



# Locally Procured Wild Game Culinary Trends in the US: A Study of the Ruffed Grouse as Entrée and Accompanying Nutritional Analysis

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Wild-caught foods including game and fish can be part of a local, sustainable food system. Beneficial environmental, personal health, and nutrition claims are often linked to locally-sourced foods. Yet, because many species of wild game and fish that are legal to hunt or catch do not have nutrient data in the USDA food composition database these claims, especially in the realm of nutrition, are not well substantiated. To address this gap, the Cornell research team collaborated with USDA scientists to address shortcomings in nutrition information for several wild game and fish species, in this case Ruffed Grouse. A wildlife biologist with the Ruffed Grouse Society collected bird samples according to USDA-determined collection protocols to obtain edible meat portions. Nutrient analysis was conducted on raw Ruffed Grouse breast meat samples at USDA-validated laboratories using approved quality assurance procedures. Analytical data were sent to NDL scientists, who reviewed and compiled the data into full nutrient profiles for Ruffed Grouse which were made available in the USDA food composition database. This new nutritional information supplements the already-well-appreciated epicurean qualities of the Ruffed Grouse and contributes to the complex social construction of the notion of hunted food as gourmet entrée.

**Keywords:** nutritional analysis, ruffed grouse, wild game consumption, local food preferences, locavore movement, locavore, sustainable food

## INTRODUCTION

A recent and growing trend in the United States has been an increase in consumers who are seeking and buying meat based on personal health concerns, ethical treatment of animals, and environmental awareness. They are looking for meat from animals that have not been treated with antibiotics or hormones and that are fed a more natural grass-based diet. Animal welfare is also of concern and consumers want assurances that the animals are treated well, have the ability to free range, and that the farming practices are sustainable and promote environmental conservation (Ellison and Brooks, 2017). Meat is being sold with consumer labels such as “Animal Welfare Approved”, “All Natural Grass-fed”, “Free Range”, “Cage Free”, “No Antibiotics or Hormones”. This consumer desire for healthy, free-range meat has created an uptick in people interested in hunting for their meat as wild game meat represents the epitome of this consumer trend (Tidball, 2016; Demartini et al., 2018). Beyond the health and

environmental benefits presented by consumption of wild game meats, there is a concurrent trend toward gourmet treatment of wild fish and game, and the culinary game movement continues to trend upward in terms of interest and participation (see for example <http://www.culinarytrends.net/Getting%20into%20the%20Game.html> and <https://www.eater.com/2017/10/25/16537266/arbys-venison-game-meat-popular-trend-elk-deer>).

In the United States, hunter participation is critical to wildlife and habitat conservation as state and federal funding depends on hunting license revenue and excise taxes paid on hunting equipment. Wild game meat is free of medicines, is able to live freely, lives in harmony with its environment, and is reasonably available on public lands. The nutritional health benefits of wild game meat are largely assumed from observation of leanness; however, many wild game species do not have research based nutritional analysis listed in the USDA/NDL (Tidball et al., 2014b). In response to this culinary trend of meat consumption and missing nutritional data, the authors sought to fill information gaps of popularly hunted wild game and fish species in the northeast area of the USA. They received grant funding from the United States Department of Agriculture's National Institute for Food and Agriculture to collect nutritional information for Brook Trout (Tidball et al., 2017), Canada Goose, and Ruffed Grouse. This paper focuses on Ruffed Grouse.

Ruffed Grouse meat is very lean white meat with a delicate flavor. Often referred to as “road chicken” the meat can be cooked in very similar fashion to chicken and is an epicurean delight. The 2015–2020 Dietary Guidelines for Americans recommends consuming lean meats and poultry as a healthy source of dietary protein (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015). Accordingly, consumption of chicken meat has risen exponentially in the USA over the past few decades with the perception that lean chicken meat is a healthier option than more fat laden red meat. Up until the study this paper describes, there was no way of knowing if Ruffed Grouse meat was nutritionally comparable to lean, domestic chicken. The authors of this study set to find out if Ruffed Grouse meat could definitively be considered a lean source of meat protein by calculating the nutritional profile of Ruffed Grouse.

With the rise of discerning consumer demand for healthy meat, it's important to have nutrition information about wild caught game and fish. Nutrition labeling helps consumers identify healthy food choices and now some food manufacturers are voluntarily including easy to read nutrition information on the front of packages to help inform consumers food choices (Lim et al., 2020). According to the U.S.A. Health and Diet national consumer survey conducted by the Food and Drug Administration (FDA), 77% of U.S. adults reported using the Nutrition Facts label always, most of the time, or sometimes when buying a food product and 79% of adults reported using the label often or sometimes when buying a product for the first time. When the label was used, it was most often used to discover the nutrient contents of a product or to compare nutrient contents between products (Lin, 2014). Nutrition knowledge supports food label use (Soederberg Miller and Cassady, 2015). An area that warrants further investigation involves the extent to which labeling, and comprehension of

that labeling, influences meat consumption choices. Much of the labeling on meat packaging in retail outlets exists for marketing purposes to help consumers with decisions, such as “Animal Welfare Approved” or “95% lean”. One study, using national USA survey data, showed a majority of respondents thought that it was very important that meat labels contain information regarding nutrition, ingredients, health claim, and production process, respectively; this labeling information informed purchases of meat and consumption (Rimal, 2005). Wild-caught game and fish are assumed to have many health attributes, but recipes using wild-caught game and fish are mostly unable to be labeled for consumers. Additionally, having the nutritional profiles for wild game and fish species provides the ability to know the nutrition content and compare it to other meat choices.

## Hunting as a Part of Local Food Systems

Reports suggest that interest in consuming food that is grown, raised, produced, or harvested locally has increased substantially (Cotler, 2009; Tidball et al., 2013; Stedman et al., 2017). This “locavore” interest has attracted attention in popular circles [see for example Pollan (2006), Cotler (2009), and Cerulli (2012)]. Similar narratives appear in print media such as newspapers (Ruth-McSwain, 2012) and magazines (Andres, 2014). A recent review of popular media and use of the term “locavore” in conjunction with the word “hunting” (using internet search engines) yielded >53,600 search results (Tidball, 2016). This growth of interest in local foods has outpaced researchers' knowledge about who is motivated by local foods and what influences their preferences and behavior. Nevertheless, some important insights are beginning to emerge (Tidball et al., 2014a; Stedman et al., 2017).

Embedded in a larger food-related movement, local food preferences are expressed by consumers and producers who desire a healthier, more sustainable lifestyle *via* utilization of localized food systems (see Applewick, 2007; Coit, 2008; Starr, 2010; DeLind, 2011; Ikerd, 2011; Tidball et al., 2013). For some, eating locally sourced food is related to personal ethical beliefs and a rejection of mass-produced or chemically enhanced produce, meat, fish, and poultry (Pollan, 2006; Cerulli, 2012). Others are attracted by perceived safety and higher nutritional quality (Tidball et al., 2014a) of home grown foods, and a strong desire to support small farms and rural communities (Nie and Zepeda, 2011; Byker C, 2012; Stanton et al., 2012). However, because some local food sources can be inconvenient, expensive, or difficult to find, accessibility can be a barrier to local food consumption (Lockeretz, 1986; Eastwood et al., 1999; Nie and Zepeda, 2011). Increased recognition of the personal health and conservation benefits associated with consumption of wild-caught, locally harvested fish and game has moved thinking about local foods beyond its agricultural crop and livestock roots. Many who express preferences for eating locally sourced foods include local wild fish and game in their diets (Pollan, 2006; Zepeda and Li, 2006; Bruckner, 2007; Tidball et al., 2014a).

## Ruffed Grouse

The Ruffed Grouse (*Bonasa umbellus*), or “partridge” is a prized game bird of mixed and northern hardwood forests in the



**FIGURE 1** | The Ruffed Grouse game bird, with extravagant display, including erecting long neck feathers to create a black “ruff” and fanning the tail, exposing a dark band near the tip. Photo courtesy of Lucas Bobay, Macaulay Library, Cornell University Lab of Ornithology.

United States and Canada (**Figure 1**). They are the most widely distributed game bird on the continent, found in 38 states and 13 Canadian provinces (Aldrich, 1963). Ruffed Grouse prefer a combination of openings, brush, and mixed forests. The birds are associated with disturbed forest habitats, and respond well to successional changes on abandoned farmlands, or logging activities in forests (Bump et al., 1947; Gullion, 1977a). The border between a forest and field creates an edge effect, and this ecotone is attractive to grouse and other wildlife. Good grouse habitat also benefits woodcock (*Scolopax minor*), cotton-tailed rabbits (*Sylvilagus floridanus*), white-tailed deer (*Odocoileus virginianus*), and many songbird species.

In northern areas where snow covers the ground from late November to early April, the continental distribution of Ruffed Grouse closely coincides with the distribution of aspen (*Populus tremuloides*, *P. grandidentata*) cover (Gullion, 1977b). Staminate flower buds and catkins of mature aspen serve as an important winter food resource (Svoboda and Gullion, 1972). It is in these aspen forests that grouse are often most abundant. The aspen ecosystem also provides important habitat for many other forest wildlife species (Flack, 1976) and occurs on about 25% of the forested lands in North America north of Mexico (Gullion, 1977a).

Typical of forest grouse, Ruffed Grouse are primarily browsers, foraging on the buds, twigs, leaves, and fruits of various forest herbs, shrubs, and trees. In non-aspen forest types, the density and quality of understory vegetation determines the potential use as Ruffed Grouse habitat. If the density of tall shrubs is >2,000 stems per acres, the area is often

attractive to grouse, even in northern hardwood or conifer stands (DeStefano et al., 2001). Shrubs that provide important food and cover for grouse include speckled alder (*Alnus incana*), common winterberry (*Ilex verticillata*), red-osier dogwood (*Cornus sericea*), hazelnut (*Corylus americana*), and prickly ash (*Zanthoxylum americanum*).

Ruffed Grouse are non-migratory, and spend their lives in a small area, as little as 6 to 10 acres (Gullion, 1977b). Males are known for “drumming,” a rapid wing beat males use to attract females during the breeding season. Hens mate once per year in spring, and she will select a nest site, incubate her eggs, and rear the chicks with no assistance from the male grouse. Hens typically lay around 10 eggs and incubate them for about 3 weeks. Once the chicks hatch and are dried, the hen leaves the nest site and raises the young for 8 to 10 weeks. Usually only 3 or 4 chicks from a brood will survive the summer months. Mortality is high during winter, and only about 45% of the young grouse alive in September will survive until spring.

Grouse hunters love the formidable sporting challenge that these birds present. Thousands of hunters are drawn to the woods each fall, as grouse hunting is truly “wild” bird hunting. The birds fly fast in thick cover and present difficult shooting even for experienced hunters. Grouse are often referenced as the “king” of game birds because of the sporting challenge of hunting them and in particular, the Ruffed Grouse because of its distinctive dark feathered neck ruffle.

## EATING THE RUFFED GROUSE

The culinary praises and accolades earned by the Ruffed Grouse are historical and numerous. A letter from an enthusiastic traveler named John Bartram sent to England about 1752 and quoted by George Edwards, an English naturalist and ornithologist, known as the “father of British ornithology”, reports of the Ruffed Grouse that “their flesh is white and good.” John James Audubon, noted American ornithologist, naturalist, and painter opined that the grouse “far surpass, as an article of food, every other land bird except the wild turkey.” Even today in Great Britain, the start of the grouse season is much anticipated and has long been named The Glorious Twelfth (of August). Since the British Game Act passed in 1831, The Glorious Twelfth has been diligently celebrated with much shooting, chasing of grouse, and fancy London restaurants serving it on the menu with keen competition among chefs to be the first to serve grouse at the beginning of the grouse hunting season. The species of grouse hunted in Great Britain is primarily red grouse (*Lagopus lagopus scotica*) which is a darker meat and more gamey in flavor than the Ruffed Grouse, yet popular press (See for example <https://www.telegraph.co.uk/news/0/grouse-shooting-12-facts-about-the-glorious-12th/>) extol the red grouse for being a delicacy and having less fat and more protein than roast chicken meat. Grouse is traditionally served in UK restaurants is roasted, slightly rare, and with a bread sauce made of milk, butter, nutmeg, and breadcrumbs. In the United States wild caught grouse cannot be served in restaurants and grouse is very hard and expensive

**TABLE 1** | Location and dissection data for Ruffed Grouse.

Ruffed Grouse #	Location harvested	Date harvested	Original with feathers and entrails removed (g)	Raw breast edible portion (g)	Refuse (g)	Notes
1	Richford, Tioga Co., NY	10/24/2012	622.5	225	397.5	Adult male
2	Richford, Tioga Co., NY	10/24/2012	573.5	204	369.5	Juvenile female
3	Richford, Tioga Co., NY	11/19/2012	579	209.5	369.5	Adult male
4	Itasca Co., MN	10/10/2012	624.5	218.5	406	Adult male
5	Hector, Schuyler Co., NY	10/12/2012	681	238.5	452.5	Adult male
6	Starksboro, Addison Co., VT	12/13/2012	683	220.5	462.5	Adult male

to raise domestically, so the meat can only be acquired through hunting. This rarity makes it even more prized as a culinary treat and also protects the species from over-hunting for market sales.

An adult Ruffed Grouse weighs between 1 to 1½ pounds in feathers and will dress out to serve about 2 people. The *L.L. Bean Game and Fish Cookbook* suggests that “grouse do not come in prodigal numbers” and the “quantity of grouse on hand can be stretched with a hearty hors d’oeuvre course” when serving guests, indicating the culinary treat/rarity it represents. The breast meat is white and can be prepared similar to many chicken recipes, with the cook taking care not to overcook the meat because it is much leaner than chicken breast meat. Sauces and barding (wrapping in bacon or similar fat) help to keep the meat moist and tender. The legs do not have much meat yet can be braised and cooked down to make delectable sauces to serve with the breast meat. Ruffed Grouse is delicious braised with mushrooms and served with toast spread with a liver pate, and there are numerous other gourmet and simple ways to prepare Ruffed Grouse meat.

## Safety Considerations

Consumption of Ruffed Grouse poses no significant health or safety concern beyond the precautions that should be taken with any other form of “poultry” or game meat, and the potential hazard to dentition by failing to remove shot pellets from meat to be eaten. However, an interesting caveat is appropriate here. According to Bloom and Grivetti (2001), the anomalous sickness called “partridge poisoning” counted as one of the more notorious forms of food poisoning in eastern North America during the late 1800’s and early, 1900’s, but it disappeared before its etiology could be properly analyzed. These scholars muse that the circumstances of its departure are still a mystery; that it may be that the conditions for the disease’s appearance were terminated by the suppression of winter hunting of Ruffed Grouse, which happened to restrict harvesting of the birds at the time of year they were most apt to feed heavily on toxic mountain laurel plants. There have been no recorded instances of partridge poisoning since the early, 1900’s and the last instance of its mention in medical publications was in, 1944 (Christian, 1944).

## METHODS

### Materials and Sampling

The research plan was established by USDA/NDL scientists requiring six different birds to be harvested from three specific

geographic regions and detailed collection and field dressing protocols (**Appendix A**) for the hunters. The Ruffed Grouse were hunted in the legal fall hunting season of, 2012 by wildlife biologists in the states of New York, Minnesota, and Vermont. From these states, 4, 1, and 1 bird, respectively, were obtained. The hunters kept harvested birds on dry ice and provided them to Cornell University staff. Collection of weights, feather and skin removal, and dissection of birds was conducted at Cornell University. Each Ruffed Grouse was carefully dissected to remove the edible portion from the skin and bone. Only boneless, skinless breast samples were used for the study. Each breast portion weight was recorded (**Table 1**). All breast samples were shipped on dry ice to the Food Analysis Laboratory and Control Center at Virginia Tech University. There the samples were combined by location into two analytical composites composed of 3 birds per composite. Composites were homogenized with liquid nitrogen, placed in jars and stored frozen at  $-65^{\circ}\text{C}$  until they were shipped to USDA-appointed analytical laboratories. Samples were analyzed ( $n = 2$ ) for proximates (moisture, protein, total fat, and ash), calcium, magnesium, phosphorus, potassium, sodium, zinc, riboflavin, niacin, thiamin, vitamin B6, vitamin B12, cholesterol and fatty acids using Association of Official Analytical Chemists (AOAC) or other validated methods (**Table 2**). Quality assurance was monitored through the use of standard reference materials, in-house control materials, and random duplicate sampling. Analytical data were sent to USDA/NDL where they were thoroughly reviewed for quality control, compiled and released into the USDA food composition database. Full nutrient profiles are available at <https://ndb.nal.usda.gov>.

### Analytical Methods

Macronutrients, vitamins, minerals, were assayed. Standard and/or published methods were used, consistent with the methods of analysis for other foods in the USDA National Food and Nutrient Analysis Program (NFNAP) (Haytowitz et al., 2008). Samples of well-characterized control composites (CC) with established tolerance limits developed for the National Food and Nutrient Analysis Program and/or certified reference materials (CRMs) were included in each analytical run to validate results (Phillips et al., 2006). CRMs were obtained from the National Institute of Standards and Technology (NIST, Gaithersburg, MD) (SRM<sup>®</sup> 2383 Babyfood, SRM<sup>®</sup> 2387 Peanut Butter) and the Institute of Reference Materials

**TABLE 2** | Assay methods used for nutrient analyses of Ruffed Grouse collected in New York, Minnesota, and Vermont, 2012.

Analyte	Method <a href="http://www.sciencedirect.com/science/article/pii/S0889157514000519#tblfn0005">http://www.sciencedirect.com/science/article/pii/S0889157514000519#tblfn0005</a>	Method description	Reference citation for method details
Moisture	Vacuum -Oven	Sample (2–13 g) in a metal dish vacuum dried at 100°C.	Association of Official Analytical Chemists (2011), method 926.08 <i>Moisture in cheese</i>
Protein	Kjeldahl Distillation	Milk digested in H <sub>2</sub> SO <sub>4</sub> using CuSO <sub>4</sub> · H <sub>2</sub> O as a catalyst with K <sub>2</sub> SO <sub>4</sub> as boiling point elevator. with the percent nitrogen converted to protein using a factor of 6.25	Association of Official Analytical Chemists (2011), method 991.20 (4.2.04), Nitrogen total in milk
Fat	Acid hydrolysis	Total fat determined gravimetrically after acid hydrolysis and recovery of extractable fat using ether and hexane	Association of Official Analytical Chemists (2011), method Modified 989.05 <i>Fat in milk</i>
Niacin	Microbiological	Sample hydrolyzed with sulfuric acid; pH adjusted to remove interferences. Niacin determined by comparing the growth response <i>Lactobacillus plantarum</i> using the sample compared to the growth response for a niacin standard, measured turbidimetrically	Association of Official Analytical Chemists (2011), methods 944.13 (45.2.04), 960.46 (45.2.01), and 985.34 (50.1.19), Niacin in foods
Vitamin B6	Microbiological	Sample hydrolyzed with dilute sulfuric acid in an autoclave; pH adjusted to remove interferences. Vitamin B6 determined by comparing the growth response of <i>Saccharomyces carlsbergensis</i> using the sample compared to the growth response for a vitamin B6 standard, measured turbidimetrically	Association of Official Analytical Chemists (2011), method 961.15 (45.2.08), Vitamin B6 (pyridoxine, pyridoxal, and pyridoxamine) in food extracts
Riboflavin	Microbiological	Sample hydrolyzed with dilute hydrochloric acid (HCl); pH adjusted to remove interferences. Riboflavin determined by comparing the growth response of <i>Lactobacillus casei</i> using the sample compared to the growth response for a riboflavin standard, measured turbidimetrically	Association of Official Analytical Chemists (2011), 940.33 (45.2.06) riboflavin (Vitamin B2) in vitamin preparations
Riboflavin	Fluorometric	Sample autoclaved in dilute acid; pH adjusted with NaOH. Dilute HCl added to precipitate protein and the sample is filtered. Acetic acid and then 4% potassium permanganate are added. Hydrogen peroxide is added to destroy the permanganate color. Fluorescence is measured, Na <sub>2</sub> S <sub>2</sub> O <sub>4</sub> added and fluorescence is measured again	Association of Official Analytical Chemists (2011), method 970.65, Riboflavin (vitamin B2) in foods and vitamin preparations
Thiamin	Fluorometric	Sample autoclaved in dilute acid to extract thiamin. Resulting solution incubated with a buffered enzyme solution to release bound thiamin. Solution purified on an ion-exchange column. Aliquot taken and reacted with potassium ferricyanide to convert thiamin to thiochrome. Thiochrome extracted into isobutyl alcohol and read on a fluorometer against a known standard	Association of Official Analytical Chemists (2011), methods 942.23 (45.2.05), 953.17 (45.1.06), and 957.17 (45.1.07), Thiamine in bread
Vitamin B12	Microbiological	Microbiological with Turbidimetric method	Association of Official Analytical Chemists (2011) 952.20 method
Cholesterol	GC/Direct Saponification/Gas Chromatographic method	Direct saponification-Saponified at high temperature with ethanolic KOH solution.	Association of Official Analytical Chemists (2011) 994.01 method
Elements (Ca, Mg, K, Na, P, Cu, Fe, Mn, Zn)	ICP	Dry ashing (500°C ± 50°C) and dissolution in concentrated HCl, or wet ashing (digestion in concentrated acid, with heat) of sample. Followed by appropriate dilution, followed by quantitation of each element using an ICP spectrometer and comparing the emission of the unknown sample against the emission of each element in standard solutions	Association of Official Analytical Chemists (2011), methods 985.01 (3.2.06) and 984.27 (50.1.15), Metals in food by ICP
Fatty acids	Gas Liquid Chromatography	Fat and fatty acids are extracted from food by acid hydrolysis. Pyrogallol acid is added to minimize oxidative degradation to analysis. Esters are quantitatively measured by GC	Association of Official Analytical Chemists (2011) Fat 996.06 (Total saturated and monounsaturated in foods)

and Methods (Geel, Belgium; purchased from RT Corp., Laramie, WY) (CRM 485 Lyophilized Mixed Vegetables, CRM 431 Lyophilized Brussel Sprouts). Results for the CCs and CRMs analyzed with the samples were compared to the certified ranges (for the CRM) and to established in-house tolerance limits (for the CC) to validate the accuracy of the measurements.

## RESULTS

The nutritional content of raw boneless skinless Ruffed Grouse was analyzed and the results are now listed in the USDA food composition databases. The USDA Food Composition Database contains nutrient data for over 8,600 foods. It is considered the authoritative and major source of nutrient data for food products

**TABLE 3** | Profile for Ruffed Grouse.

Full Report (All Nutrients)

Report Run at: March 27

2017

14:07

EDT

Nutrient data for: 05363, Ruffed Grouse, breast meat, skinless, raw

Food Group: Poultry Products

Common Name: Ruffed Grouse

Nutrient	Unit	Value per 100 g	Data points	Std. Error	4.0 oz = 113.0g	1 breast = 219.0g	1 bird = 627.0g
<b>Proximates</b>							
Water	g	72.93	2	–	82.41	159.72	457.27
Energy	kcal	112	–	–	127	245	702
Energy	kJ	467	–	–	528	1023	2928
Protein	g	25.94	2	–	29.31	56.81	162.64
Total lipid (fat)	g	0.88	2	–	0.99	1.93	5.52
Ash	g	1.07	2	–	1.21	2.34	6.71
Carbohydrate, by difference	g	0	–	–	0	0	0
Fiber, total dietary	g	0	–	–	0	0	0
Sugars, total	g	0	–	–	0	0	0
<b>Minerals</b>							
Calcium, Ca	mg	5	2	–	6	11	31
Iron, Fe	mg	0.58	2	–	0.66	1.27	3.64
Magnesium, Mg	mg	32	2	–	36	70	201
Phosphorus, P	mg	229	2	–	259	502	1436
Potassium, K	mg	311	2	–	351	681	1950
Sodium, Na	mg	50	2	–	56	110	314
Zinc, Zn	mg	0.51	2	–	0.58	1.12	3.2
Copper, Cu	mg	0.058	2	–	0.066	0.127	0.364
Manganese, Mn	mg	0.016	2	–	0.018	0.035	0.1
<b>Vitamins</b>							
Vitamin C, total ascorbic acid	mg	0	–	–	0	0	0
Thiamin	mg	0.042	2	–	0.047	0.092	0.263
Riboflavin	mg	0.28	2	–	0.316	0.613	1.756
Niacin	mg	11.6	2	–	13.108	25.404	72.732
Vitamin B-6	mg	1.275	2	–	1.441	2.792	7.994
Vitamin B-12	µg	2.9	2	–	3.28	6.35	18.18
Vitamin B-12, added	µg	0	–	–	0	0	0
Vitamin A, RAE	µg	5	–	–	6	11	31
Retinol	µg	5	1	–	6	11	31
Carotene, beta	µg	0	–	–	0	0	0
Carotene, alpha	µg	0	–	–	0	0	0
Cryptoxanthin, beta	µg	0	–	–	0	0	0
Vitamin A, IU	IU	16	–	–	18	35	100
Lycopene	µg	0	–	–	0	0	0
Lutein + zeaxanthin	µg	0	–	–	0	0	0
Vitamin E (alpha-tocopherol)	mg	0.73	2	–	0.82	1.6	4.58
Vitamin E, added	mg	0	–	–	0	0	0
Tocopherol, beta	mg	0	2	–	0	0	0
Tocopherol, gamma	mg	0	2	–	0	0	0
Tocopherol, delta	mg	0	2	–	0	0	0
<b>Lipids</b>							
Fatty acids, total saturated	g	0.13	–	–	0.147	0.285	0.815
4:00	g	0	2	–	0	0	0
6:00	g	0	2	–	0	0	0

(Continued)

**TABLE 3** | Continued

8:00	g	0	2	–	0	0	0
10:00	g	0	2	–	0	0	0
12:00	g	0	2	–	0	0	0
14:00	g	0.002	2	–	0.002	0.004	0.013
15:00	g	0.001	2	–	0.001	0.002	0.006
16:00	g	0.068	2	–	0.077	0.149	0.426
17:00	g	0.002	2	–	0.002	0.004	0.013
18:00	g	0.056	2	–	0.063	0.123	0.351
20:00	g	0.001	2	–	0.001	0.002	0.006
22:00	g	0.002	2	–	0.002	0.004	0.013
24:00:00	g	0	2	–	0	0	0
Fatty acids, total monounsaturated	g	0.042	–	–	0.047	0.092	0.263
14:01	g	0	2	–	0	0	0
15:01	g	0	2	–	0	0	0
16:1 undifferentiated	g	0.002	–	–	0.002	0.004	0.013
16:1 c	g	0.002	2	–	0.002	0.004	0.013
16:1 t	g	0	2	–	0	0	0
17:01	g	0	2	–	0	0	0
18:1 undifferentiated	g	0.04	–	–	0.045	0.088	0.251
18:1 c	g	0.04	2	–	0.045	0.088	0.251
18:1 t	g	0	2	–	0	0	0
20:01	g	0	2	–	0	0	0
22:1 undifferentiated	g	0	–	–	0	0	0
22:1 c	g	0	2	–	0	0	0
22:1 t	g	0	2	–	0	0	0
24:1 c	g	0	2	–	0	0	0
Fatty acids, total polyunsaturated	g	0.132	–	–	0.149	0.289	0.828
18:2 undifferentiated	g	0.071	–	–	0.08	0.155	0.445
18:2 n-6 c,c	g	0.071	2	–	0.08	0.155	0.445
18:2 CLAs	g	0	2	–	0	0	0
18:2 t not further defined	g	0	2	–	0	0	0
18:3 undifferentiated	g	0.008	–	–	0.009	0.018	0.05
18:3 n-3 c,c,c (ALA)	g	0.008	2	–	0.009	0.018	0.05
18:3 n-6 c,c,c	g	0	2	–	0	0	0
18:3i	g	0	2	–	0	0	0
18:04	g	0	2	–	0	0	0
20:2 n-6 c,c	g	0.001	2	–	0.001	0.002	0.006
20:3 undifferentiated	g	0.001	–	–	0.001	0.002	0.006
20:3 n-6	g	0.001	2	–	0.001	0.002	0.006
20:4 undifferentiated	g	0.03	2	–	0.034	0.066	0.188
20:5 n-3 (EPA)	g	0.003	2	–	0.003	0.007	0.019
22:04	g	0.001	2	–	0.001	0.002	0.006
22:5 n-3 (DPA)	g	0.008	2	–	0.009	0.018	0.05
22:6 n-3 (DHA)	g	0.009	2	–	0.01	0.02	0.056
Fatty acids, total trans	g	0	–	–	0	0	0
Fatty acids, total trans-monoenoic	g	0	–	–	0	0	0
Cholesterol	mg	40	2	–	45	88	251
Amino Acids							
Other							
Alcohol, ethyl	g	0	–	–	0	0	0
Caffeine	mg	0	–	–	0	0	0
Theobromine	mg	0	–	–	0	0	0

Data Source: US Department of Agriculture (USDA), Agricultural Research Service, Nutrient Data Laboratory. USDA National Nutrient Database for Standard Reference, Legacy. Version Current: April 2018. Internet: <http://www.ars.usda.gov/nutrientdata>.

**TABLE 4** | Ruffed grouse nutrient content compared to domestically raised chicken meat.

<b>Ruffed grouse</b>	<b>Domestic chicken</b>	
<b>Breast meat, skinless, raw</b>	<b>Breast meat, skinless, raw</b>	
<b>Serving size: 100 g</b>	<b>Serving size: 100 g</b>	
<b>Amount per serving:</b>	<b>Amount per serving:</b>	
<b>Energy: 112 kcal</b>	<b>Energy: 120 kcal</b>	
Protein (g)	25.94	22.5
Fat (g)	0.88	2.62
Total saturated fat (g)	0.13	0.56
Total Mono-unsaturated fat (g)	0.04	0.689
Total Poly-unsaturated fat (g)	0.13	0.424
Cholesterol (mg)	40	73
Calcium (mg)	5	5
Iron (mg)	0.58	0.37
Magnesium (mg)	32	28
Phosphorus (mg)	229	213
Potassium (mg)	311	334
Sodium (mg)	50	45
Zinc (mg)	0.51	0.68
Selenium (mg)	N/A	22.8
Vitamin C (mg)	0	0
Vitamin A (IU)	16	30
Thiamin (mg)	0.04	0.09
Riboflavin	0.28	0.18
Niacin (mg)	11.6	9.6

Data Source: U.S. Department of Agriculture, Agricultural Research Service, 2018. USDA National Nutrient Database for Standard Reference, Release 28. Nutrient Data Laboratory Home Page, <http://www.ars.usda.gov/ba/bhnrc/nd>. Compiled by Moira M. Tidball, Cornell Cooperative Extension, 2018.

consumed in the United States. Consumers have access to the nutritional content of specific foods on a searchable database that is currently available online at <https://ndb.nal.usda.gov/ndb/>. The following chart is the full report of all nutrients analyzed for Ruffed Grouse meat (Table 3).

## DISCUSSION

Fitting with Dietary Guidelines for American's recommendation to consume "lean protein" sources, the results of this study indicate that Ruffed Grouse meat is high in protein and very low in total fat content. Compared to highly consumed domestic, boneless, skinless chicken breast meat, Ruffed Grouse has more protein per 100 gram serving (25.9 g vs. 22.5 g), less calories (112 kcal vs. 120 kcal), and significantly less total fat (0.88 g vs. 2.62 g) and saturated fat (0.13 g vs. 0.56 g). The cholesterol content of grouse is also lower than domestic chicken (40 mg vs. 73 mg), which represents roughly 13% of recommended total daily intake. Much of the vitamin and mineral content of Ruffed Grouse compared to chicken were similar with grouse having slightly higher amounts of iron, magnesium, phosphorous, sodium, riboflavin, and niacin. Chicken meat had slightly higher amounts of potassium, zinc, and Vitamin A (see Table 4). These nutritional differences are likely due to the differing diets and

<b>Nutrition Facts</b>	
servings per container	
<b>Serving size</b>	<b>(366g)</b>
<b>Amount per serving</b>	
<b>Calories</b>	<b>340</b>
<b>% Daily Value*</b>	
<b>Total Fat 8g</b>	<b>10%</b>
Saturated Fat 3.5g	<b>18%</b>
Trans Fat 0g	
<b>Cholesterol 80mg</b>	<b>27%</b>
<b>Sodium 420mg</b>	<b>18%</b>
<b>Total Carbohydrate 8g</b>	<b>3%</b>
Dietary Fiber 1g	<b>4%</b>
Total Sugars 2g	
Includes 0g Added Sugars	<b>0%</b>
<b>Protein 50g</b>	
<b>Vitamin D 0mcg</b>	<b>0%</b>
<b>Calcium 45mg</b>	<b>4%</b>
<b>Iron 2mg</b>	<b>10%</b>
<b>Potassium 862mg</b>	<b>20%</b>

\*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

**FIGURE 2** | Braised Ruffed Grouse white nutrition fact label. Source: [www.wildharvesttable.com](http://www.wildharvesttable.com).

exercise of domestically raised chickens vs. wild, foraging birds, Ruffed Grouse.

Beyond nutritional health benefits potentially derived from consumers replacing or augmenting their current white meat consumption with Ruffed Grouse meat are the healthful benefits of pursuing and procuring Ruffed Grouse. The, 2017–2018 New York State Grouse hunter study data referenced earlier [New York State Department of Environment Conservation (NYS DEC), 2018] reveal that hunters participating in the survey logged 25 h afield during the, 2017–18 season. They took about 9 trips afield for the season and spent about 3 h afield per trip. If we credit them with a very modest 1.5 mile per hour pace on these walks in the woods with gun in hand to procure Ruffed Grouse, then we can estimate that that these hunters are getting a roughly 4.5 mile walk in each outing. This derivative health and wellness benefit is accrued whether successful in harvesting a grouse or not, and is on top of the multitude of benefits being attributed generally to time spent outdoors (Samson and Pretty, 2006; Abram, 2012).

Consumers of Ruffed Grouse meat will likely be glad to know the nutritional content of the meat that they enjoy, but will the knowledge of the nutritional content of Ruffed Grouse meat create larger consumption of or more acceptance of Ruffed Grouse? This is hard to determine. Recipes often include



nutrition information and now these nutritional fact labels can be generated for Ruffed Grouse recipes (example **Figure 2**). This may add some legitimacy to the idea of consuming this healthful meat for consumers who might otherwise be averse to eating wild game.

Some people object to even trying wild game meats and could be considered “neophobic” eaters who are unwilling to try new or unusual food (Veeck, 2010). One study, suggests that epistemic values can influence consumers’ willingness to eat game meat and be positively influenced by curiosity and the desire for knowledge about food (D’Souza, 2022). Perhaps the possibility of adding nutrition information to wild game recipes will contribute to a kind of normalizing of wild game meat, increasing consumer willingness to sample it or accept it. This warrants further study and discussion that is beyond the scope of this particular study.

Grouse meat is also challenging to harvest. During the, 2017/2018 grouse hunting season in New York State, a grouse hunter spent an average of, 19 h of hunting and harvested an average of one bird [New York State Department of Environment Conservation (NYS DEC), 2018]. The most successful grouse hunters have well trained hunting dogs to assist them, making grouse hunting less accessible to the average hunter. Perhaps these challenges in successfully harvesting a bird, help create a sense of preciousness and even more appreciation for the meat. And though one could argue that promoting the healthfulness of grouse meat consumption might increase pressure on grouse populations, state conservation agencies set limits on how many animals can be harvested and at what times of year to avoid over hunting of wild game species. Ruffed Grouse can be part of a healthy diet but is not likely to be eaten in quantity throughout the year.

A final consideration that merits brief discussion has to do with the manner of taking or procuring gamebirds. Generally, game birds are harvested using shotguns that down the flying birds. Flying gamebirds are disabled and dispatched by lead shot. Some of this lead shot remain in the carcass of the harvested bird and should be removed to mitigate ingestion or possible tooth damage. There are ongoing discussions regarding use of lead in procuring game meat (see Streater, 2009; Gerofke et al., 2018), but those discussions are well beyond the scope of this study.

## CONCLUSION

This study demonstrates that gaps in nutritional information for wild caught fish and game can be filled using established research and laboratory protocols. The availability of nutritional data for Ruffed Grouse contributes greater scientific understanding in the area of inquiry dealing with nutritional comparison of wild caught vs. domestically raised foods, while addressing a gap in nutritional knowledge. It also adds legitimacy to claims that wild game birds such as the Ruffed Grouse are healthful foods and an important component of rural local food systems. Though nutrition fact labeling is not required for meats, accurate nutrition labels can now be generated for recipes that include Ruffed Grouse. It is now possible to compare the major nutritional components of Ruffed Grouse to other wild and

domestic forms of poultry. Still, many game birds that are legal to catch and consume do not have nutritional information in the USDA Food Composition Databases. The satisfaction of procuring your own dinner, knowing exactly where your food comes from, plus the value of nature interaction may add to the nutritional health benefits of hunting and consuming wild game birds (Tidball et al., 2014a,b). Further, because of where Ruffed Grouse are generally found, hunters who seek Ruffed Grouse may develop a greater appreciation of the surroundings within which they thrive and may further engage forest restoration projects and other conservation activities.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Materials**. Further inquiries can be directed to the corresponding author/s.

## ETHICS STATEMENT

The animal study was reviewed and approved by Cornell University Internal Review Board.

## AUTHOR CONTRIBUTIONS

KT provided overall manuscript supervision, significant writing and literature review, and supporting sample procurement. MT provided nutritional analysis, supervised sample method and analysis, and contributed to manuscript writing. PC provided wildlife biology review and writing on ruffed grouse. All authors contributed to the article and approved the submitted version.

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## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2022.852163/full#supplementary-material>

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