

Short Note

Intertidal foraging by gentoo penguins in a macroalgal raft

JAMES B. MCCLINTOCK ¹, CHARLES D. AMSLER ¹, MARGARET O. AMSLER¹ and WILLIAM R. FRASER²

¹Department of Biology, University of Alabama at Birmingham, Birmingham, AL 35294, USA

²Polar Oceans Research Group, Sheridan, MT 59749, USA

mcclinto@uab.edu

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Introduction

Foraging strategies in gentoo penguins (*Pygoscelis papua*) have been well studied (e.g. Croxall *et al.* 1988, Robinson & Hindell 1996, Lescroël *et al.* 2004, Takahashi *et al.* 2008, Xavier *et al.* 2017). The general consensus is this largest member of the three pygoscelid penguins displays both nearshore benthic and pelagic foraging tactics to consume combinations of crustaceans and fish. In a recent study, Carpenter-Kling *et al.* (2017) reported that gentoos at sub-Antarctic Marion Island displayed a novel foraging strategy that consisted of alternating typical lengthy foraging trips with much shorter nearshore afternoon trips. They suggest the latter foraging behaviour may be a response to suboptimal feeding conditions caused by local environmental change. This novel discovery reinforces the fact that, despite considerable study, not all foraging tactics in penguins have been documented. In this paper, we describe what we believe to be, yet another undocumented foraging tactic employed by gentoos.

Observations

Observations of gentoo behaviours were made on 11 January 2019 in the intertidal zone of a small cove adjacent to the Caillet-Bois Argentine refuge hut on D'Hainaut Island (63°54'00"S, 60°47'00"W). This small island is located in Mikkelsen Harbor, Palmer Archipelago, western Antarctic Peninsula. The cove had a soft, sandy bottom, and along the shoreline there was a dense raft of drift algae comprised wholly of the red macroalga *Palmaria decipiens* (identified later from photographs taken of 20 individual thalli). The macroalgal raft extended from the beach to ~5 m offshore at shallow depth (< 1 m). Eight adult gentoos were observed over a period of 2 h moving repeatedly back and forth from the shore to the macroalgal raft. The presumptive foraging behaviour consisted of an individual wading out a few metres from shore to a depth of ~20–30 cm and then diving below the water from a standing position for a period of ~10–20 s. As each individual resurfaced and stood up, pieces of macroalgal drift were observed in the grasp of, or draped over, the beak (Fig. 1). This visual observation suggested penguins

had been using their beaks to forage for prey among the drift. After ~5–10 dives, individuals returned to shore for several minutes, only to wade back into the macroalgal raft and repeat the diving behaviour.

Discussion

While it was not possible during these observations to determine the targeted prey (e.g. through stomach content analyses), the observed foraging bouts were highly focused, individualistic and repetitive, all factors that argue against a social behaviour or bathing. While mesograzers amphipods are known to associate in abundance with the red alga *P. decipiens* (Huang *et al.* 2007), the most probable prey item that gentoos were searching for among the macroalgal drift was dead individuals of the krill *Euphausia superba*. They have occasionally been observed washed up along rocky shores, presumably the result of strong storms (M.O. Amsler, personal observation 2016). Such storms would also simultaneously drive dislodged rafts of algae onto shore. Moreover, krill, rather than amphipods, are by far the major crustacean prey animals found in the stomach contents of gentoos in the region of these observations (Fraser, personal observation 2016).

The novel foraging strategy described by Carpenter-Kling *et al.* (2017) in gentoos at sub-Antarctic Marion Island was suggested to be a response to recent regional oceanographical changes limiting prey availability that, in turn, may be reducing regional gentoo numbers. Therefore, augmentation of lengthy feeding trips with foraging bouts of short duration may have become a necessity. In contrast, the present observation of intertidal foraging by gentoos in a macroalgal raft is more probably incidental and opportunistic. This is supported by unpublished observations of similar patterns of repetitive intertidal diving behaviour by gentoos at a variety of locations along the western Antarctic Peninsula (Fraser, personal observation 2009–2018). Moreover, prey such as krill do not appear to be limiting for gentoos in the Palmer Archipelago (Steinberg *et al.* 2015, Fraser, personal observation

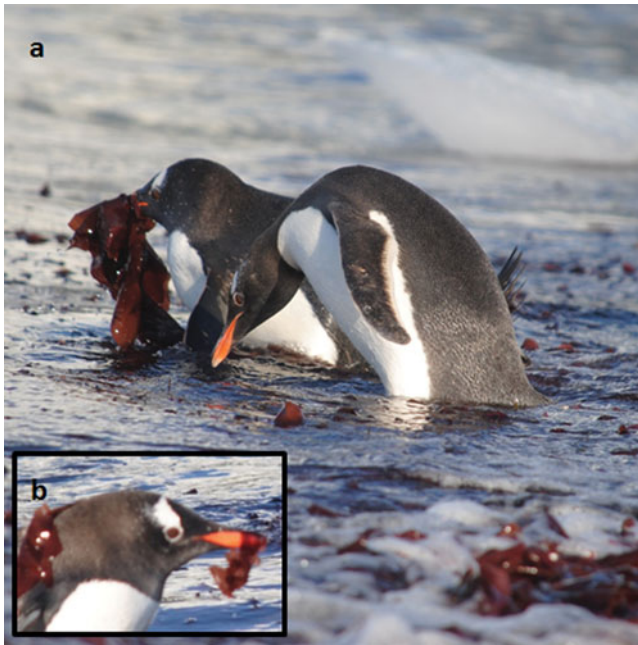


Fig. 1. a. Gentoo penguins foraging among a dense raft of drift of the red alga *Palmaria decipiens* along the shoreline of a small cove on D'Hainaut Island, Antarctic Peninsula. **b.** Gentoo penguin with *P. decipiens* draped over, not in, its beak.

2009–2018), as evidenced by diet composition and ongoing regional range extension and population increase (Ducklow *et al.* 2007, McClintock *et al.* 2010).

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Author contributions

JBM led the study and carried out the observations. MOA and CDA identified the red alga from images of thalli and contributed to the interpretation of the diving behaviour. WRF contributed to the evaluation of the intertidal diving behaviours, the potential nature of the prey and penguin ecology in general. All authors contributed to aspects of editing the final manuscript.

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References

- CARPENTER-KLING, T., HANDLEY, J.M., GREEN, D.B., REISINGER, R.R., MAKHADO, A.B., CRAWFORD, R.J.M. & PISTORIUS, P.A. 2017. A novel foraging strategy with gentoo penguins breeding at sub-Antarctic Marion Island. *Marine Biology*, **164**, 10.1007/s00227-016-3066-9.
- CROXALL, J.P., DAVIES, R.W. & O'CONNELL, M.J. 1988. Diving patterns in relation to diet of gentoo and macaroni penguins at South Georgia. *Condor*, **90**, 10.2307/136844.
- DUCKLOW, H.W., BAKER, K., MARTINSON, D.G., QUETIN, L.B., ROSS, R.M., SMITH, R.C., *et al.* 2007. Marine pelagic ecosystems: the West Antarctic Peninsula. *Philosophical Transactions of the Royal Society*, **B362**, 10.1098/rstb.2006.1955.
- HUANG, Y.M., AMSLER, M.O., MCCLINTOCK, J.B., AMSLER, C.D. & BAKER, B.J. 2007. Patterns of gammaridean amphipod abundance and species composition associated with dominant subtidal macroalgae from the western Antarctic Peninsula. *Polar Biology*, **30**, 10.1007/200300-007-0303-1.
- LESCROËL, A.R.Y., RIDOUX, V. & BOST, C.-A. 2004. Spatial and temporal variation in the diet of the gentoo penguins (*Pygoscelis papua*) at Kerguelen Islands. *Polar Biology*, **27**, 10.1007/s00300-003-0571-3.
- MCCLINTOCK, J.B., SILVA-RODRIGUEZ, P. & FRASER, W.R. 2010. Southerly breeding in gentoo penguins for the eastern Antarctic Peninsula: further evidence for unprecedented climate-change. *Antarctic Science*, **22**, 10.1017/S0954/S0954102010000076.
- ROBINSON, S.A. & HINDELL, M.A. 1996. Foraging ecology of gentoo penguins *Pygoscelis papua* in Macquarie Island during the period of chick care. *Ibis*, **138**, 10.1111/j.1474-919x.1996.tb08829.x.
- STEINBERG, D.K., RUCK, K.E., GLEIBER, M.R., GARZIO, L.M., COPE, J.S., BERNARD, K.S., *et al.* 2015. Long-term (1993–2013) changes in macrozooplankton off the western Antarctic Peninsula. *Deep Sea Research I*, **101**, 10.1016/j.dsr.2015.02.009.
- TAKAHASHI, A., KOKUBUN, N., MORI, Y. & SHIN, H.-C. 2008. Krill-feeding behaviours of gentoo penguins as shown by animal-borne camera loggers. *Polar Biology*, **31**, 10.1007/s00300-008-0502-4.
- XAVIER, J.C., TRATHAN, P.N., CEIA, F.R., TARLING, G.A., ADLARD, S., FOX, D., *et al.* 2017. Sexual and individual foraging segregation in gentoo penguins *Pygoscelis papua* from the Southern Ocean during an abnormal winter. *PLoS One*, **12**, e0174850.