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CIRCADIAN ACTIVITY RHYTHM OF THE CHINSTRAP PENGUIN OF ISLA MEDIA LUNA, SOUTH SHETLAND ISLANDS, ARGENTINE ANTARCTICA

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Abstract.—The circadian activity of Chinstrap Penguins (*Pygoscelis antarctica*) at Isla Media Luna (South Shetland Islands, Antarctica) was registered as the number of animals crossing a certain point on their route to and from the colony. A two-peak rhythm was found, with a clear distinction between dawn (going from the colony to the coast) and evening (coming back). Both patterns had a 24-h period perhaps driven by an endogenous circadian clock. This activity did not correlate with environmental variables such as light or temperature.

ACTIVIDAD DE RITMO CIRCADIANO EN *PYGOSCELIS ANTARCTICA*, EN ISLA MEDIA LUNA, ARGENTINA

Sinopsis.—La actividad circadiana en pingüinos (*Pygoscelis antarctica*) de la Isla Media Luna, de la Antártida Argentina, fue registrada como el número de aves que cruzaban un punto particular en su ruta hacia y desde una colonia. Se encontró un ritmo con dos picos, con una distinción clara entre el amanecer (moviéndose de la colonia hacia la costa) y el atardecer (movimiento de regreso). Ambos patrones tienen un periodo de 24 horas, tal vez motivados por factores endógenos. Esta actividad no pudo correlacionarse con variables ambientales tales como luz o temperatura.

The locomotory pattern of a species can be considered an adaptation to its environment. Aschoff (1981) even discussed a temporal component of ecological niches, and a physiological organization in the 'time' domain.

Antarctica poses particular environmental problems, due to the stability of zeitgebers (Hamner et al. 1962). For example, daily light–dark (L:D) and temperature cycles are attenuated seasonally. Because such environments allow study of the endogenous component of biological clocks (Brown and Woodland Hastings 1970), we investigated the activity rhythm of the Chinstrap Penguin (*Pygoscelis antarctica*) population at Media Luna Island. We did this work as part of the 1988–1989 summer campaign of the Instituto Antártico Argentino.

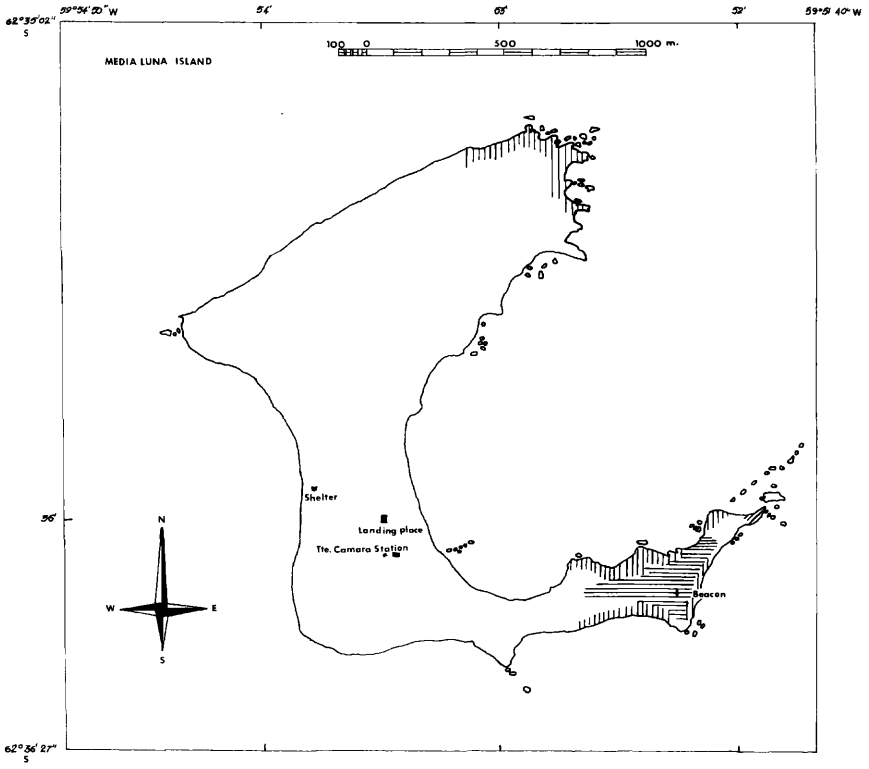

FIGURE 1. Media Luna Island, indicating nesting sites of different species: ▥ *L. dominicanus, S. vitattta, Ch. Alba*; ▤ *P. antarctica*; ▨ *P. atriceps.*

METHODS

The Chinstrap Penguin colony was located at the southeastern coast of Media Luna Island (62°36'S, 59°54'W) approximately 40 m above sea level (Fig. 1). We first counted the total number of nests in the colony, and then estimated the adult population by doubling this number. Most nests had eggs or squabs.

Penguins use well-defined routes to and from the colony to the coast. As penguins regularly travel these routes throughout the day, we considered the number of animals passing a particular point as representative of the periodic locomotor activity of the population.

We positioned ourselves at one side of the route, and counted the number of penguins passing. Animals passing in either direction were counted every 30 min without interruption for 24- and 48-h periods during January and February 1989. We recorded temperature daily at 3-h intervals with a mercury thermometer. We analyzed data with periodograms and Fourier Fast Transform (FFT) using autocorrelation function (Statgraphics Statistical Package and specially designed programs).

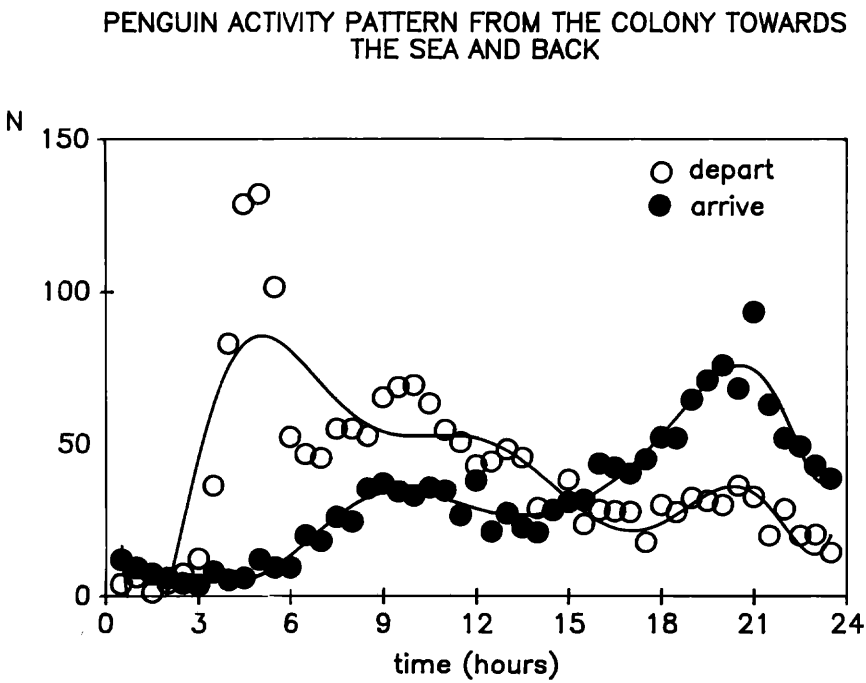

FIGURE 2. Number of penguins arriving and departing the colony. Data are expressed as mean number of birds crossing a certain point throughout the day for 3 d during January and February 1989. Fitted lines are 8th order polynomial regressions.

RESULTS

We counted 4608 adults, and recorded the daily passage of about 2000 individuals through the chosen route in each direction. In other words, almost half the population used the chosen route daily.

Penguins, both going to the coast and coming back, demonstrated a conspicuous circadian rhythm (Fig. 2). Individuals going toward the coast had a rhythm of exactly 24 h, with activity peaks at dawn. Other frequency components revealed by the periodogram (Fig. 3a) are of 8 (the main of secondary components), 12 and 6 h.

Penguins returning to the colony had a rhythm of slightly less than 24 h, and a maximum activity at dusk (Fig. 3b).

We also looked at the difference between animals going from and to the colony throughout the day (Fig. 4). The greatest difference was in the morning, disappeared toward the afternoon, and inverted itself during the evening.

Ambient temperatures varied slightly and highest temperatures occurred by noon in January and February. Temperature patterns were similar for both months, although February temperatures (daily range 1.0–2.8 C) were higher than those of January (range 1.0–2.0 C).

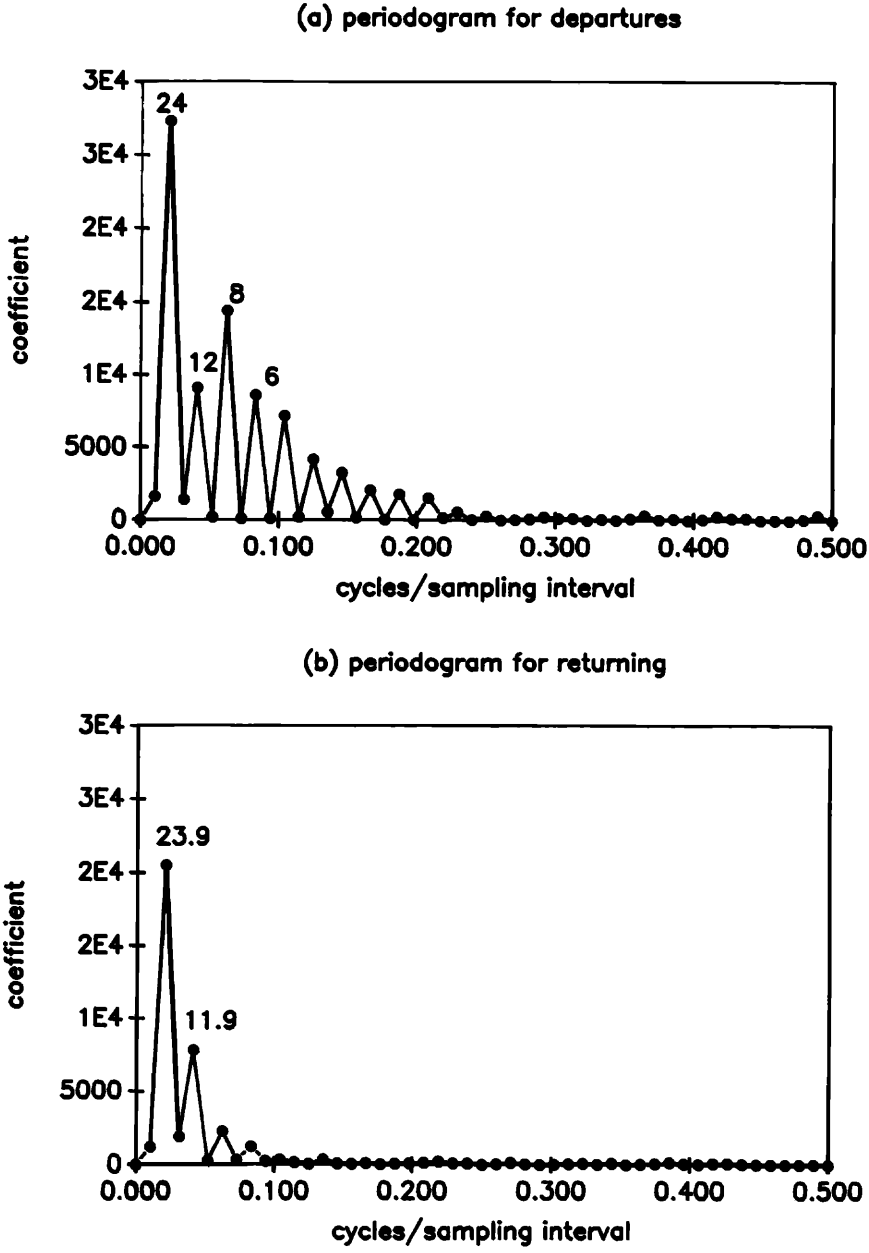

FIGURE 3. a. Periodogram for departures. Ordinates represent the power spectrum coefficient for each cycle per sampling interval ratio. Principal harmonics are detached. b. Periodogram for returning activity.

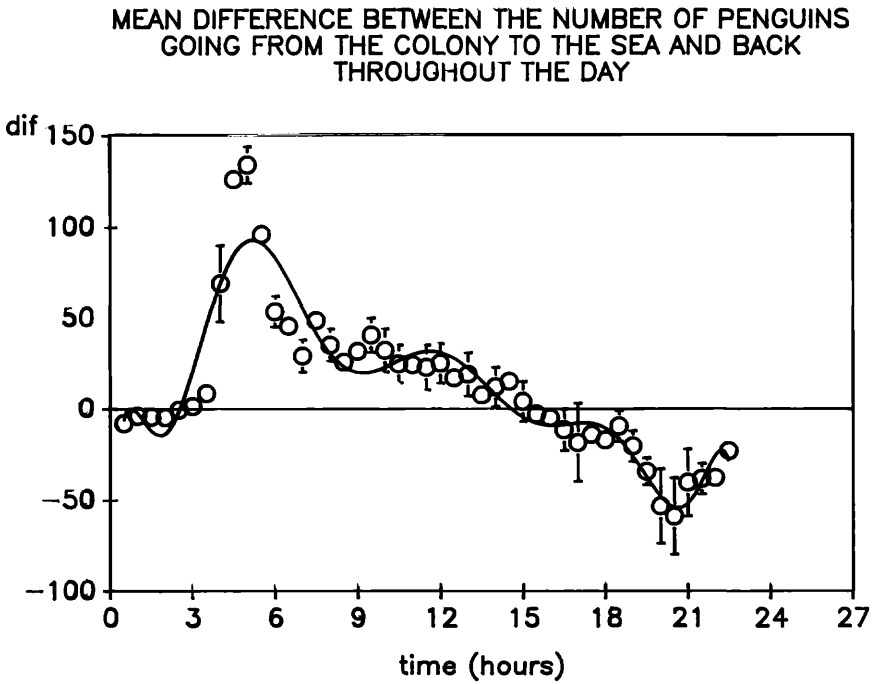

FIGURE 4. Mean difference between the number of penguins leaving the colony and returning throughout the day. Data are expressed as difference means (±SE) of animals for each time of the day.

DISCUSSION

The activity pattern of Chinstrap Penguins does not correlate with environmental temperature as observed by Capurro et al. (1988) for Magellanic Penguins (*Spheniscus magellanicus*) in Patagonia. The amplitude of the temperature rhythm was much lower in our study (2–5 C) than in Patagonia (almost 30 C). During cool and cloudy days the activity rhythm of Magellanic Penguins was almost completely lost.

On the basis of our results, Chinstrap Penguins seem to have a truly endogenous locomotor rhythm, because the start of the activity period anticipates possible thermal or light signals that could be used as potential zeitgebers. This interpretation is further supported by the similarity between data from January and February, after which environmental clues varied much more (appearance of nights, more thermal variation, etc.).

If activity is taken as a whole, i.e., not divided into a "going" and a "returning" phase, then a two-peak pattern was exhibited, something common in other species (Aschoff 1966). As data were collected during the chick feeding season of this penguin, the presence of two activity peaks probably represented the nest relief schedule. At any one time one parent remained at the nest, while the other foraged at sea (Jablonski 1985,

Lishman 1985). During the time of observations we did not detect creches of chicks. These results are consistent with those found in the literature (Capurro et al. 1988, Stonehouse 1975) regarding the general pattern of locomotor activity of penguins.

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