

**Sea Duck Joint Venture**  
**Annual Project Summary**  
**FY22 (October 1, 2021 – September 30, 2022)**

**Project Title:**

Nutrient Reserve Dynamics of American Common Eiders in New Brunswick throughout the annual cycle – data entry.

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**Project Description:**

The American subspecies of the common eider has been declining in the southern portion of their breeding range starting sometime between 2000 and 2005 (Gilliland 2019, Giroux *et al.* 2021, Noel *et al.* 2021). During this period the number of eiders breeding in southwestern New Brunswick is estimated to have declined from about 10,000 to 2,250 breeding pairs (K. Connor unpubl. data). The cause of the decline has not been determined. The age ratios measured by the National harvest surveys from Canada and the USA suggest reproduction has been unusually low for most of this period and abundance has been declining at the rate of adult mortality (see Milton *et al.* 2016, Allen *et al.* 2019, Giroux *et al.* 2021). Several potential limitations have been identified for this population, however, the effects of ocean warming in the Gulf of Maine (Pershing *et al.* 2015) resulting in significant decline of abundance (Sortie *et al.* 2017, Petraitis and Dudgeon 2020) and quality of blue mussels (Waldek and Larsson 2013) is likely the driving factor (Gilliland 2019, Noel *et al.* 2021).

Starvation of sea stars, a specialist predator of mollusks, resulting from the effect of ocean warming on the quantity and quality of blue mussel has recently been documented (Melzner *et al.* 2020). Common Eiders are also a specialist predator of blue mussels, and as capital breeder, rely heavily on mussels to accumulate nutrient reserves required for breeding (Laursen *et al.* 2019) and collapses of blue mussels may have had negative effects on their survival and reproduction.

Recent estimates of survival for American Common eiders suggest adult female survival was good for eiders breeding in Maine, Québec and Labrador (Allen et al. 2019, Giroux et al. 2021), but was much lower than expected for females breeding in Nova Scotia (Milton et al. 2016). An ongoing study of the impacts of gull predation on duckling survival in Maine unexpectedly detected very high rates of non-breeding (>50%) suggesting females maybe challenged to accumulate adequate nutrient reserves for breeding (Savoy 2018, BRI 2020) .

As capital breeders, adult female eiders must accumulate nutrient reserves prior to breeding that are adequate to build a clutch of eggs and sustain the females during incubation and the early brood-rearing period. The cost of breeding with inadequate reserves can be very high as it may result in starvation (Ankeny and McInnis 1978) and long-lived species should defer breeding if resources are inadequate. Indeed, high rates of non-breeding appear to be common in eiders (Coulson 2010, P. Hicklin unpubl. data). There is evidence that female survival maybe low (Milton et al. 2016) and rates of non-breeding may exceed 50% for females breeding (Savoy 2018) for segments of the American common eider breeding in the southern portion of their range.

The SDJV is interested in understanding the relationships between ocean conditions, food availability/quality and body condition for American common eiders. This will require an understanding of nutrient reserve dynamics and require the development of a body condition indices for this population. Most indices of body condition are based on body mass that maybe adjusted for body size, however, there are concerns that use of these indices may in ecological models may reduce their precision (Sparling et al. 1992, Shambler et al. 2009) and it has been recommended that body composition analyses is required to develop appropriate indices of condition. These indices may also vary by age, sex and annual life cycle stage of interest (Shambler et al. 2009). To address Science Needs 6 and 11, researchers will require appropriate condition indices for this subspecies.

### **Project Goals and Objectives:**

The primary objective for this study is the entry of a large dataset containing morphometric, lipid and protein content of American common eiders. Over the next year, we will produce a manuscript that documents the nutrient dynamics of Common Eiders over the annual cycle prior to their decline. This will provide a set of models that allow researchers to estimate body condition (lipid and protein levels) of American common eiders throughout the annual cycle. The objectives were:

1. Collate and copy a large dataset on body composition analyses of American common eiders that has been archived on paper datasheets.
2. Develop a database to expedite efficient and accurate enter of the data and facilitate the linkages with ancillary datasets on gut contents, parasite loadings and nest success.
3. Data entry and validation

### **Preliminary Results:**

The dataset consists of 588 Common Eiders collected in southwestern New Brunswick between 1984 and 1987. The focus of the study was on breeding energetics and the collection dominated by adult females collected from mid-April to early July. However, birds of all age/sex cohorts were collected though out the annual cycle. We've preliminary divided the collection into two age classes (Juveniles and Adults) based on presence/absence of a bursal sack.

Birds were sampled year-round; however, sample size was low for juveniles and low for all birds during August and September (Fig. 1.), and except for a sample of adult males collected early in remigial moult, information on body condition of post fledging ducklings and moulting birds will be limited.

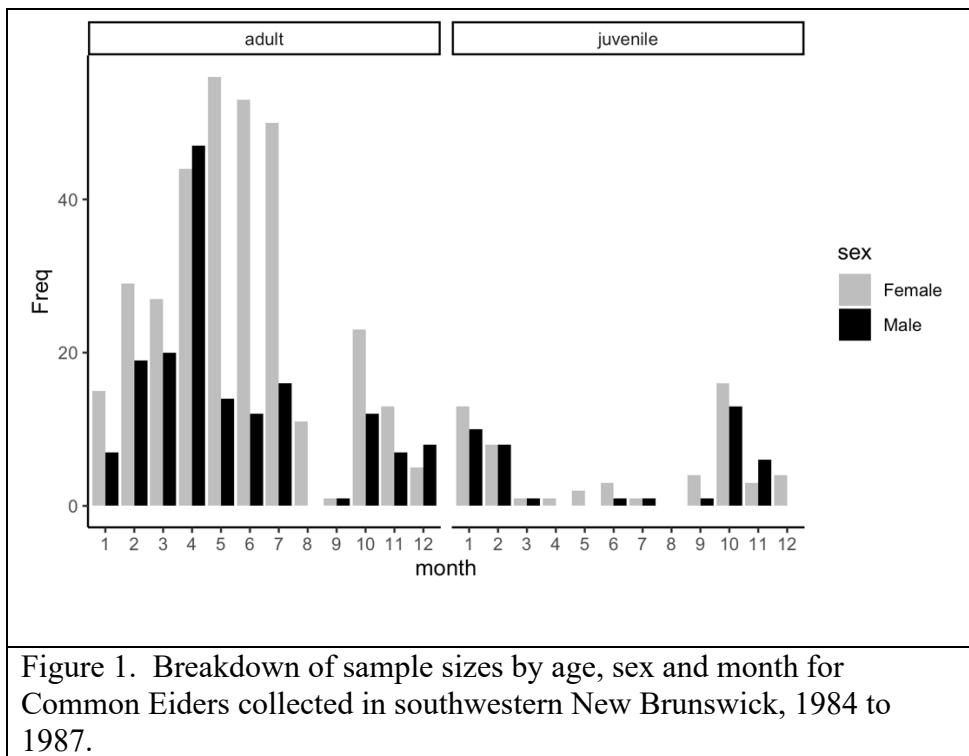


Figure 1. Breakdown of sample sizes by age, sex and month for Common Eiders collected in southwestern New Brunswick, 1984 to 1987.

We've summarized body mass of Common Eiders by age, sex and month of year. Males were heavier than females and adults heavier than juveniles (Fig. 2). Note, these summaries have not been corrected for variation in body size and include gut contents, and only provide a gross comparison of condition. Preliminary summaries of lipid content of the birds suggest females are relatively fatter than males when body size is held constant. Females are heaviest just before breeding (April; Fig. 3) and the lightest at the completion of incubation (July, Fig. 3). Males are heaviest during winter and start losing mass at the onset of breeding and continue to lose mass up to the beginning of moult in July (Fig 3).

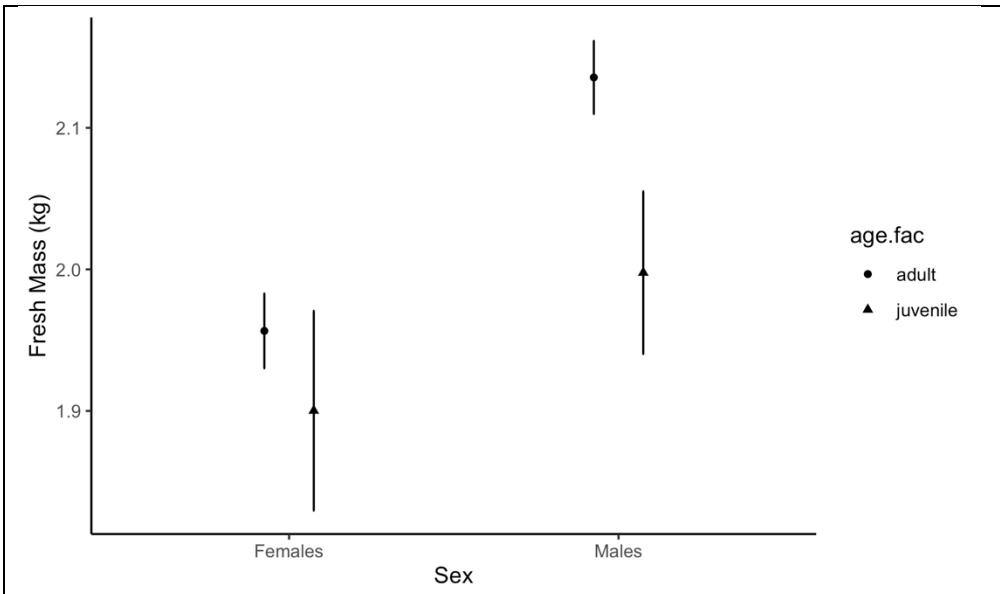


Figure 2. Mean body mass by age and sex for Common Eiders collected in southwestern New Brunswick, 1984-1987.

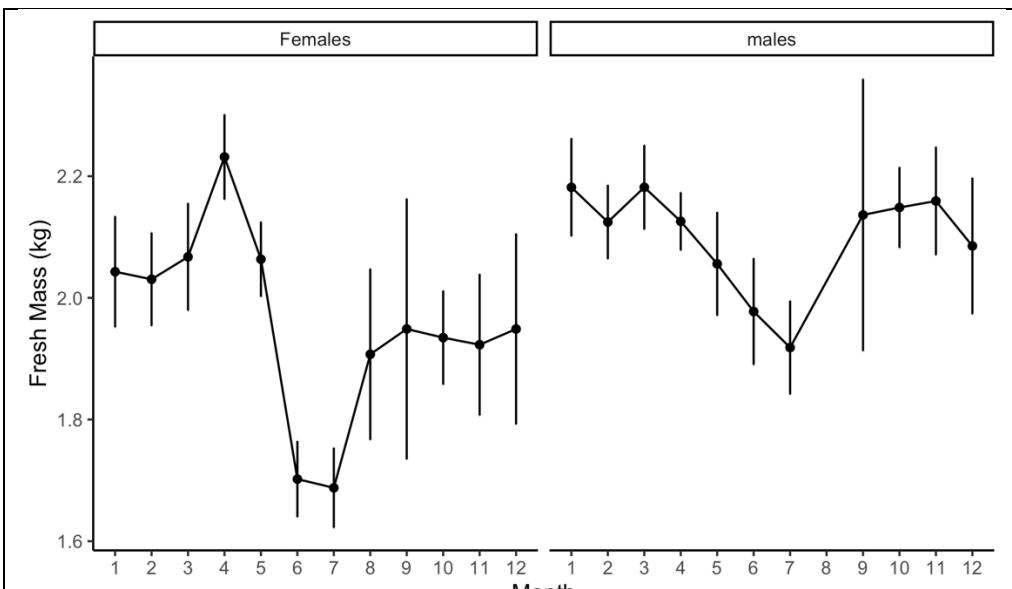


Figure 3. Mean body mass by month for male and female Common Eiders collected in southwestern New Brunswick, 1984-1987.

### Project Status:

In winter 2021, we developed the data entry component of database. To minimize errors during data entry we created entry forms for breeding and non-breeding birds that copied the format of

datasheets and minimize typos by including functions to detect common entry errors as the data is entered (Fig. 3). The database was designed to link with related datasets on parasite loadings, gut contents and reproduction. The database consists of 239 fields and the structure of the database is summarized in Appendix 1. Data entry was completed in March 2022. The data has been validated and we've begun coding the various calculations required to estimate lipid and protein content of the various organs. These calculations are preliminary and have not been checked for errors. Over the next year, we will produce a manuscript that documents the nutrient dynamics of Common Eiders over the annual cycle prior to their decline.

Figure 4. Example of data sheet (a), and non-breeding (b) and breeding (c) data entry forms.

a.	b.	c.

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## Appendix 1. Structure of the database.

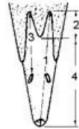
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AFTERSH	Number		FOLMSAM	Number	
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AGEP	Text	Calculation (Text) = IF(G6>Number(FURSALLG3-1); "yv"; "nf")	FOLLEAN	Number	
AGROT	Text	Calculation (Text) = CANCSASH+LIVMASHT	FOLMW2	Number	
ATHETIC	Number		FOLMW3	Number	
BESTFLX	Number		FOLMW4	Text	Calculation (Number) = FOL_AW1+FOLAW2+FOLAW3+FOLAW4+FOLAW5
BESTFLX2	Number	Indexed	FOLMW5	Text	Calculation (Number) = ADIF_AW1+FOLTO+
BESTSH1	Number		FATPRO	Text	Calculation (Number) = ADIF_AW1+FOLTO+FATPRO+FATOM
BILH1	Number		FATOM	Text	Calculation (Number) = ADIF_AW1+FOLTO+CANCASH+LEGATTI+LIMATTO
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BOONNN	Number		Flag	Text	Indexed
BREASPRO	Text	Calculation (Number) = BREASTER-BREATO	Flag reason	Text	Indexed
BREASTER	Number		FOL_Def1	Text	
BREATO	Number		FOL_Def2	Text	
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BREAWTF	Text	Calculation (Number) = BRESAMFT_BRESAMFT	FOL_Def4	Text	
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BRESMFT	Text	Calculation (Number) = TISAMA-TIWAIA	FOL_Def6	Text	
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BURSALLG	Number		FOL_excluded	Text	
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CANCSORF	Text	Calculation (Number) = CANCSWET-CANCSWAT	FOL_FAW2_excluded	Text	
CANCSWAT	Text	Calculation (Number) = CANCSWET-CANCSWAT	FOL_FAW3_excluded	Text	
CANCSWED	Text	Calculation (Number) = CANCSWET+LIVMASHT1	FOL_FAW4_excluded	Text	
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Duck_Nr	Number		FOL_FAW7_excluded	Text	
Duck_Size	Text	Calculation (Text) = calculate_fol_exclusion_and_fol_reduction	FOL_FAW8_excluded	Text	
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FOLMW74	Number		FOL_FAW101	Text	Calculation (Number) = FOLDRY85-FOLAW85
FOLMW75	Number		FOL_FAW102	Text	Calculation (Number) = FOLDRY86-FOLAW86
FOLMW76	Number		FOL_FAW103	Text	Calculation (Number) = FOLDRY87-FOLAW87
FOLMW77	Number		FOL_FAW104	Text	Calculation (Number) = FOLDRY88-FOLAW88
FOLMW78	Number		FOL_FAW105	Text	Calculation (Number) = FOLDRY89-FOLAW89
FOLMW79	Number		FOL_FAW106	Text	Calculation (Number) = FOLDRY90-FOLAW90
FOLMW80	Number		FOL_FAW107	Text	Calculation (Number) = FOLDRY91-FOLAW91
FOLMW81	Number		FOL_FAW108	Text	Calculation (Number) = FOLDRY92-FOLAW92
FOLMW82	Number		FOL_FAW109	Text	Calculation (Number) = FOLDRY93-FOLAW93
FOLMW83	Number		FOL_FAW110	Text	Calculation (Number) = FOLDRY94-FOLAW94
FOLMW84	Number		FOL_FAW111	Text	Calculation (Number) = FOLDRY95-FOLAW95
FOLMW85	Number		FOL_FAW112	Text	Calculation (Number) = FOLDRY96-FOLAW96
FOLMW86	Number		FOL_FAW113	Text	Calculation (Number) = FOLDRY97-FOLAW97
FOLMW87	Number		FOL_FAW114	Text	Calculation (Number) = FOLDRY98-FOLAW98
FOLMW88	Number		FOL_FAW115	Text	Calculation (Number) = FOLDRY99-FOLAW99
FOLMW89	Number		FOL_FAW116	Text	Calculation (Number) = FOLDRY100-FOLAW100
FOLMW90	Number		FOL_FAW117	Text	Calculation (Number) = FOLDRY101-FOLAW101
FOLMW91	Number		FOL_FAW118	Text	Calculation (Number) = FOLDRY102-FOLAW102
FOLMW92	Number		FOL_FAW119	Text	Calculation (Number) = FOLDRY103-FOLAW103
FOLMW93	Number		FOL_FAW120	Text	Calculation (Number) = FOLDRY104-FOLAW104
FOLMW94	Number		FOL_FAW121	Text	Calculation (Number) = FOLDRY105-FOLAW105
FOLMW95	Number		FOL_FAW122	Text	Calculation (Number) = FOLDRY106-FOLAW106
FOLMW96	Number		FOL_FAW123	Text	Calculation (Number) = FOLDRY107-FOLAW107
FOLMW97	Number		FOL_FAW124	Text	Calculation (Number) = FOLDRY108-FOLAW108
FOLMW98	Number		FOL_FAW125	Text	Calculation (Number) = FOLDRY109-FOLAW109
FOLMW99	Number		FOL_FAW126	Text	Calculation (Number) = FOLDRY110-FOLAW110
FOLMW100	Number		FOL_FAW127	Text	Calculation (Number) = FOLDRY111-FOLAW111
FOLMW101	Number		FOL_FAW128	Text	Calculation (Number) = FOLDRY112-FOLAW112
FOLMW102	Number		FOL_FAW129	Text	Calculation (Number) = FOLDRY113-FOLAW113
FOLMW103	Number		FOL_FAW130	Text	Calculation (Number) = FOLDRY114-FOLAW114
FOLMW104	Number		FOL_FAW131	Text	Calculation (Number) = FOLDRY115-FOLAW115
FOLMW105	Number		FOL_FAW132	Text	Calculation (Number) = FOLDRY116-FOLAW116
FOLMW106	Number		FOL_FAW133	Text	Calculation (Number) = FOLDRY117-FOLAW117
FOLMW107	Number		FOL_FAW134	Text	Calculation (Number) = FOLDRY118-FOLAW118
FOLMW108	Number		FOL_FAW135	Text	Calculation (Number) = FOLDRY119-FOLAW119
FOLMW109	Number		FOL_FAW136	Text	Calculation (Number) = FOLDRY120-FOLAW120
FOLMW110	Number		FOL_FAW137	Text	Calculation (Number) = FOLDRY121-FOLAW121
FOLMW111	Number		FOL_FAW138	Text	Calculation (Number) = FOLDRY122-FOLAW122
FOLMW112	Number		FOL_FAW139	Text	Calculation (Number) = FOLDRY123-FOLAW123
FOLMW113	Number		FOL_FAW140	Text	Calculation (Number) = FOLDRY124-FOLAW124
FOLMW114	Number		FOL_FAW141	Text	Calculation (Number) = FOLDRY125-FOLAW125
FOLMW115	Number		FOL_FAW142	Text	Calculation (Number) = FOLDRY126-FOLAW126
FOLMW116	Number		FOL_FAW143	Text	Calculation (Number) = FOLDRY127-FOLAW127
FOLMW117	Number		FOL_FAW144	Text	Calculation (Number) = FOLDRY128-FOLAW128
FOLMW118	Number		FOL_FAW145	Text	Calculation (Number) = FOLDRY129-FOLAW129
FOLMW119	Number		FOL_FAW146	Text	Calculation (Number) = FOLDRY130-FOLAW130
FOLMW120	Number		FOL_FAW147	Text	Calculation (Number) = FOLDRY131-FOLAW131
FOLMW121	Number		FOL_FAW148	Text	Calculation (Number) = FOLDRY132-FOLAW132
FOLMW122	Number		FOL_FAW149	Text	Calculation (Number) = FOLDRY133-FOLAW133
FOLMW123	Number		FOL_FAW150	Text	Calculation (Number) = FOLDRY134-FOLAW134
FOLMW124	Number		FOL_FAW151	Text	Calculation (Number) = FOLDRY135-FOLAW135
FOLMW125	Number		FOL_FAW152	Text	Calculation (Number) = FOLDRY136-FOLAW136
FOLMW126	Number		FOL_FAW153	Text	Calculation (Number) = FOLDRY137-FOLAW137
FOLMW127	Number		FOL_FAW154	Text	Calculation (Number) = FOLDRY138-FOLAW138
FOLMW128	Number		FOL_FAW155	Text	Calculation (Number) = FOLDRY139-FOLAW139
FOLMW129	Number		FOL_FAW156	Text	Calculation (Number) = FOLDRY140-FOLAW140
FOLMW130	Number		FOL_FAW157	Text	Calculation (Number) = FOLDRY141-FOLAW141
FOLMW131	Number				

Field Name	Field Type	Formula / Early Options
FOLWTR5	Number	
FOLWTR6	Number	
FRESWTR	Number	
GIZZWTR	Calculation (Number)	=GIZZWTF-GIZZWTE
GIZZWE	Number	
GIZZWTF	Number	
HEADTR	Number	
HEADW	Number	
HOMD	Number	
HOMFTR	Number	
HOMAFTR1	Calculation (Number)	=CRUSAMH-CRUFAM1
HOMAFTR1	Calculation (Number)	=HOMSAMF1/HOMSMW1
HOMASP1	Calculation (Number)	=HOMSAMW1/HOMSMW1
HOMATF1	Calculation (Number)	=HOMATP1/HOMGOMY1
HOMASR1	Calculation (Number)	=HOMASP1/HOMGOMY1
HOMGOMY1	Number	
HOMGOMY2	Number	
HOMGOMY1	Calculation (Number)	=HOMGOMY1-HOMEAF1-HOMGASH1
HOMKWM1	Calculation (Number)	=HOMKWM1/HOMGOMY1
HOMKWMET	Number	
HOMKWMET	Number	
HOMKWMF	Number	
HOMSAMF1	Calculation (Number)	=TMSAMH-TMELAM1
HOMSFTR1	Calculation (Number)	=HOMGOMY1/HOMGOMY1
HOMSMW1	Calculation (Number)	=TMSAMH-TMAM1
HOMSAH1	Calculation (Number)	=CRUSAH1-CHAM1
HOMWFTR1	Calculation (Number)	=HOMWFTR1/HOMGOMY1
INDUM	Text	Induced
Incitation_time	Number	Estimated by regression of model
JDATE	Calculation (Number)	DayNumber(DATE)
JdateOld	Calculation (Number)	Induced = If(YearNumber(JDATE) < 300 And GetYearNumber(JDATE) > 200, JDATE-200, JDATE+70)
JmonthOld	Calculation (Number)	Induced = If(GYearNumber(MONTH) > 10, MONTH-10, MONTH+3)
KEEL	Number	
LAT	Number	
LEGORY	Calculation (Number)	=LEGAFAMF1/LEGSAMW1
LEGATND	Calculation (Number)	=LEGATP1-LEGUDY
LEGATO	Calculation (Number)	=LEGORY-LEGATO
LEGASMI	Calculation (Number)	=TMSAMF1/TMELAM1
LEGSAMWF	Calculation (Number)	=TMSAMF1-TMAM1
LEGWATER	Calculation (Number)	=LEGWET-LEGORY
LEGWET	Number	
GNOL	Number	
LGDNWTS	Calculation (Number)	=LGDNWTF-LGDNWTE
LGNLIGL	Number	
LGNTWTE	Number	
LGNTWTF	Number	
LGWSHFT	Calculation (Number)	=LGWSHWF/LGWSHWT
LGASH1	Calculation (Number)	=LGASHWF-1/LGASHWT
LGASH2	Calculation (Number)	=CRUSHC-CRUMTC
LGCOLUR	Text	Induced
LGDRY	Number	
LGIMWTR	Calculation (Number)	=LGIMWTF-LGIMWRY
LGIMWRY	Number	
LGIMWTF	Calculation (Number)	=LGIMWTF/LGIMWRY
LGIMTR	Calculation (Number)	=LGIMTF-LGIMWRY
LGIMTRT	Calculation (Number)	=LGIMDY-LGIMTF-LGASHWF
LGISAMFT	Calculation (Number)	=TMSAMC-TMELANC
LGISAMWF	Calculation (Number)	=TMSAMC-TMWC
LGISAMWTF	Calculation (Number)	=CRUSAMC-CRUMTC
LOC	Text	Induced
LOI	Number	

Field Name	Field Type	Formula / Early Options
MONTH	Number	Indeed
Neat_No	Number	
NINERFM	Number	
NODEVOL	Number	
NOTES	Text	Indeed
DWRY_extended	Text	User defined if extended and add sample data elsewhere
DWRY_id_extended	Number	User defined extended and add sample data elsewhere
DWRYOR	Number	
DWRYWFM	Calculation (Number)	= DWRYWF - DWRYOR
DWRYWIT	Number	
DWYDCTOR	Number	
DWYDCTR	Number	
DWYDOR	Number	
DWYGANT	Number	
DWGG	Text	Indeed
DWEGGDR	Number	
DWEGGMN	Number	
DWEGSR	Number	
DWEGSM	Number	
DWEGSMF	Number	
DWEGSMR	Number	
DWEGSMR	Number	
DWEGSMW	Number	
DWEGWF	Calculation (Number)	= DWYSWF / DWYSAWF
DWEMATO	Calculation (Number)	= (DWYDOR * DWYSWF) > 0; (DWEMATO * DWYDOR); DWYSWF
DWYSAMF	Calculation (Number)	= DWYSAM - DWYMEAN
DWYSAMW	Calculation (Number)	= DWYSAM - DWYMF
DWYMEAN	Number	
DWYSAM	Number	
DWYMF	Number	
DWYMF	Calculation (Number)	= (DWYSWF * DWYSWF) / 1000
POFOM	Calculation (Number)	= FOFOM + FOLODF + FOLOSF + FOLODF + FOLOSF + FOLODF
POSTOM	Calculation (Number)	= BIAKDF + BACANGDF + BLEGDF + BIAKDF + BACANGDF + BLEGDF
PROTOM	Number	
PROTOMPRO	Calculation (Number)	= POFOM + DWECDTR
PROTOT	Calculation (Number)	= POSTOM + PROTOMPRO
SALTGRND	Number	
SAMPLE	Text	Indeed
SEX	Text	Indeed
SMCANTS	Calculation (Number)	= SMINTWF - SMINTWE
SMINILG	Number	
SMINWTE	Number	
SMINWTF	Number	
SPECIES	Text	Indeed
SUDSUS	Text	Indeed
TAE	Number	
LARONE	Number	
LARFOR	Number	
TESTESWF	Number	
TMFANF	Number	
TMFLANF	Number	
TMFLAND	Number	
TMFLANF	Number	
TMFSAM	Number	
TMFSAM	Number	
TMFSAMF	Number	
TMFWIC	Number	
TMFWIF	Number	
tmfwifharm	Calculation (Number)	Indeed = IF(WeekOfYear(DATE)<40, WeekOfYear(DATE)-40, WeekOfYear(DATE))

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Field Name	Field Type	Formula / Entry Options
WING	Number	(DZU1)*9
YEAR	Number	Induced

**CULMEN** (Mendell 1986)

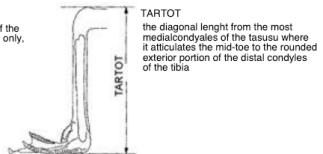


CUL1 - Total Length  
CUL2 - Frontal Extension  
CUL3 - Nostril Extension  
CUL4 - Culmen Mid-line

**TARSUS** (Dzubin and Cooch)



**TARBONE**  
The diagonal length of the tarsometatarsus bone only, outside length



**TARTOT**  
the diagonal length from the most distal point of the tarsus where it articulates the mid-toe to the rounded exterior portion of the distal condyles of the tibia

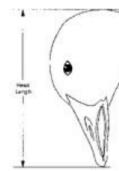
**WING** (Dzubin and Cooch)

**WING**  
The distance from the butt end of the wrist joint to the end of the longest primary; with the wing flattened against a wing board and the longest primary extended upward to lie perpendicular to the bend of the wing.

**NINEPRIM**  
The total length of the ninth primary measured from the insertion of the reminge calamus at the skin surface to the distal end of the feather



**KEEL** (Dzubin and Cooch)  
**KEEL**  
The length from the proximal end of the deflected sternum (cartilaginous tissues on proximal and distal ends removed).



**HEADLG**  
The length of the skull from the external occipital ridge to the distal tip of the bill nail!