

DOCUMENTATION OF SEA OTTERS AND BIRDS AS PREY FOR KILLER WHALES

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An adult male killer whale (*Orcinus orca*) from the transient AT1 population was found dead on 19 April 2003 in southwest Prince William Sound (PWS) floating in LaTouche Passage, near the village of Chenega Bay (60.05°N, 147.93°W). It was examined by BAM, Brad Smith (NMFS), Dr. Kathy Burek (Alaska Veterinary Pathology Services), and Andy McLaughlin (a local resident) on 23 April 2003. Stomach contents were collected and later placed in 1.00-mm mesh screens and rinsed. Prey items were sorted macroscopically into major taxonomic groups, identified to the lowest taxonomic level possible, and weighed to the nearest 0.1 g. Mammal parts were identified by LTQ by comparison with known reference material at Alaska Department of Fish and Game. Bird parts were identified using University of Alaska Museum specimens and the assistance of Daniel Gibson. The octopus beak was identified by William Walker at NOAA's National Marine Mammal Laboratory (NMML), and its estimated mantle length was calculated using Clarke (1986). The weight of an octopus of comparable size was estimated using the NMML reference collection. Other invertebrates were identified by Chris Stark at the Biological Oceanography Laboratory, Institute of Marine Science at the University of Alaska. The minimum age of harbor seals (*Phoca vitulina*) was determined using foreclaw annuli (McLaren 1958). The killer whale's age was estimated by counting growth layer groups (GLGs) of a longitudinal midsection of an etched, unstained section of tooth, with one GLG considered to represent an annual increment.

Genetic analysis confirmed this was a killer whale from the AT1 population¹ and that it could be one of two individuals: AT14, traveling alone since his former traveling partner AT1 was found dead at Orca Inlet in 2000; or AT13 that has not

¹ Personal communication from Lance Barrett-Lennard, Vancouver Aquarium Marine Science Centre, 845 Avison Way, Vancouver, BC V6G 3E2, Canada, 29 March 2005.

been seen since 2001.² Both males would have been about 40 yr of age or older based on estimates of age from the first recorded sighting and the number of years since the attainment of physical maturity, which occurs at about age 16 and is determined by dorsal fin size.² The whale was 7.0 m long, with a dorsal fin base width of 91 cm, a fluke width of 194 cm, and a blubber thickness of 11 cm measured 30 cm lateral from the posterior edge of the dorsal fin. The killer whale (aged by a tooth section) was a minimum of 40 yr old.³ The whale was moderately decomposed, and no evidence of entanglement or other external injuries was observed. Cause of death could not be determined.

The rinsed contents of the stomach weighed a total of 6.8 kg (excluding 4.1 kg of rocks and 0.2 kg of kelp). Individual components of prey items are listed in Table 1.

The minimum number of animals determined from prey items found in the stomach contents included nine harbor seals, five sea otters (*Enhydra lutris*), one river otter (*Lontra canadensis*), one cormorant (*Phalacrocorax* spp.), one sea duck (*Anatidae*, genus unknown), and one octopus (*Octopus dofleini*). Ages of the nine harbor seals were estimated to be one pup (<1 yr old; 10 foreclaws), three subadults (1–2 yr old; 23 foreclaws), and five adults (49 foreclaws). Due to the effects of digestion, only a few of the sea otter long bones had intact ends. The ends showed both open and closed epiphyses indicating adult and subadult sea otters were eaten. No skin, blubber, or teeth were present that would indicate any cetaceans had been eaten recently. No fish otoliths or bones were found.

Transient killer whales in PWS were seen to prey only on marine mammals during 13 yr of monitoring (1984–1996) (Saulitis *et al.* 2000). During this period of studies (Matkin *et al.* 1999, Scheel *et al.* 2001), the range of the AT1 group appeared to be centered in the Knight Island passage area of PWS. More recently, the AT1 population has been seen more often outside PWS to the west, in the Kenai Fjords area.²

During the 13-yr study, 30 attacks or harassments of potential prey were documented, including harbor seals (12), humpback whales (6), Dall's porpoise (4), Steller sea lions (4), sea otters (2), a river otter, and a salmon (Saulitis *et al.* 2000). Thirty-one kills by the AT1 group were documented by Saulitis *et al.* (2000) including Dall's porpoises (12), harbor seals (10), harbor porpoises (2), and unidentified marine mammals (7).

Stomachs have been analyzed from four AT1 killer whales that died in PWS. The first, in 1990 near Culross Island (60.70°N, 148.18°W) contained bone, whiskers, and hair from adult and juvenile harbor seals and the dorsal fin from a Dall's porpoise. The second, in 1990 at Beartrap Bay (60.75°N, 146.05°W) was empty. The third, in 2000 in Orca Inlet (60.49°N, 145.96°W) had eaten a minimum of three harbor seals (1 adult female, 1 adult male, and 1 pup). The fourth, in 2001 at Hinchinbrook Island (60.33°N, 146.83°W) contained a harbor seal flipper, fur, and claws from at least two harbor seals, and bull kelp (Heise *et al.* 2003). Although, data on attacks

² Personal communication from Craig Matkin, North Gulf Oceanic Society, 2030 Mary Allen Avenue, Homer, AK 99603, 16 March 2005.

³ Personal communication from Michael Etiner, National Marine Mammal Lab, 7600 Sand Point Way N.E. F/AKC3, Seattle, WA 98115-6349, 24 February 2005.

Table 1. Individual components of prey items by species found in an AT1 male killer whale from Prince William Sound, Alaska, in April 2003.

Species	Item	Quantity	Comments
Sea otter (<i>Enhydra lutris</i>)	Mandibles	5	3 right, 2 left
	Teeth	63	14 canines, 11 incisors, 38 molars
	Humerus	5	2 right, 3 left
	Ulna	9	4 right, 5 left
	Plevis	6	3 right, 3 left
	Claws	36	
	Femur	2	1 right, 1 left
	Tibia	3	2 right, 1 left
River otter (<i>Lontra canadensis</i>)	Teeth	5	4 upper molars, 1 lower molar
Harbor seal (<i>Phoca vitulina</i>)	Whiskers	127	
	Tympanic bullae	4	2 left, 2 right
	Mandibles	5	3 left, 2 right
	Teeth	31	9 canines, 5 incisors, 17 molars
	Humerus	2	1 left, 1 right
	Radius	2	1 left, 1 right
	Ulna	1	0 left, 1 right
	Fore claws	82	10 pup, 23 subadult, 49 adult
	Hind claws	21	
Sea duck (<i>Anatidae</i> , spp.)	Tip of bill	1	
Cormorant (<i>Phalacrocorax</i> spp.)	Feathers	1,285	
Octopus (<i>Octopus dofleini</i>)	Upper and lower beak	1	Beak measurements indicate mantle length ~247 mm, weight ~6 kg
Bivalves (possibly <i>Mya</i> spp.)	Periostricum from siphons	3	
Kelp (<i>Nereocystis</i> spp.)	Stipes	0.2 kg	Longest piece 13 cm
Rocks	Range 0.2–1.4 kg	8	Total weight 4.1 kg
	Mean = 0.5 kg		

and harassments of marine mammals by killer whales suggest that the diet of PWS transient killer whales is more diverse than indicated by observed kills (Saulitis *et al.* 2000), thus far (including this whale examined in 2003), harbor seals have been the primary prey found in killer whale stomachs.

In Alaska, transient killer whales are known to kill and presumably prey on 15 species of cetaceans, six species of pinnipeds, sea otters, river otters, moose (*Alces alces*), and cephalopods (Matkin and Saulitis 1994, Hatfield *et al.* 1998, Saulitis *et al.* 2000). Harbor seals and small cetaceans are a major food item for transient killer whales in PWS (Heise *et al.* 2003) as is the case for transient killer whales found throughout the northern hemisphere (Jefferson *et al.* 1991).

Harassment and consumption of birds by transient killer whales has been documented in southeastern Alaska and British Columbia (Ford *et al.* 1998). Bird predation

has been associated with subadult whales as training for chasing and hunting (Matkin and Dahlheim 1995, Ford *et al.* 1998), but birds are not thought to be a significant food source (Ford *et al.* 1998). In this case, however, the sampled whale was a lone adult male, and no young have been recruited into the AT1 pod since 1984 (Matkin and Saulitis 1997).

River otter remains have been documented by stomach analysis in one other killer whale in Alaska waters, an animal that stranded on the Bering Sea side of the Alaska Peninsula near Izembek Lagoon (55.31°N, 162.84°W) (Heise *et al.* 2003). The Izembek whale, similar to the whale in this study, had also consumed kelp, bird feathers, harbor seals, and rocks (Heise *et al.* 2003). Observations of killer whales harassing, pursuing, attacking, and killing sea otters have occurred in PWS (Hatfield *et al.* 1998, Saulitis *et al.* 2000).

Although octopus and squid have been documented as killer whale prey (Matkin and Saulitis 1994, Heise *et al.* 2003) the size of this octopus (mantle length ~247 mm, weight ~6 kg) does not rule out the possibility that it could have been eaten by a harbor seal or a sea otter, both of which are known to prey on octopus (Calkins 1978, Pitcher 1980). The periostricum (outer covering) of bivalve-siphons likely came from clams ingested by sea otters.

Stomach content analyses of killer whales are important because it is often difficult to distinguish between predation and harassment from observations of living animals. On the other hand, stomach content analyses are of limited value because they show only what an animal ate just before it died. Furthermore, because hard parts resist digestion and may stay in the stomach longer than soft tissues, interpretation of stomach contents must be done with caution. Nonetheless, this is the first report of sea otter and bird remains from the stomach of a transient killer whale in PWS, and it is also the first report of sea otter remains in the stomach of a transient killer whale in Alaska. Although harbor seals were the most important component of the recent diet of this whale, the component made up by sea otters was substantial and may suggest sea otters are important prey for AT1 transient killer whales. It is unknown whether the prey items found in this stomach comprise the normal diet for this individual whale (an older whale, possibly hunting alone), or the AT1 population in general.

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LITERATURE CITED

- CALKINS, D. G. 1978. Feeding behavior and major prey species of the sea otter, *Enhydra lutris*, in Montague Strait, Prince William Sound, Alaska. U.S. National Marine Fisheries Service Fisheries Bulletin 76:125–131.

- CLARKE, M. R., ED. 1986. Handbook for the identification of cephalopod beaks. Oxford University Press, New York, NY.
- FORD, J. K. B., G. M. ELLIS, L. G. BARRETT-LENNARD, A. B. MORTON, R. S. PALM AND K. C. BALCOMB III. 1998. Dietary specialization in two sympatric populations of killer whales (*Orcinus orca*) in coastal British Columbia and adjacent waters. *Canadian Journal of Zoology* 76:1451–1471.
- HATFIELD, B. B., D. MARKS, M. T. TINKER, K. NOLAN AND J. PEIRCE. 1998. Attacks on sea otters by killer whales. *Marine Mammal Science* 14:888–894.
- HEISE, K., L. G. BARRETT-LENNARD, E. SAULITIS, C. O. MATKIN AND D. BAIN. 2003. Examining the evidence for killer whale predation on Steller sea lions in British Columbia and Alaska. *Aquatic Mammals* 29:325–334.
- JEFFERSON, T. A., P. J. STACEY AND R. W. BAIRD. 1991. A review of killer whale interactions with other marine mammals: Predation to co-existence. *Mammal Review* 21:151–180.
- MATKIN, D. R., AND M. E. DAHLHEIM. 1995. Feeding behaviors of killer whales in northern southeastern Alaska. Pages 246–253 in D. R. Endstrom, ed. Proceedings of the Third Glacier Bay Science Symposium, 15–18 September 1993. U.S. Department of the Interior, National Park Service, Anchorage, AK.
- MATKIN, C. O., AND E. SAULITIS. 1994. Killer whale (*Orcinus orca*): Biology and management in Alaska. Unpublished report. Available from U.S. Marine Mammal Commission, 1825 Connecticut Avenue, Washington, DC.
- MATKIN, C., AND E. SAULITIS. 1997. Killer whale, *Orcinus orca*. Restoration Notebook, Exxon Valdez Oil Spill Trustee Council Notebook Series. 12 pp.
- MATKIN, C., G. ELLIS, E. SAULITIS, L. BARRETT-LENNARD, AND D. MATKIN. 1999. Killer whales of southern Alaska. North Gulf Oceanic Society Press, Homer, AK.
- MCLAREN, I. A. 1958. The biology of the ringed seal (*Phoca hispida* Schreber) in the eastern Canadian Arctic. Fisheries Research Board of Canada Bulletin No. 118:1–97.
- PITCHER, K. W. 1980. Food of the harbor seal, *Phoca vitulina richardsi*, in the Gulf of Alaska. U.S. National Marine Fisheries Service Fisheries Bulletin 78:544–549.
- SCHEEL, D., C. O. MATKIN AND E. SAULITIS. 2001. Distribution of killer whale pods in Prince William Sound, Alaska 1984–1996. *Marine Mammal Science* 17:555–569.
- SAULITIS, E., C. MATKIN, L. BARRETT-LENNARD, K. HEISE AND G. ELLIS. 2000. Foraging strategies of sympatric killer whale (*Orcinus orca*) populations in Prince William Sound, Alaska. *Marine Mammal Science* 16:94–109.

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