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Résumé de l'article

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PLEISTOCENE EIDER DUCK *(SOMATERIA* CF. *MOLLISSIMA)* FROM CHAMPLAIN SEA DEPOSITS NEAR SHAWINIGAN, QUÉBEC

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ABSTRACT Most of a pelvic bone of a large eider duck *(Somateria* cf. *mollissima)* was collected in place in a unit of stratified clay and sandy silt near Shawinigan, Québec. The fossil is important because it is the first bird specimen from Champlain Sea deposits to be identified to the generic level. Evidently the duck died and was deposited near the northern shore of the Champlain Sea a few hundred years before the sea drained. A sample from a bed of large, marine mollusc shells *(Mya arenaria)* found in place just above the eider duck fossil yielded a radiocarbon date of 10 300 ± 100 years BP.

RÉSUMÉ L'os pelvique relativement complet d'un eider de grande taille *(Somateria* cf. *mollissima)* a été récolté en place, dans un dépôt de silt argileux et sableux stratifié, près de Shawinigan, Québec. Ce fossile est important car il représente le premier spécimen d'oiseau identifié, au niveau du genre, dans les dépôts de la mer de Champlain. Cet os a été enfoui près de la rive nord de la mer de Champlain. Son origine remonte à quelques centaines d'années avant la fin de la régression marine. Des coquilles de mollusques marins *(Mya arenaria)*, prélevées à environ 50 cm au-dessus du fossile d'eider, ont donné un âge de 10 300 ± 100 BP, en années ^{14}C de coquilles de mers froides.

INTRODUCTION

The Champlain Sea was a significant feature of the landscape in eastern North America from late Wisconsin time to the earliest Holocene. As the Laurentide ice sheet retreated northward, the St. Lawrence Lowlands were opened to Atlantic Ocean water approximately 12 000 years ago. That submergence created a large inland sea — the Champlain Sea. At maximum extent it covered an area of about 53 100 km^2 or more in Ontario and Québec, between Québec City and Brockville, including part of the lower Ottawa River valley and the Lake Champlain valley in New York and Vermont (Fig. 1; ELSON, 1968; HILLAIRE-MARCEL, 1979). Generally speaking, as a consequence of glacioisostatic rebound the sea became shallower, warmer and fresher as time progressed. It drained about 9 800 years ago (HILLAIRE-MARCEL and OCCHIETTI, 1977). Remains of many species of plants, invertebrates and vertebrates have been recovered and identified from Champlain Sea deposits (HARINGTON, 1977, p. 508-510). Here we wish to focus on vertebrates, specifically the fossil of a vertebrate which lived toward the close of the Champlain Sea episode.

During the summer of 1971, while studying Quaternary deposits and events in the lower St. Maurice region, the second author (OCCHIETTI, 1976, 1979) collected a bone fragment from Champlain Sea deposits exposed near Séminaire Saint-Joseph, Shawinigan, Québec (46°34′35″N, 72°43′40″W; Fig. 1). The specimen was found *in situ* in a unit of stratified marine clay and sandy silt, approximately 4 to 5 m from the base of a continuous 12 m-thick sequence of sediments (Fig. 2). This sedimentary sequence records events that occurred during the final stage of recession of the Champlain Sea in the region. Large marine mollusc shells *(Mya arenaria)* found *in situ* about 50 cm above the bone fragment are indicative of a relatively warm littoral marine environment (ELSON, 1969; HILLAIRE-MARCEL, 1972). A sample (GSC-2101) of these well preserved shells, some with articulated valves, yielded a radiocarbon date of 10 300 ± 100 years of cold seas BP. (cf. MANGERUD and GULLIKSEN, 1975; HILLAIRE-MARCEL and OCCHIETTI, 1977). As the rate of marine sedimentation in the Shawinigan area is estimated at between 3 to 10 cm per year (OCCHIETTI 1979, p. 228), the eider duck would be only about 5 to 16 years older than that date — an insignificant difference considering

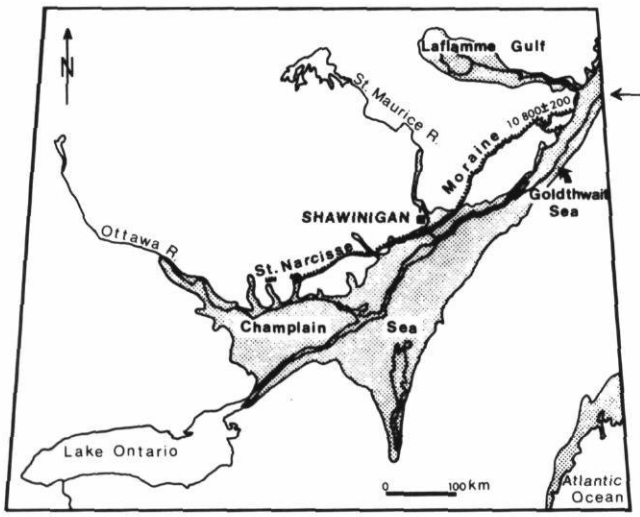

FIGURE 1. Map showing location of the eider duck fossil from near Shawinigan, Québec (black square) and its relationship to the Champlain Sea (maximum extent) and St. Narcisse moraine.

Carte de localisation de l'eider fossile, près de Shawinigan (carré noir), Québec, par rapport à la mer de Champlain (limite maximale diachronique) et à la moraine de Saint-Narcisse.

that the date has an error of ±100 years BP. Clearly, the bone fragment had been deposited after the withdrawal of ice from the St. Narcisse moraine about 10 800 years BP (Fig. 1; OCCHIETTI, 1976), and at least a few hundred years before the Champlain Sea drained (about 9 800 ± 200 years BP).

In 1978, the first author received and identified the bone as a pelvic fragment of an eider duck *(Somateria* cf. *mollissima).* Evidently it is the first eider duck fossil reported for North America (WETMORE, 1956, p. 31-33). More generally, BRODKORB (1964, p. 245) lists no Pleistocene eiders, but reports Common Eider remains from archaeological sites in Ireland, Scotland, Norway, Denmark and Alaska, and King Eider remains from archaeological sites in Alaska. Because records of bird remains from Champlain Sea deposits are rare (Table I), and since none has been identified to the generic level, the purpose of this paper is to describe, illustrate, compare and provide measurements for the specimen. We also wish to discuss paleo-environmental implications of the fossil.

SYSTEMATIC DESCRIPTION

Order Anseriformes
Family Anatidae
Genus *Somateria*
Somateria cf. *Mollissima*

Referred specimen: NMC (National Museum of Canada) 34960 (Figs. 3-5, Table I) consists of most of a pelvis lacking anterolateral margins of the preacetabular ilium, most of the dorsal surface of the median dorsal ridge, approximately the posterior half of the postacetabular portion of the pelvis, and the posterior two-thirds of the pubes. In morphological pattern, the speci-

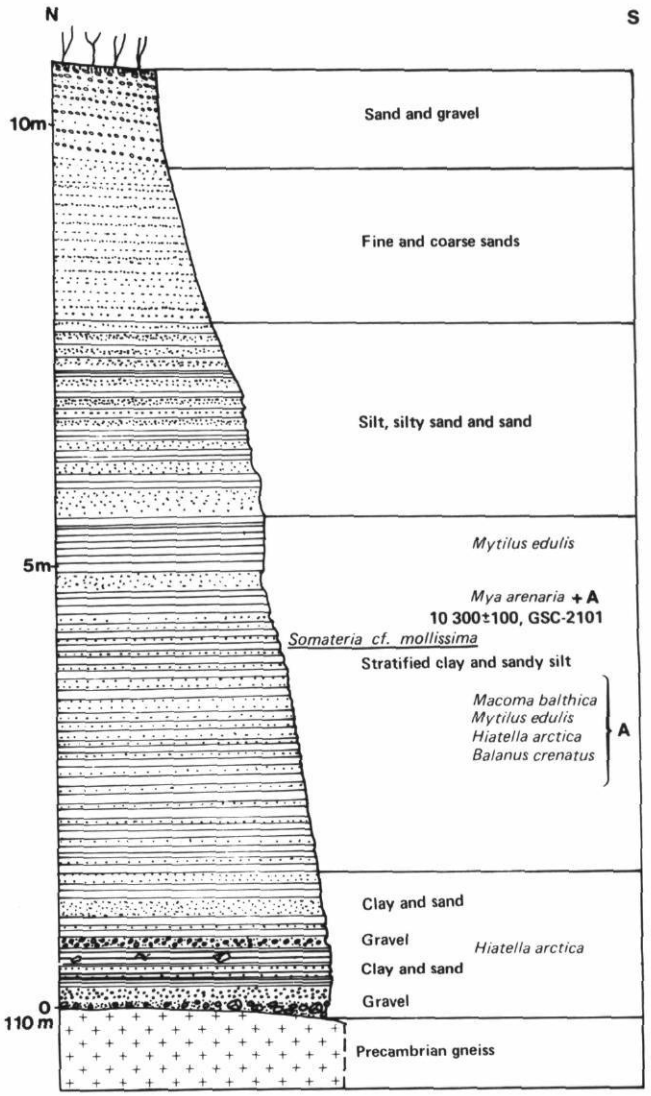

FIGURE 2. Simplified diagram of Champlain Sea sediments near Shawinigan, Québec showing approximate position of eider duck *(Somateria* cf. *mollissima*, NMC 34960) fossil in relation to a slightly higher layer of large marine mollusc shells *(Mya arenaria)* radiocarbon dated at 10,300 ± 100 years B.P.

Coupe simplifiée des dépôts de la mer de Champlain, près du Séminaire de Shawinigan, Québec, montrant la position approximative de l'eider fossile (Somateria *cf.* mollissima, *NMC 34960). Les coquilles de grande taille du mollusque marin* (Mya arenaria), *datées de 10 300 ± 100 BP (en années* ^{14}C *de coquilles de mer froides) ont été prélevées dans un lit situé légèrement au-dessus du vertébré.*

TABLE I

Previous records of bird remains from Champlain Sea deposits

Specimens	Locality	Remarks and References
Bones (unspecified).	Montréal, Québec.	Collected before 1863. Logan (1863, p. 920) first mentions these specimens, "At Messrs. Bulmer and Shepherd's brick-yard, close by [Messrs. Peel and Comte's clay pit in St. Mary's suburbs] several of the bones of a young seal were met with, and a few of those of other animals, including one or two which appear to be the bones of a bird." Lambe (1904, p. 30) remarks on "— some undetermined [bird] bones that were obtained many years ago from the Leda clay at Montreal —". Lambe (1912, p. 13-14) again mentions the specimens. Present whereabouts unknown.
Feather impression.	Probably from Green Creek, near Ottawa, Ontario.	Dawson (1871, p. 403) mentions "— a bird's feather in a nodule on the Ottawa —", and later (Dawson 1893, p. 267) states, "A few specimens of feathers have been preserved in nodules at Green's Creek. They have apparently belonged to small wading birds." The latter report may well relate to the feather mentioned in 1871 and the feather specimen collected by the Marquis of Lorne in 1881 (see below).
Feather impression (GSC 6600).	Green Creek, near Ottawa, Ontario.	Lambe (1904, p. 30) comments on "— an impression of a small feather beautifully preserved in a nodule collected from the same [Leda clay] deposit at Green's Creek near Ottawa in 1881." This specimen consists of a broken calcareous nodule with impressions of a feather on both sides. It was collected by the Marquis of Lorne in 1881 and is in collections of the Geological Survey of Canada, Ottawa.
Feather impression (NMC 36089).	Between mouth of Green Creek and Hiawatha Park, near Ottawa, Ontario	Collected by N. R. Gadd in 1962. Presently displayed in the National Museum of Natural Sciences. The specimen consists of a broken calcareous nodule with impressions of a feather on both parts. Because of its size, the feather appears to be from a rather large bird. The specimen is in collections of the National Museums of Canada, Ottawa.
Thoracic vertebra (eroded and lacking most of the neural spine and tips of transverse processes; NMC 17902).	Sand pit near International Airport, south of Ottawa, Ontario.	Collected by R. Taylor in 1969. The specimen appears to be from a rather large bird. It is in collections of the National Museums of Canada, Ottawa.

men corresponds most closely to pelves of ducks and geese. It is smaller than pelves of adult Canada Geese *(Branta canadensis)* and larger than those of adult Mallards *(Anas platyrhynchos)*. Furthermore, the latter species and all other relatively large ducks examined excepting eiders, have narrower, more deeply-arched (transversely) pelves than the fossil. While comparing the specimen, the first author noted that two notch-like fossae (ilioneural canals; see GEORGE and BERGER, 1966, p. 15) opening on either side of the mid-line at the posterior margin of the median dorsal ridge were absent in all geese pelves examined, but were present in all duck pelves seen. This feature, also seen in the turkey (*Meleagris*; *e.g.* OLSEN, 1968, Fig. 6), evidently separates ducks from geese. It led to the conclusion that the fossil represented a very large duck. Because NMC 34960 was derived from marine littoral sediments its identification as a large marine duck such as the eider seemed most likely.

All morphological features of NMC 34960, including important ones such as great breadth and shallowness, were most closely matched in pelves of Common Eiders *(Somateria mollissima)* and King Eiders *(Somateria spectabilis)*. Therefore, we disagree in part with WOOLFENDEN's (1961, p. 87) statement that "The pelvis is too poor an element taxonomically to allow for characterizing the diverse subfamily[1] of ducks". Of 2 modern eider pelves to which the fossil was compared, it was surpassed (marginally) in size by only one — a female Common Eider (*S. m. sedentaria*; ROM 75496)

1. Woolfenden is referring to the subfamily Anatinae, in which he includes the eiders (see WOOLFENDEN, 1961, p. 106-107).

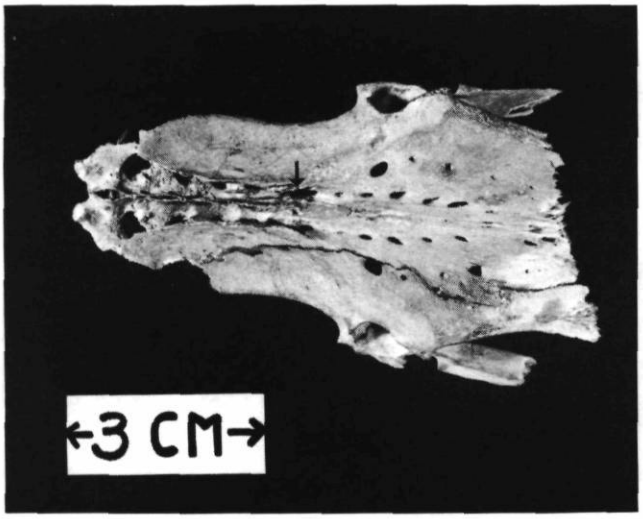

FIGURE 3. Dorsal view of eider duck *(Somateria* cf. *mollissima,* NMC 34960) pelvic fragment from Champlain Sea deposits near Shawinigan, Québec. Note twin notches (openings of the ilioneural canals) at posterior margin of the median dorsal ridge (see arrow). This feature separates ducks from geese. The bone which covered the ilioneural canals has been broken away.

Vue dorsale du fragment d'os pelvique de l'eider (Somateria *cf.* mollissima, *NMC 34960) provenant de dépôts de la mer de Champlain près de Shawinigan, Québec. Noter les échancrures jumelles (ouvertures des canaux neuro-iliaques) sur la marge postérieure de la crête médio-dorsale (flèche). Ce caractère distingue les canards des oies. La partie osseuse qui recouvrait les canaux neuro-iliaques a été enlevée.*

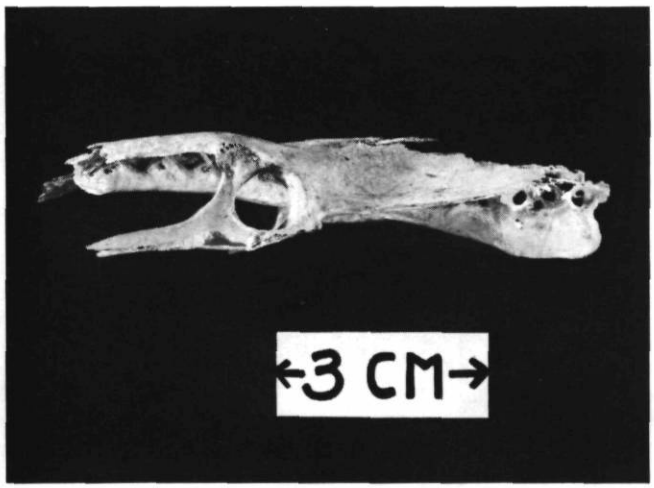

FIGURE 4. Right side view of eider duck (*Somateria* cf. *mollissima,* NMC 34960) pelvic fragment from Champlain Sea deposits near Shawinigan, Québec. Shallowness of the pelvis is typical of eider ducks. Anterior of specimen is at right; acetabulum is left of centre.

Vue latérale droite du fragment d'os pelvique de l'eider (Somateria *cf.* mollissima, *NMC 34960) provenant de dépôts de la mer de Champlain près de Shawinigan, Québec. Le peu de profondeur du pelvis est typique des eiders. L'avant est vers la droite; l'acetabulum est à gauche du centre.*

from Ontario. Next closest was a male of *S. m. dresseri* (ROM 92299) from Québec (Table II). On the basis of its large size, NMC 34960 is best referred to a Common Eider. The colonial nesting habits and habitat of the Common Eider also suggest that remains of this species, rather than the King Eider, would be more likely preserved in the fossil record at such a site (see Discussion).

However, because only six King Eider pelves were available for comparison, and two were immature, it seems advisable to refer the fossil to *Somateria* cf. *mollissima*, H. Savage (personal communication) has pointed out to the first author that there is a possibility that the fossil may represent the extinct Labrador Duck *(Camptorhynchus labradorius).* Although eiders were once included with the Labrador Duck, Harlequin Duck, Oldsquaw, scoters, goldeneyes and mergansers in the Tribe Mergini (DELACOUR and MAYR, 1945), later, more detailed studies (HUMPHREY, 1958, p. 134; (HUMPHREY and BUTSCH, 1958, p. 21) indicate that eiders have their closest relationships with the Anatini and that they should be placed in a separate Tribe Somateriini,

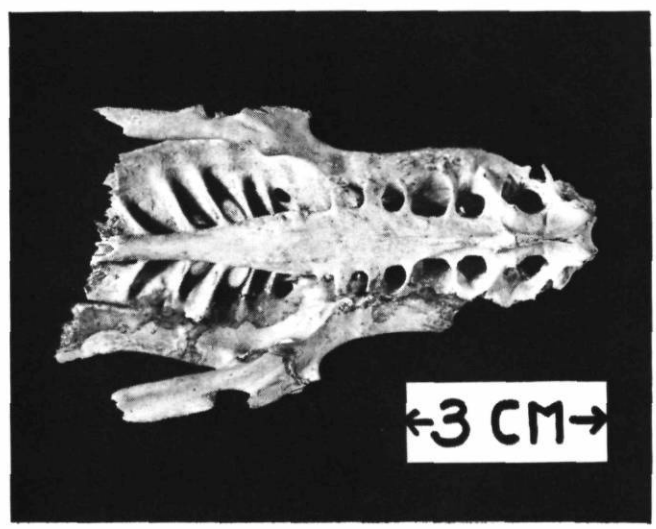

FIGURE 5. Ventral view of eider duck (*Somateria* cf. mollissima, NMC 34960) pelvic fragment from Champlain Sea deposits near Shawinigan, Québec. Two anteriormost vertebrae shown (at the right) are synsacral thoracics. Those posterior are lumbar, sacral and synsacral caudal vertebrae.

Vue ventrale du fragment d'os pelvique de l'eider (Somateria *cf.* mollissima, *NMC 34960) provenant de dépôts de la mer de Champlain près de Shawinigan, Québec. Les deux vertèbres les plus antérieures, à droite, sont des vertèbres thoraciques synsacrées. Vers la partie postérieure, on observe les vertèbres lombaires, sacrées et caudales synsacrées.*

TABLE II

Measurements of a Pleistocene eider duck (Somateria *cf.* mollissima) *pelvis from near Shawinigan, Québec compared to those of Recent Common Eiders* (S. mollissima) *and King Eiders* (S. spectabilis) *from Canada*

Specimens	Sex	Measurements (mm)* 1	2	3	4	5	6	7**	8**	9
Pleistocene										
Somateria cf. *mollissima* NMC 34960 Shawinigan P.Q.		26.8 – 31.5		41.3	9.8	18.5	5.6	38.8	55.6	16.8
Recent										
Somateria mollissima										
(combined†) M(σ)		24.07(1.21)	27.91(1.89)	39.14(1.99)	9.49(0.71)	17.57(1.59)	5.32(0.49)	36.12(2.29)	54.76(3.61)	17.54(1.03)
OR		27.3-22.4	32.3-25.0	43.7-35.3	11.2-8.2	21.2-14.5	6.2-4.3	41.1-32.1	64.2-50.0	20.2-15.9
N		18	18	18	18	18	18	18	18	18
Somateria mollisima borealis										
ROM 126388 N.W.T.	–	23.7	30.0	40.6	9.2	19.5	5.6	37.5	55.8	18.0
ROM 126387 N.W.T.	♂	23.4	27.4	38.9	8.9	14.5	4.3	37.0	54.4	17.1
NMC ("FCS-57") P.Q.	♂	22.8	25.2	35.5	8.2	16.4	4.7	33.4	50.6	17.3
Somateria mollissima sedentaria										
ROM 75496 Ont.	♀	27.3	32.2	43.7	9.9	21.2	5.8	38.9	59.0	20.2
Somateria mollissima nigra										
ROM 125103 N.W.T.	♂	23.7	28.1	41.1	11.2	18.6	4.9	38.7	58.4	18.4
Somateria mollissima dresseri										
ROM 92299 P.Q.	♂	25.6	30.1	40.4	10.0	17.4	5.9	37.4	60.0	16.7
ROM 95217 Ont. (zoo)	♂	25.1	26.7	37.8	8.6	16.9	4.8	33.4	51.7	16.6
ROM 114713 Ont. (zoo)	♀	24.5	26.8	39.3	9.8	15.5	6.2	36.7	55.3	17.5
ROM 108976 Ont.	♀	24.4	27.5	39.2	9.6	18.0	5.4	38.3	56.9	18.2
ROM 106416 Ont. (zoo)	♂	22.9	25.0	35.3	9.3	15.1	5.5	35.5	53.1	15.9
ROM 106415 Ont. (zoo)	♂	22.4	25.3	37.9	9.7	16.2	5.0	36.1	53.5	17.9
Somateria mollissima										
NMC S-5760 P.Q.	♀	25.4	29.1	38.9	8.4	18.7	5.1	33.0	50.0	18.2
NMC Z-105 N.S.	–	25.0	29.9	41.3	9.1	18.2	5.3	32.1	51.6	18.1
NMC S-5128 N.B.	♂	23.9	29.3	40.9	9.9	18.8	5.3	41.1	64.2	18.9
NMC Z-104 N.S.	–	23.7	28.6	39.6	9.6	18.2	5.1	35.0	51.7	16.3
NMC S-5129 N.B.	♀	23.3	27.7	37.7	10.3	17.8	6.2	36.4	53.2	16.4
NMC S-5130 N.B.	♀	23.3	27.0	38.1	10.0	17.5	5.2	34.9	52.9	17.0
NMC S-5774 P.Q.	♂	22.8	26.4	38.4	9.2	17.8	5.5	34.7	53.4	17.1
Somateria spectabilis										
(combined†) M(σ)		21.83(0.58)	25.18(0.88)	34.85(1.28)	8.4 (0.54)	17.03(0.84)	4.85(0.70)	35.58(1.62)	53.68(2.29)	15.8(0.85)
OR		22.8-21.3	26.6-24.4	36.9-33.4	9.2-7.7	17.8-15.7	5.8-4.0	37.9-33.7	56.2-50.0	17.1-15.2
N		4	4	4	4	4	4	4	4	4
Somateria spectabilis										
ROM 92316 Ont.	♀	22.8	25.2	34.7	8.5	17.8	5.8	37.9	54.7	14.9
NMC AR-347 Ont.	♀	21.7	26.6	36.9	8.2	16.9	5.2	36.2	56.2	17.1
ROM 93622 Ont.	♀	21.5	24.4	34.4	7.7	15.7	4.4	34.5	53.8	16.0
ROM 92318 Ont.	♂	21.3	24.5	33.4	9.2	17.7	4.0	33.7	50.0	15.2
ROM 123739 Ont.	♂ imm.	21.2	24.8	32.8	7.8	16.2	4.4	32.6	47.3	14.8
ROM 66931 Ont.	♀ imm.	18.7	24.0	32.4	7.9	14.6	5.0	34.2	52.7	15.5

*1. Minimum width across ilium (SB of von den Driesch, 1976, p. 123).
2. Minimum width across anterior borders of acetabula (AA of von den Driesch, 1976, p. 123).
3. Maximum width across antitrochanters (BA of von den Driesch, 1976, p. 123).
4. Diameter of Acetabulum (DiA of von den Driesch, 1976, p. 122).
5. Minimum length from anterior margin of notch of ilioneural canal on median dorsal ridge of ilium to nearest margin of acetabulum.
6. Length of obturator foramen.
7. Minimum length from anterior of centrum of anteriormost thoracic synsacral vertebra to posterior margin of posteriormost lumbar vertebra parapophysis (approximate).
8. Minimum length from anterior of centrum of anteriormost thoracic synsacral vertebra to posterior margin of largest caudal vertebra parapophysis (approximate).
9. Depth of pelvis taken at the level of the antitrochanters.

** These measurements are less reliable than the others because of variability in number of vertebra in the anterior pelvic region of *Somateria* (see Woolfenden 1961, p. 93) and degree of development of parapophyses. They are included so as to provide an approximate idea of the length of the fossil as compared to Recent specimens.

† M = mean; = standard deviation; OR = observed range; N = number in s sample. Specimens known to be from immature birds are omitted.

next to the Anatini. The Labrador Duck is evidently most closely allied with the scoters and Oldsquaw. Thus, the relationship between *Camptorhynchus* and *Somateria* is not close. Unfortunately, no specimens of the Labrador Duck were available for comparison, so Savage's suggestion cannot be entirely dismissed. However, where large size appears to be of importance, it is worth noting that the Labrador Duck seems to have

been smaller ("19 to 23.5 in.") in total length than the Common Eider ("20 to 26 in.") or the King Eider ("20.75 to 24.00 in.") (GODFREY, 1966, p. 74, 75, 77).

In the course of removing sandy silt matrix adhering to the surface of NMC 34960, the first author recovered several small (3.9-6.2 mm in maximum length), complete shells of *Mytilus edulis*, and a small (4.5 mm in maximum length), complete specimen of *Hiatella arctica*. The fact that valves of both species were articulated supports the evidence that the fossil was *in situ* in deposits containing abundant *Mytilus edulis, Hiatella arctica, Macoma balthica* and *Balanus crenatus* situated just below the layer of *Mya arenaria* shells (Fig. 2).

DISCUSSION

What can be said about the environment of the Shawinigan area some 10 300 years ago, when eider ducks lived near the northern shore of the Champlain Sea? Perhaps the site was within 120 km of the southern margin of the Laurentide ice sheet, and was affected by strong, cold katabatic winds flowing off the ice. Eiders are well adapted to such rigorous conditions (SNYDER, 1957, p. 84; DRIVER, 1974, p. 64), and it is quite possible that these large ducks would have been nesting there (F. G. COOCH, personal communication, 1978). For example, Common Eiders presently nest near the southern margin of the Penny Ice Cap on Baffin Island (SNYDER, 1957, p. 83).

Common Eiders are usually highly colonial during the nesting period and their nests are commonly near salt water in rock-sheltered situations or in depressions in low vegetation (GODFREY, 1966, p. 75). DRIVER (1974, p. 67) specifies "low-lying coastlines, islands and skerries" as prime nesting habitat for this species. So, it is interesting to note that a bedrock hill lying a few metres north of the geological section at Séminaire de Shawinigan was, at the time of deposition of the eider duck, a rocky island near the northern margin of the Champlain Sea. In contrast, King Eiders are not colonial during the nesting period and their nests are usually near fresh water — sometimes on flat tundra at considerable distance from water (GODFREY, 1966, p. 78). Therefore, if eiders were in the Shawinigan area during the breeding season, the colonial habits and preferred nesting habitat of Common Eiders would seem to favour preservation of their remains in the fossil record rather than those of King Eiders.

The Common Eider is a marine species that habitually feeds in shallow waters off low-lying muddy or sandy shores and rocky coastlines (DRIVER, 1974, p. 64). The birds commonly dive to depths of 2 or 3 m for their food, but they are capable of going down to about 16 m (PALMER, 1976, p. 34; DRIVER, 1974, p. 65). In the St. Lawrence estuary, in summer, these birds regulate their feeding according to the tidal level, and they prefer to feed in the upper part of the intertidal zone (CANTIN *et al.* 1973, p. 319, 321, 322). Their principal feeding adaptations (a strong bill and gizzard) are for the capture and digestion of molluscs (DRIVER, 1974, p. 64). In winter, their main food is the edible mussel *(Mytilus edulis)* (BENT, 1925, p. 100; CANTIN *et al.*, 1973, p. 319), although they take other molluscs, crustaceans, echinoderms, worms and fish eggs. In summer, CANTIN *et al.* (1973, p. 323-325) state that the food of the eider, in the St-Lawrence estuary, consists of *Littorina spp., Mytilus edulis* and *Gammarus oceanicus.* PALMER (1976, p. 80-81) prominently lists *Mytilus edulis* and *Macoma balthica* in the diet of this bird, and SALOMONSEN (1950, p. 128-129) notes that *Mytilus edulis* and *Hiatella (= "Saxicava") arctica* are among eight species of bivalves in the Common Eider's diet. Thus, three abundant species of bivalves identified from the zone in which the eider fossil was found (Fig. 2) — *Mytilus edulis, Macoma balthica* and *Hiatella arctica* — are known to be important food for the Common Eider, and a compatible paleoenvironmental picture emerges.

SUMMARY

Study of a pelvic fragment — probably that of a Common Eider *(Somateria cf. mollissima)* — from marine littoral sediments near Shawinigan, Québec, indicates that a population of eiders occupied the northern shore of the Champlain Sea about 10 300 years BP. Food and habitat requirements of living Common Eiders appear to have been met in the Shawinigan area at that time. In other words, the bird fossil is compatible with associated paleoenvironmental evidence.

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