of significance when considering southern hemisphere migratory birds, and 3. that seabird feeding and its impact on fisheries in the area of the Gorda Ridge be included in future studies, to accurately assess the actual utilization of trophic resources in this area by seabirds.

APPENDIX A

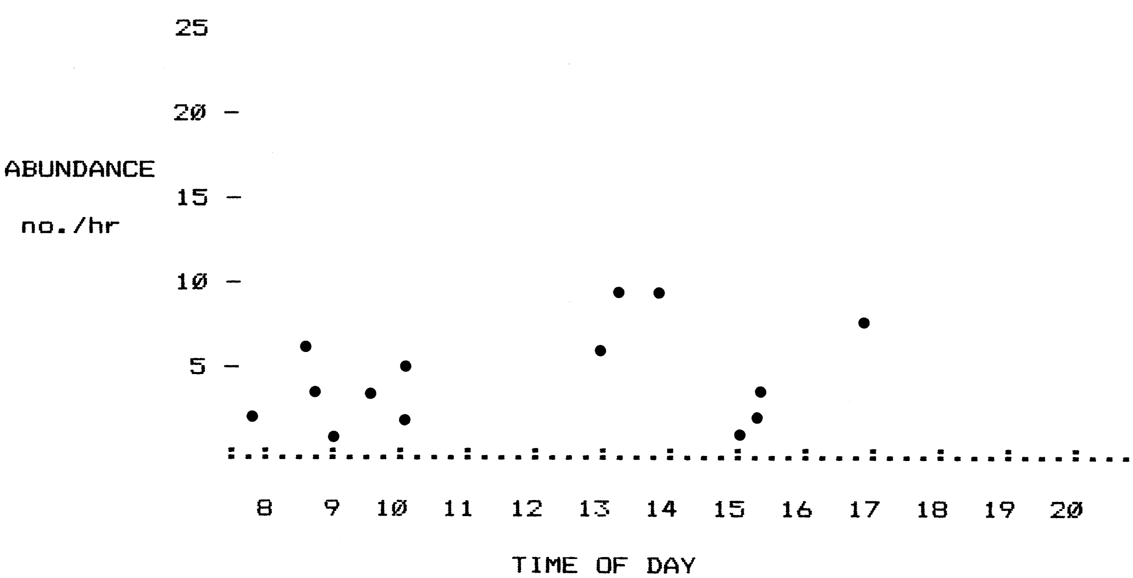
DISTRIBUTION AND ABUNDANCE GRAPHS

BLACKFOOTED ALBATROSS

ABUNDANCE AS A FUNCTION OF DISTANCE OFFSHORE

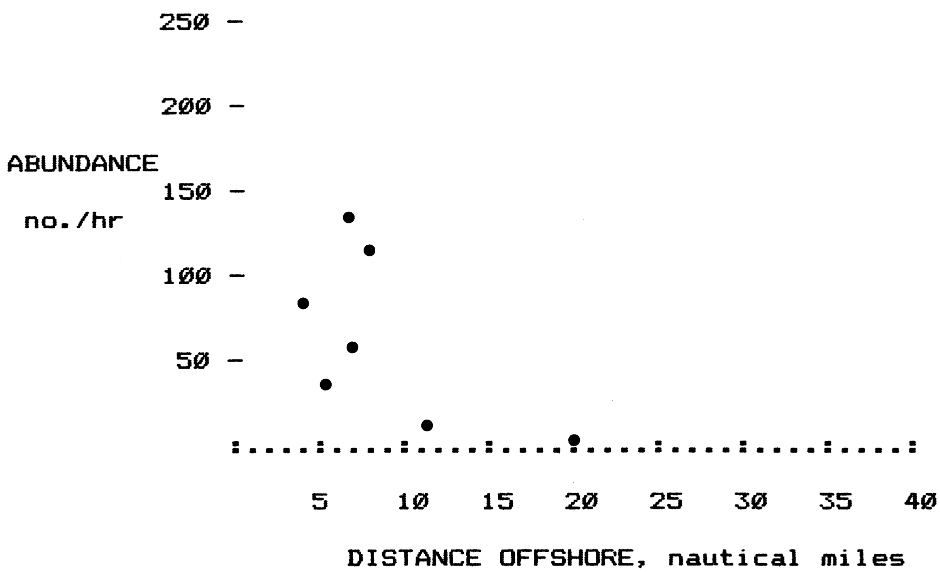


ABUNDANCE AS A FUNCTION OF TIME OF DAY, 150 naut. mi. offshore



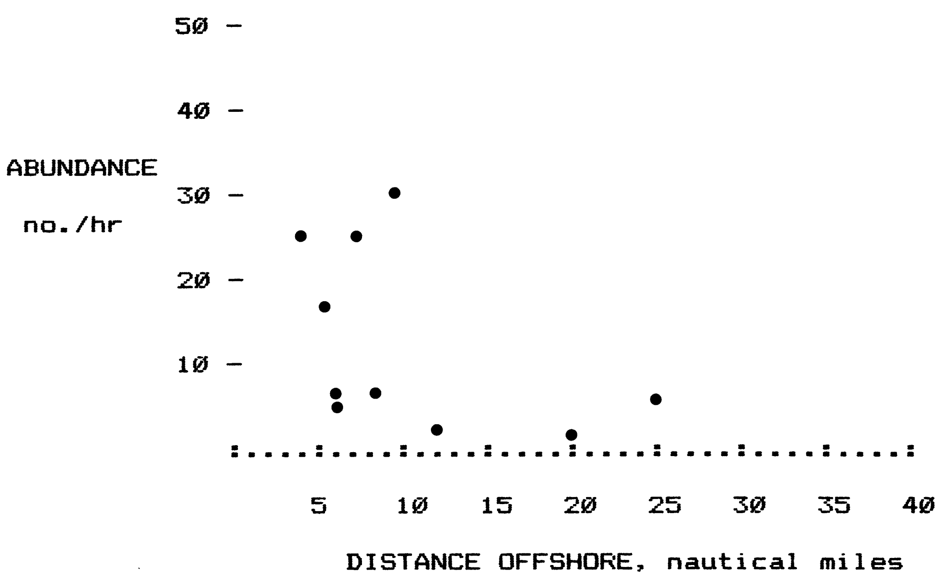
COMMON MURRES

ABUNDANCE AS A FUNCTION OF DISTANCE OFFSHORE



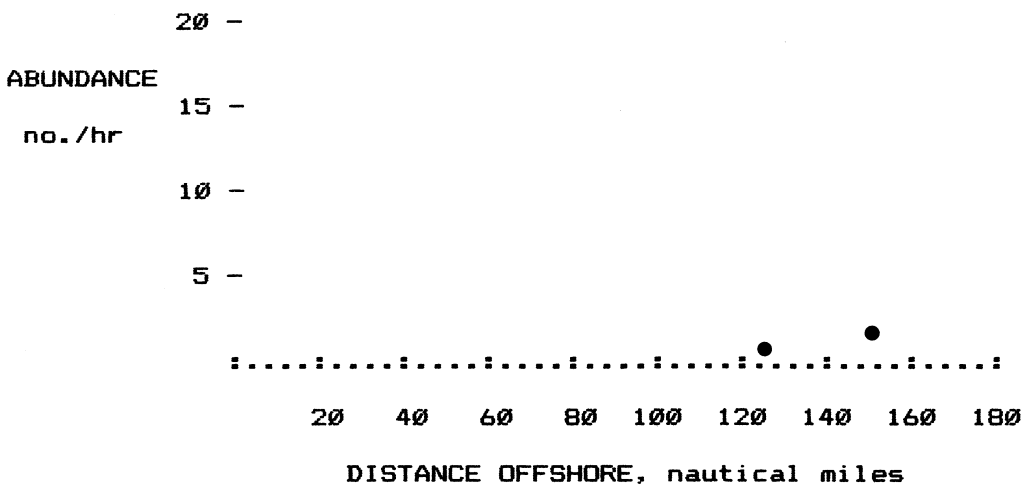
GULLS

ABUNDANCE AS A FUNCTION OF DISTANCE OFFSHORE

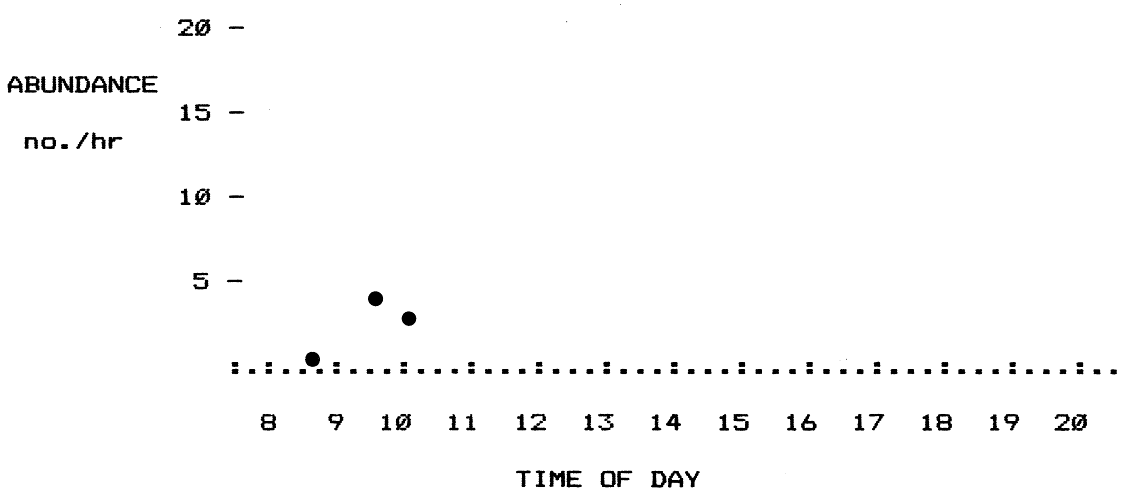


JAEGERS

ABUNDANCE AS A FUNCTION OF DISTANCE OFFSHORE

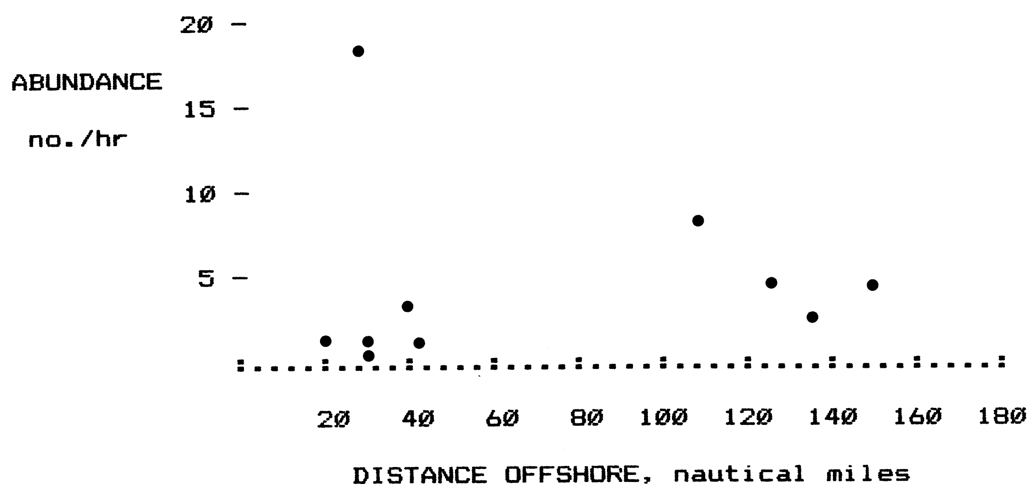


ABUNDANCE AS A FUNCTION OF TIME OF DAY, 150 naut. mi. offshore

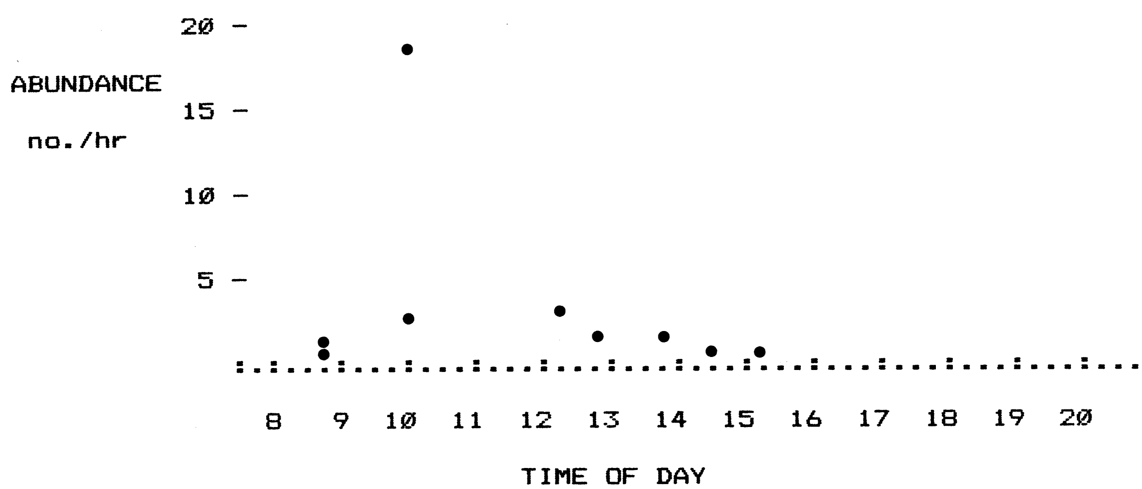


LEACH'S STORM PETREL

ABUNDANCE AS A FUNCTION OF DISTANCE OFFSHORE

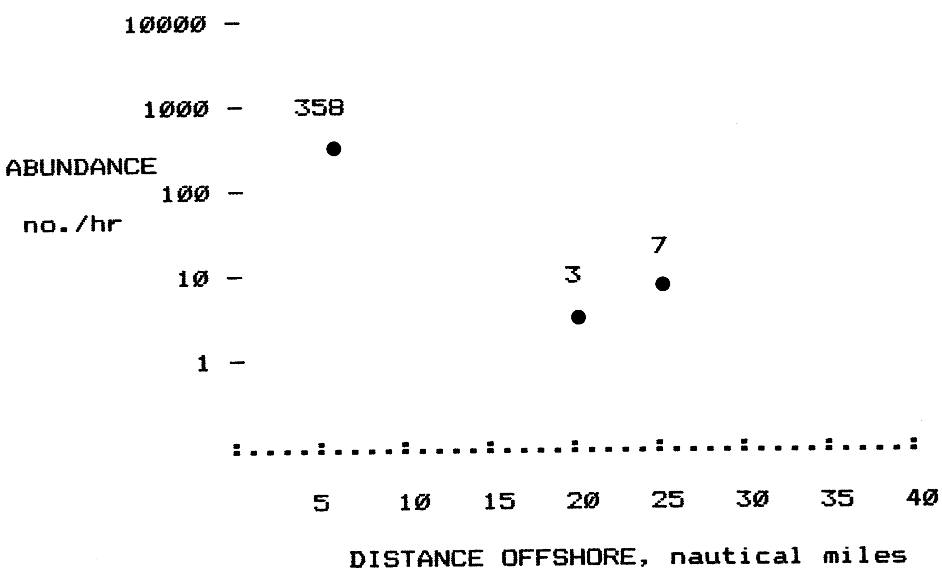


ABUNDANCE AS A FUNCTION OF TIME OF DAY, 150 naut. mi. offshore



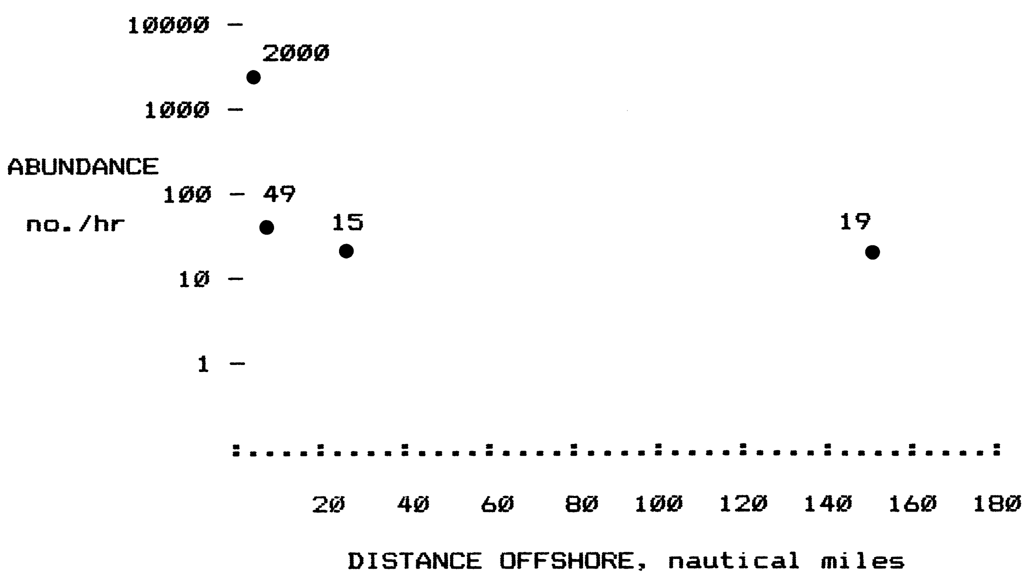
CASSINS AUKLET

ABUNDANCE AS A FUNCTION OF DISTANCE OFFSHORE

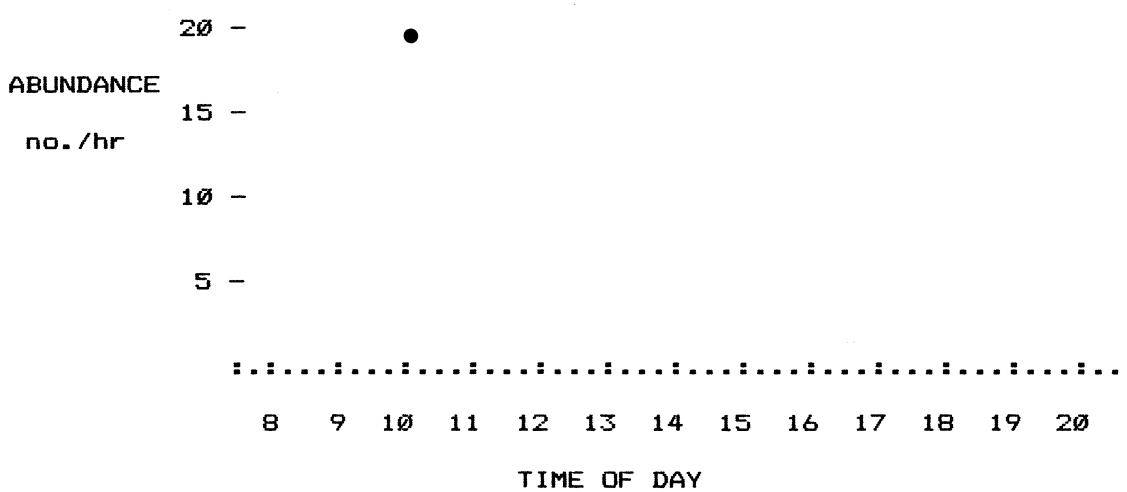


RED-NECKED PHALAROPE

ABUNDANCE AS A FUNCTION OF DISTANCE OFFSHORE

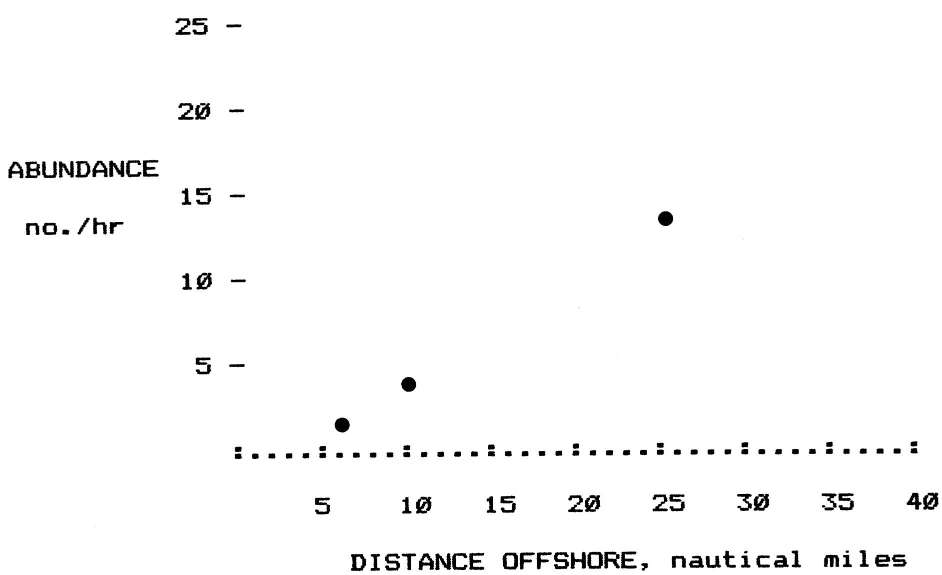


ABUNDANCE AS A FUNCTION OF TIME OF DAY, 150 naut. mi. offshore



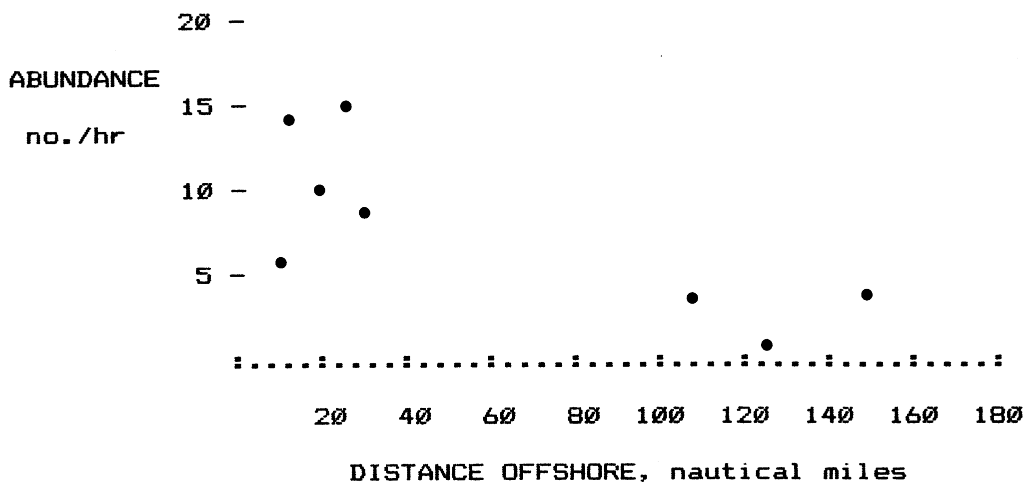
SOOTY SHEARWATER

ABUNDANCE AS A FUNCTION OF DISTANCE OFFSHORE

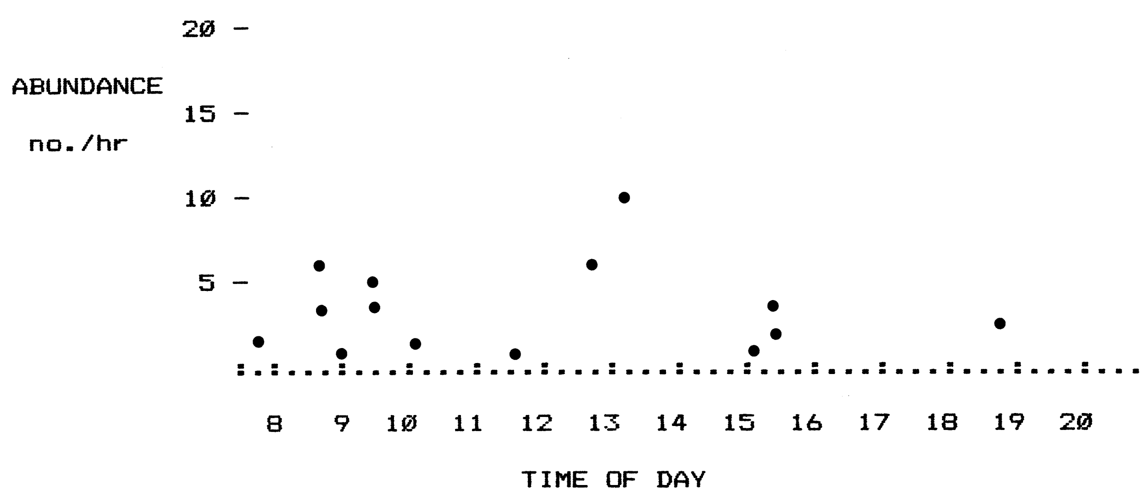


NORTHERN FULMAR

ABUNDANCE AS A FUNCTION OF DISTANCE OFFSHORE



ABUNDANCE AS A FUNCTION OF TIME OF DAY, 150 naut. mi. offshore



APPENDIX B

DISTRIBUTION AND ABUNDANCE DATA TABLES

Abundance of Blackfooted Albatross

DATE 1986	TIME	DISTANCE OFFSHORE* naut mi	NUMBER	ABUNDANCE** no./hr
7/19	Ø8ØØ-Ø921	15Ø	2	6
	Ø921-Ø945	15Ø	1	3
	Ø945-1ØØ2	15Ø		
	1ØØ2-1Ø4Ø	15Ø		
	12ØØ-1235	15Ø		
	1235-13Ø5	15Ø	3	6
	13Ø5-1336	15Ø	5	1Ø
7/2Ø	Ø73Ø-Ø83Ø	15Ø	2	2
	Ø91Ø-1Ø5Ø	15Ø	9	5
	142Ø-155Ø	15Ø	2	1
	184Ø-19Ø4	15Ø		
7/21	Ø8ØØ-1ØØØ	15Ø	2	1
	12ØØ-133Ø	15Ø		
	142Ø-163Ø	15Ø	6	3
	182Ø-192Ø	15Ø	3	3
7/22	Ø8ØØ-Ø93Ø	15Ø	4	3
	Ø93Ø-1Ø37	15Ø	2	2
	1Ø37-1237	15Ø	1	1
	1425-16Ø5	15Ø	2	2
7/25	1Ø25-1Ø55	6		
	13Ø7-14Ø5	2Ø	1Ø	1Ø
	14Ø5-1446	25	1Ø	15
	163Ø-17ØØ	32	4	8

* Indicates distance offshore measured from the midpoint of the transect segment for the time indicated.
** appearance of no numbers indicates zero individuals sighted.

Abundance of Blackfooted Albatross

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/17	1301-1310	4		
	1310-1321	5		
	1321-1331	6		
	1331-1341	7		
	1341-1352	8		
	1352-1402	9		
	1424-1440	10		
	1440-1459	12	2	6
	1459-1524	14	6	14
	1824-1854	32		
	1932-2010	35		
	2010-2029	38		
	2029-2055	42		
7/18	0814-1901	108	3	4
	0901-0914	110		
	1154-1354	125	1	1
	1450-1554	137		

Abundance of Common Murres

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/17	1301-1310	4	12	80
	1310-1321	5	25	136
	1321-1331	6	19	114
	1331-1341	7	8	48
	1341-1352	8	7	38
	1352-1402	9	9	54
	1424-1440	10	3	11
	1440-1459	12		
	1459-1524	14		
	1824-1854	32		
	1932-2010	35		
	2010-2029	38		
	2029-2055	42		
7/18	0814-1901	108		
	0901-0914	110		
	1154-1354	125		
	1450-1554	137		

Abundance of Common Murres

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/19	0800-0921	150		
	0921-0945	150		
	0945-1002	150		
	1002-1040	150		
	1200-1235	150		
	1235-1305	150		
	1305-1336	150		
7/20	0910-1050	150		
	1840-1904	150		
7/21	0800-1000	150		
	1420-1630	150		
7/22	0800-0930	150		
	0930-1037	150		
	1037-1237	150		
7/25	1025-1055	6	56	112
	1307-1405	20	1	1
	1405-1446	25		

Abundance of Gulls

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/17	1301-1310	4	4	24
	1310-1321	5	3	18
	1321-1331	6	1	6
	1331-1341	7	4	24
	1341-1352	8	1	6
	1352-1402	9		
	1424-1440	10	8	30
	1440-1459	12	1	3
	1459-1524	14		
	1824-1854	32		
	1932-2010	35		
	2010-2029	38		
	2029-2055	42		
7/18	0814-1901	108		
	0901-0914	110		
	1154-1354	125		
	1450-1554	137		

Abundance of Gulls

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/19	0800-0921	150		
	0921-0945	150		
	0945-1002	150		
	1002-1040	150		
	1200-1235	150		
	1235-1305	150		
	1305-1336	150		
7/20	0910-1050	150		
	1840-1904	150		
7/21	0800-1000	150		
	1420-1630	150		
7/22	0800-0930	150		
	0930-1037	150		
	1037-1237	150		
7/25	1025-1055	6	5	10
	1307-1405	20	2	2
	1405-1446	25	5	7

Abundance of Jaegers

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/17	1301-1310	4		
	1310-1321	5		
	1321-1331	6		
	1331-1341	7		
	1341-1352	8		
	1352-1402	9		
	1424-1440	10		
	1440-1459	12		
	1459-1524	14		
	1824-1854	32		
	1932-2010	35		
	2010-2029	38		
	2029-2055	42		
7/18	0814-1901	108		
	0901-0914	110		
	1154-1354	125	1	1
	1450-1554	137		

Abundance of Jaegers

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/19	0800-0921	150	2	1
	0921-0945	150	6	4
	0945-1002	150		
	1002-1040	150	2	3
	1200-1235	150		
	1235-1305	150		
	1305-1336	150		
7/20	0910-1050	150		
	1420-1550	150	2	1
	1840-1904	150		
7/21	0800-1000	150		
	1200-1330	150	1	1
	1420-1630	150		
7/22	0800-0930	150		
	0930-1037	150		
	1037-1237	150		
7/25	1025-1055	6		
	1307-1405	20		
	1405-1446	25		

Abundance of Leachs Storm Petrel

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/17	1301-1310	4		
	1310-1321	5		
	1321-1331	6		
	1331-1341	7		
	1341-1352	8		
	1352-1402	9		
	1424-1440	10		
	1440-1459	12		
	1459-1524	14		
	1824-1854	32	9	18
	1932-2010	35	1	2
	2010-2029	38	1	3
	2029-2055	42	1	2
7/18	0814-1901	108	6	8
	0901-0914	110		
	1154-1354	125	5	5
	1450-1554	137	3	3

Abundance of Leachs Storm Petrel

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/19	0800-0921	150	1	1
	0921-0945	150		
	0945-1002	150		
	1002-1040	150		
	1200-1235	150	2	3
	1235-1305	150	1	2
	1305-1336	150		
7/20	0730-0830	150	8	8
	0910-1050	150	12	18
	1420-1550	150	4	2
	1840-1904	150		
7/21	0800-1000	150		
	1200-1330	150	3	2
	1420-1630	150	2	1
	1820-1920	150	2	2
7/22	0800-0930	150	3	2
	0930-1037	150	6	3
	1037-1237	150		
	1425-1605	150	1	1
7/25	1025-1055	6		
	1307-1405	20	2	2
	1405-1446	25	1	1
	1630-1700	32	2	4

Abundance of Cassins Auklet

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/19	Ø800-Ø921	15Ø		
	Ø921-Ø945	15Ø		
	Ø945-1ØØ2	15Ø		
	1ØØ2-1Ø4Ø	15Ø		
	12ØØ-1235	15Ø		
	1235-13Ø5	15Ø		
	13Ø5-1336	15Ø		
7/2Ø	Ø91Ø-1Ø5Ø	15Ø		
	184Ø-19Ø4	15Ø		
7/21	Ø8ØØ-1ØØØ	15Ø		
	142Ø-163Ø	15Ø		
7/22	Ø8ØØ-Ø93Ø	15Ø		
	Ø93Ø-1Ø37	15Ø		
	1Ø37-1237	15Ø		
7/25	1Ø25-1Ø55	6	179	358
	13Ø7-14Ø5	2Ø	3	3
	14Ø5-1446	25	5	7

Abundance of Red-necked Phalarope

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/17	1301-1310	4		
	1310-1321	5		
	1321-1331	6		
	1331-1341	7	9	49
	1341-1352	8		
	1352-1402	9		
	1424-1440	10		
	1440-1459	12		
	1459-1524	14		
	1824-1854	32		
	1932-2010	35		
	2010-2029	38		
	2029-2055	42		
7/18	0814-1901	108		
	0901-0914	110		
	1154-1354	125		
	1450-1554	137		

Abundance of Red-necked Phalarope

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/19	0800-0921	150		
	0921-0945	150		
	0945-1002	150		
	1002-1040	150	12	19
	1200-1235	150		
	1235-1305	150		
	1305-1336	150		
7/20	0910-1050	150		
	1840-1904	150		
7/21	0800-1000	150		
	1420-1630	150		
7/22	0800-0930	150		
	0930-1037	150		
	1037-1237	150		
7/25	0930	4	2000	
	1025-1055	6		
	1307-1405	20		
	1405-1446	25	10	15

Abundance of Sooty Shearwaters

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/17	1301-1310	4		
	1310-1321	5		
	1321-1331	6		
	1331-1341	7		
	1341-1352	8		
	1352-1402	9		
	1424-1440	10	1	4
	1440-1459	12		
	1459-1524	14		
	1824-1854	32		
	1932-2010	35		
	2010-2029	38		
	2029-2055	42		
7/18	0814-1901	108		
	0901-0914	110		
	1154-1354	125		
	1450-1554	137		

Abundance of Sooty Shearwaters

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/19	0800-0921	150		
	0921-0945	150		
	0945-1002	150		
	1002-1040	150		
	1200-1235	150		
	1235-1305	150		
	1305-1336	150		
7/20	0910-1050	150		
	1840-1904	150		
7/21	0800-1000	150		
	1420-1630	150		
7/22	0800-0930	150		
	0930-1037	150		
	1037-1237	150		
7/25	1025-1055	6	1	2
	1307-1405	20		
	1405-1446	25	9	13
	1630-1700	32	4	8

Abundance of Northern Fulmar

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/17	1301-1310	4		
	1310-1321	5		
	1321-1331	6		
	1331-1341	7		
	1341-1352	8		
	1352-1402	9		
	1424-1440	10	1	4
	1440-1459	12	1	3
	1459-1524	14	1	2
	1824-1854	32		
	1932-2010	35		
	2010-2029	38		
	2029-2055	42		
7/18	0814-1901	108		
	0901-0914	110		
	1154-1354	125	1	1
	1450-1554	137		

Abundance of Northern Fulmar

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/19	0800-0921	150		
	0921-0945	150		
	0945-1002	150		
	1002-1040	150		
	1200-1235	150		
	1235-1305	150		
	1305-1336	150		
7/20	0910-1050	150		
	1840-1904	150		
7/21	0800-1000	150		
	1420-1630	150		
7/22	0800-0930	150	1	1
	0930-1037	150		
	1037-1237	150		
7/25	1025-1055	6		
	1307-1405	20	9	9
	1405-1446	25		
	1630-1700	32	1	2

Abundance of Fork-tailed Storm Petrels

DATE 1986	TIME	DISTANCE OFFSHORE naut mi	NUMBER	ABUNDANCE no./hr
7/19	0800-0921	150		
	0921-0945	150		
	0945-1002	150		
	1002-1040	150		
	1200-1235	150		
	1235-1305	150		
	1305-1336	150		
7/20	0910-1050	150		
	1840-1904	150		
7/21	0800-1000	150		
	1420-1630	150		
7/22	0800-0930	150		
	0930-1037	150		
	1037-1237	150		
7/25	1025-1055	6		
	1307-1405	20		
	1405-1446	25	300	140

ACKNOWLEDGEMENTS

The author is grateful to the scientific and technical crews of the research vessels Transquest and S.P. Lee and the Naval crew of the DSV-4 Sea Cliff for support and assistance during the Gorda Ridge Project. Thanks are also given to the members of the Gorda Ridge Task Force, Dr. Greg MacMurray in particular. Thanks to Dr. Janet Hodder, Oregon Institute of Marine Biology, and Michael Greybill, Director, South Slough National Estuarine Sanctuary, for helpful reviews of this paper. And thanks for the support of staff members of the Oregon Institute of Marine Biology, Charleston, Oregon.

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